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EXPLORING THE INTERPLAY OF ENVIRONMENTAL DYNAMISM, SUPPLY CHAIN AMBIDEXTERITY, INCENTIVE GOVERNANCE AND DIGITAL QUALITY MANAGEMENT SYSTEM IN ACHIEVING HEALTHCARE SUPPLYCHAIN SUSTAINABILITY

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ABSTRACT

This study explores the intricate interplay of environmental dynamism (ED), supply chain ambidexterity (SA), and incentive governance (IG) in shaping the sustainability of healthcare supply chains (HSC). The research, prompted by vulnerabilities revealed during the COVID- 19 pandemic and heightened by demographic shifts and healthcare challenges, underscores the necessity for adaptable and customized supply chain structures. Supply chain ambidexterity emerges as a crucial concept, balancing operational efficiency with innovation. Incentive governance aligns stakeholder interests, and the adoption of technophilia and blockchain presents transformative opportunities. The study aims to guide healthcare organizations, policymakers, and stakeholders in fostering sustainable practices amid unprecedented challenges. The methodology employs purposive sampling, targeting healthcare supply chain managers and employees with supply chain knowledge. A questionnaire, distributed through Google Forms, addresses six key constructs adapted from validated sources, receiving 108 responses. Hypotheses explore relationships and interactions guided by a theoretical framework. Demographic analysis reveals diverse participant characteristics. Model validationinvolves convergent validity and composite reliability assessments. The findings indicate strong factor loadings, reliable data, and valid measures. Discriminant validity, assessed through Fornell-Larcker criterion and factor cross-loading data, confirms the distinctiveness of constructs. The meticulous application of these validation techniques ensures methodological integrity. Hypothesis testing examines the impact of environmental dynamism on healthcare supply chain sustainability, considering mediating and moderating factors. Results affirm significant effects, emphasizing the role of supply chain ambidexterity, incentive governance,and digital quality management. Effect size estimations categorize impacts as medium to large, underscoring the relevance of the explored relationships. The study contributes to bridging knowledge gaps, offering actionable insights to enhance healthcare supply chain adaptability, efficiency, and sustainability amid dynamic environmental conditions and technological advancements. Researchers and practitioners can rely on these findings, grounded in a comprehensive and rigorous approach to measurement and analysis.

Keywords: Environmental Dynamism, Supply Chain Ambidexterity, Incentive Governance, Digital quality management system, Healthcare.

1.INTRODUCTION

Effective healthcare supply chains play a pivotal role in ensuring the well-being of individualshealthcare systems. The vulnerabilities exposed by the COVID-19 pandemic, along with broader challenges such as demographic shifts, rising healthcare costs, and chronic diseases, have intensified the need for healthcare supply chains to balance the demands of sustainability,efficiency, and adaptability. (Nabelsi, 2012)

The impact of environmental dynamism on healthcare supply chains and emphasizes the needfor flexibility in response to external changes. Environmental dynamism includes factors like market volatility, technological disruptions, and evolving regulations, which can disrupt supplychain processes and affect patient care. a rigid supply chain structure is inadequate, and organizations should prioritize adaptability to navigate challenges effectively. (Atkins, 2017) Contingency theory is introduced, suggesting that there is no universal approach to organizational structure, and effectiveness depends on aligning internal strategies with external factors. In the context of healthcare supply chains, customization is essential to address environmental dynamism, requiring processes contingent on dynamic external conditions. The concept of ambidexterity is discussed, emphasizing the need to balance efficiency and adaptability by simultaneously optimizing current operations and innovating for the future. (Durga Prasad Dube, 2022)

Supply chain ambidexterity is a dynamic approach that acknowledges the need for both exploitation and exploration. Exploitation optimizes existing resources and processes for operational efficiency and cost-effectiveness, critical for ensuring the stable and continuous delivery of healthcare services, especially during high-demand or disruptions. (Saurabh Ambulkar, 2023) Exploration, on the other hand, focuses on innovation and adaptability to address emerging healthcare challenges, such as those posed by novel diseases or environmental changes. Achieving the right balance between these two dimensions is a complex endeavor, as emphasizing one may compromise the other. Supply chain ambidexterity represents an organization's capacity to simultaneously exploit existing resources and capabilities for efficiency and stability while exploring new opportunities and innovations to adapt to rapidly changing environments. In the context of healthcare supply chains, ambidexterity implies the ability to maintain uninterrupted access to essential medical products and services while also being agile enough to respond swiftly to emerging healthcare crises and evolving environmental dynamics, such as climate change and resource scarcity. However, the interplay between supply chain ambidexterity, healthcare supply chain sustainability, incentive governance, and environmental dynamism remains a complex and underexplored domain of research. (Mojtaba Sadegh, 2021)

Incentive governance is equally crucial, aligning the interests of stakeholders within healthcare supply chains, including healthcare providers, manufacturers, regulators, and patients. Incentive structures, regulations, and ethical guidelines shape stakeholder behavior. This studyaims to explore how incentive governance impacts the ability of healthcare supply chains to achieve ambidexterity and sustainability. Environmental dynamism introduces an additional layer of complexity. (Jayasinghe, 2023) The healthcare sector, like many others, faces challenges related to climate change, resource depletion, and the need for environmentally responsible practices. Healthcare supply chains must adapt to these environmental dynamics by reducing their ecological footprint, minimizing waste, and adopting sustainable sourcing and distribution practices. Balancing these environmental imperatives with the healthcare sector. (Amit Vishwakarma, 2022)

In the ever-evolving landscape of the healthcare sector, the integration of a Digital Quality Management System (DQMS) stands as an indispensable cornerstone, representing a pivotal shift from conventional methodologies to a technologically advanced era. This imperative is underscored by the historical trajectory of quality management within the healthcare domain. Historically, healthcare quality management was predominantly reliant on manual, paper-based systems, which, while functional, were inherently prone to human errors, inefficiencies, and challenges in maintaining comprehensive traceability. (John R. Kimberly, 1999) The cumbersome nature of these traditional approaches often hindered the seamless monitoring ofquality metrics, leading to a pressing need for innovation. The advent of digital technologies marked a watershed moment in the evolution of quality management within the healthcare sector. The transition from paper-based systems to digital platforms brought about a seismic shift, promising enhanced efficiency, heightened accuracy, and improved traceability of critical quality data. This shift not only streamlined existing processes but also paved the way for a more proactive and responsive approach to quality management. (Ilya I. Livshitz, 2019) The multifaceted benefits of a Digital Quality Management System become increasingly evident when considering the complex and stringent regulatory landscape governing the healthcare industry. The real-time nature of digital systems allows for prompt identification and rectification of any deviations from established quality norms, fostering a culture of continuous improvement in patient outcomes. (Daniel Baily, 2020) The healthcare supply chain, which plays a pivotal role in ensuring the availability of essential medical products, a DQMS adds anextra layer of resilience and efficiency. By digitizing quality control processes across the supplychain, organizations can proactively identify and address potential issues, ensuring the consistent delivery of high-quality products to end-users. As the healthcare industry continuesto embrace digital transformation, the role of a Digital Quality Management System becomes even more pronounced. It acts as a catalyst for innovation, paving the way for the integration of emerging technologies such as artificial intelligence, machine learning, and data analytics into quality management processes. (Hale Kaynak, 2023) These technologies further enhance the predictive and prescriptive capabilities of a DQMS, enabling organizations to anticipate and address quality issues before they escalate mission to save lives and improve well-being presents unique challenges and opportunities. (Hale Kaynak, 2023)

In healthcare supply chain sustainability, technophilia serves as a catalyst for transformative change. It encapsulates a forward-thinking orientation that actively seeks to harness the potential of technological innovations, offering solutions to the challenges posed by environmental dynamism, fostering supply chain ambidexterity, and aligning incentive structures with overarching sustainability objectives. (Seyed Mojib Zahraee, 2022) The technophilic approach involves the judicious deployment of state-of-the-art technologies, such as blockchain for secure and transparent data management, advanced data analytics for informed decision-making, and intelligent logistics systems for optimized supply chain operations. By doing so, stakeholders in the healthcare supply chain can enhance visibility into the entire continuum, ensuring real-time monitoring of critical parameters, traceability of products, and adaptive responsiveness to environmental changes. In the pursuit of sustainability, the technophilic lens brings forth a paradigm where innovation becomes a cornerstone of supply chain resilience. This is particularly crucial in an era characterized by dynamic environmental factors, demanding a nimble and adaptable supply chain infrastructure. Additionally, the integration of technophilia aligns with the concept of supply chain ambidexterity, wherein the healthcare supply chain not only efficiently meets current demandsbut also possesses the agility to adapt to evolving circumstances. Moreover, technophilia contributes significantly to incentive governance within the healthcare supply chain. (Shuojiang Xu, 2020) By aligning incentives with sustainability goals, technology-driven solutions can drive efficiency gains, cost savings, and environmental stewardship. For instance, the implementation of smart logistics systems powered by IoT devices enables precise monitoring of inventory levels, reducing wastage and contributing to sustainability objectives.Technophilia emerges as a transformative force in healthcare supply chain management, facilitating the creation of a resilient, adaptive, and sustainable ecosystem. By embracing a technophilic mindset, stakeholders can navigate the complexities of environmental dynamism,foster ambidextrous supply chain capabilities, and align incentives to achieve enduring sustainability in the healthcare supply chain. As the industry continues to evolve, the integration of technophilia becomes not just a strategic choice but an imperative for those committed to shaping the future of healthcare supply chain sustainability. (Christos Bialas, 2023). Blockchain technology, a recent innovation, diverges from traditional data storage methods centralized on a single server or within a specific institution. It operates through a peer-to-peer network that distributes data among all participants for storage, with each user responsible forhosting and managing the data. (Randhir Kumar, 2020) This approach significantly enhances data safety, reliability, integrity, and transparency compared to conventional centralized networks. In typical centralized systems, data is stored on a central server, restricting access toa single institution. In contrast, blockchain-based distribution networks assign an account containing distributable data to each user. This inherent decentralization makes hacking virtually impossible, as any attempt to modify stored data would require simultaneous access to a multitude of user accounts. Leveraging this advantage, blockchain technology has found applications in diverse sectors such as finance, distribution, logistics, public services, and the arts. The healthcare sector has recently shown a growing interest in adopting blockchain technology. Specifically, its utilization in the transfer of medical data empowers patients to own their medical information, shifting control from hospitals to individuals. This patient-centric approach facilitates the seamless submission of comprehensive medical data to any hospital during a transfer, allowing physicians to better understand patients and plan suitable treatments based on the provided information. Furthermore, this approach has the potential to reduce healthcare costs by minimizing redundant medical examinations when complete medical information is readily available. Importantly, it significantly mitigates the risk of unauthorized disclosure of patient medical information. The inherent advantages of blockchain technology are poised to positively impact clinicians and patients alike, marking a transformative shift in healthcare data management and contributing to the broader goal of achieving sustainability inhealthcare supply chains. (Robert J. Mockler, 2006)

The objective of this research is to bridge the critical knowledge gap by investigating the relationship between supply chain ambidexterity, healthcare supply chain sustainability, incentive governance, and environmental dynamism. The central premise is that achieving sustainability in healthcare supply chains requires a careful balance between exploiting existing resources and capabilities, exploring new strategies, adhering to ethical and governance principles, and adapting to dynamic environmental conditions.

This study recognizes the multifaceted landscape within which healthcare supply chains operate and the need to address not only short-term challenges but also long-term sustainabilitygoals. By understanding and optimizing the interplay between these key elements, we aim to provide insights that can enhance the effectiveness and environmental responsibility of healthcare supply chains in an era marked by unprecedented challenges. The importance of robust healthcare supply chains cannot be overstated. They are the lifeblood of healthcare systems, ensuring that essential medical products, equipment, and medications are readily available for patient care. Without efficient supply chains, healthcare systems are at risk of failing to meet the demands of patients, especially in times of crises such as pandemics or natural disasters.

Furthermore, the performance of healthcare supply chains is closely linked to the overall healthoutcomes of a nation. A well-functioning supply chain can ensure that medical interventions are timely and accessible, leading to better patient outcomes. Conversely, disruptions or inefficiencies in the supply chain can result in delays in care, inadequate resources, and suboptimal outcomes.

The healthcare sector has faced numerous challenges in recent years, especially during pandemic, which began in 2019, demonstrated the vulnerability of healthcare supply chains toexternal shocks. (Carr, 2023) The sudden surge in demand for personal protective equipment (PPE), ventilators, and critical medications exposed shortcomings in supply chain responsiveness and flexibility. Healthcare providers and policymakers were confronted with supply chain disruptions that hindered their ability to provide essential care. Demographic

shifts, including aging populations and increased urbanization, have placed additional pressure on healthcare systems. With an aging population, the demand for healthcare services and products is expected to increase. Supply chains must adapt to meet the evolving needs of this changing demographic. The rising costs of healthcare pose a significant challenge. Efficient supply chains can help mitigate these costs by reducing waste, optimizing resource allocation, and streamlining processes. The increasing prevalence of chronic diseases places a higher demand on healthcare supply chains. Managing the ongoing needs of patients with chronic conditions requires a consistent and reliable supply of medications and medical devices. These challenges underscore the urgent need for healthcare supply chains to adapt and become moreresilient while maintaining a focus on sustainability. (Zarei, 2022)

In the ever-evolving landscape of healthcare supply chains, ensuring sustainability is of paramount importance. This entails not only addressing routine challenges but also being prepared for unforeseen disruptions, especially in the face of a pandemic outbreak. While the concept of supply chain ambidexterity has gained attention, its impact on healthcare supply chain sustainability remains relatively unexplored. This thesis aims to bridge the research gap by investigating the effect of supply chain ambidexterity on healthcare supply chain sustainability, while considering incentive governance and environmental dynamism as critical factors. Despite the increasing importance of supply chain ambidexterity, research on its impact on healthcare supply chain sustainability is scarce. (Eltantawy, 2011) While supply chain ambidexterity has been examined in various contexts, its application in the healthcare sector, especially during pandemic outbreaks, remains underexplored. Existing approaches to supply chain sustainability often lack comprehensive consideration of supply chain ambidexterity. Thecurrent knowledge in this field falls short in addressing the integration of supply chain ambidexterity, incentive governance, and environmental dynamism, which are essential factorsin healthcare supply chain sustainability. The significance of performance evaluation in the context of supply chain sustainability cannot be understated. It has become a prominent topic of interest for both scholars and industry practitioners. As healthcare supply chains face increasing challenges, the need for robust performance evaluation methodologies becomes evident. The healthcare sector, especially during epidemic outbreaks, is characterized by extreme disruptions and uncertainties. (John Nsikan, 2022) The existing approaches to supplychain sustainability often fall short when dealing with such unforeseen and extreme situations.Uncertainty management within supply chains is a unique challenge that requires specialized attention. Most notably, none of the existing approaches adequately address the confluence of supply chain ambidexterity, incentive governance, and environmental dynamism. Additionally,considering the potential influence of blockchain adoption and technophilia remains an uncharted territory in the study of healthcare supply chain sustainability. To bridge the researchgap, it is imperative to develop holistic approaches that consider the intersection of supply chain ambidexterity, incentive governance, and environmental dynamism. (Tuljak-Suban,2016)

Specialized approaches are needed to address the uncertainty and extreme disruptions that healthcare supply chains face during epidemic outbreaks. These approaches should be designed to enhance supply chain ambidexterity and adaptability in the face of unforeseen challenges. Furthermore, there is a compelling need to investigate the impact of emerging technologies likeblockchain adoption and technophilia on healthcare supply chain sustainability. These elementshave the potential to revolutionize healthcare supply chains and should be included in the research framework. (Roberta Pinna, 2015) The research gap in understanding the impact of supply chain ambidexterity, incentive governance, and environmental dynamism on healthcare supply chain sustainability is evident. To address this gap, a comprehensive and holistic approach is required. This approach should consider the unique challenges posed by uncertainty and extreme disruptions in healthcare supply chains, as well as the potential influence of emerging technologies like blockchain adoption and technophilia. By bridging these research gaps, this thesis aims to provide valuable insights that can guide healthcare organizations towards sustainable supply chain practices.

1.1

1.2 Statement of the problem:

This study helps us to know how does the interplay of environmental dynamism, supply chain ambidexterity, and incentive governance impact the sustainability of healthcare supply chains,and what strategies can be developed to enhance the integration of environmental concerns, adaptability, and governance mechanisms to achieve sustainability goals in the healthcare sector.

1.3

1.4 Purpose of the Study:

This research endeavors to bridge this critical knowledge gap by investigating the relationship between supply chain ambidexterity, healthcare supply chain sustainability, incentive governance, and environmental dynamism. The fundamental premise of this study is that achieving sustainability in healthcare supply chains necessitates a balance between the exploitation of existing resources and capabilities and the exploration of new strategies, all while adhering to ethical and governance principles and adapting to the dynamic environmental conditions. In recent years, healthcare supply chains have been under immense pressure due to a confluence of factors. In particular environmental dynamism, brought to light the vulnerabilities of these supply chains, highlighting issues such as shortages of personal protective equipment (PPE), ventilators, and critical medications. Moreover, as the world grapples with the ongoing pandemic, healthcare systems also need to address the broader, long-term challenges posed by demographic shifts, rising healthcare costs, and the increasing prevalence of chronic diseases. This multifaceted landscape has underscored the urgent need for healthcare supply chains to not only ensure the availability and affordability of essential medical products but also to do so in a manner that is environmentally sustainable.

2. LITERATURE REVIEW

Healthcare Supply Chains (SCs) constitute a critical nexus in the provision of essential medical devices and services to the populace. The exigencies following a pandemic underscore the imperative for instantaneous medical assistance (Verma & Gustafsson, 2020). The COVID-19 pandemic, a paradigmatic case, has engendered adverse ramifications for healthcare SCs, categorizing pandemic diseases such as COVID-19 and SARS as distinct and potent risks to the resilience of SCs. In the crucible of epidemic outbreaks, the efficacy of healthcare SCs transcends mere provision, extending to the amelioration of disruptions by not only ensuring the seamless supply of medical equipment but also orchestrating strategic interventions (Rainisch et al., 2020).

The advent of a pandemic precipitates an exponential escalation in the demand for medical assistance, thereby placing an onerous burden on healthcare SCs to streamline their operations expeditiously and efficaciously (Dolinskaya et al., 2018). The underpinning challenge lies in the fact that the efficiency of healthcare SCs is inherently compromised when confronted with elevated levels of demand uncertainty (Hoyos et al., 2015). This uncertainty, a characteristic feature of pandemic scenarios, necessitates a paradigm shift in the modus operandi of healthcare SCs to enhance their adaptive capabilities. The intricate structures inherent in healthcare SCs render them susceptible to perturbations caused by unforeseen events, thereby prompting substantial alterations in the services extended to patients (Md Hamzah et al., 2021). Noteworthy in this regard is the pivotal role played by accurate needs assessment, as discrepancies in this process can cascade into shortages of pivotal medical devices and services.

The salient example of inaccurate evaluations precipitating deficiencies underscores the importance of meticulous planning and forecasting within the purview of healthcare SCs. In the realm of mitigating such challenges, the implementation of efficient transportation systems emerges as a linchpin in augmenting inventory management and capacity within healthcare SCs (Ruan et al., 2014). Transportation systems, characterized by their efficiency and strategic deployment, serve as conduits for enhancing the agility of healthcare SCs in responding to dynamic demands. By optimizing transportation mechanisms, healthcare SCs can circumvent potential bottlenecks and logistical impediments, thereby fortifying their operational foundations. Addressing the multifaceted challenges posed by pandemic diseases requires a holistic approach encompassing strategic planning, risk management, and technological integration within healthcare SCs. Proactive measures, such as robust forecasting models, agile supply chain practices, and technology-enabled solutions, constitute indispensable components in fortifying the resilience and responsiveness of healthcare SCs. The orchestration of these elements not only facilitates the expeditious fulfillment of escalated demands during pandemics but also lays the groundwork for sustained operational efficacy and uninterrupted service delivery.

2.1. Sustainable Supply chain:

A sustainable supply chain is a holistic and strategic approach that goes beyond mere economic considerations, encompassing environmental and social dimensions in its operations. It involves the integration of practices and technologies aimed at reducing environmental impact, promoting resource efficiency, and upholding ethical standards throughout the supply chain's life cycle. (Deniz, 2023) From responsible sourcing of raw materials to eco-friendly manufacturing processes and ethical labor practices, sustainability in the supply chain addresses ecological concerns and social responsibilities. By adopting transparent governance mechanisms, embracing innovative technologies, and fostering collaboration with stakeholders, a sustainable supply chain seeks to balance economic viability withenvironmental stewardship and social equity. This multifaceted approach not only mitigates risks associated with resource depletion and climate change but also enhances resilience, ensuring long-term value creation and societal well-being. (Thomas B. Long, 2022)

After the COVID 19, the major risk of healthcare sector to provide quality health services to maintain and establish the strong interconnected supply chain and make it sustain. In 2022 Majid azadi et al studied about the extended to deal with the different types of data such as ratio, integer, undesirable, and zero in efficiency measurement of sustainable and resilient healthcare Supply chains. To mitigate conditions of uncertainty in performance evaluation results, they use chance-constrained programming to proposed approach suggests how to improve the efficiency of healthcare SCs. (Majid Azadi, 2022)

Most interpretations of sustainable development acknowledge the presence of constraints on prolonged human activities, stemming from limitations in material and energy resources, as well as the Earth's capacity to manage waste and emissions. Within these limitations, the ethical principle of inter- and intra-generational equity emerges as a fundamental cornerstone of sustainability. Consequently, three dimensions of sustainable development are delineated: techno-economic, ecological, and social. It assesses the evolution of indicators designed to capture these dimensions, with applicability to industrial sectors, companies, and broad categories of products or services. While indicators gauging environmental and economic performance are well-established and can be amalgamated to assess the sustainability of products, services, and supply chains, indicators of social performance pose greater challenges, especially those describing the social value of products and services. Examination of cases from process industries, petroleum and petrochemicals, electronics, and fast-moving consumergoods sectors underscores the necessity of public participation in developing social indicators.(Clift., 2003)

2.2. Environmental Dynamism:

Environmental dynamism pertains to the extent of fluctuation, diversity, and unpredictability in external factors affecting an organizational or industrial setting. In a technical and professional framework, the analysis of environmental dynamism entails examining how elements like market conditions, regulations, technological advancements, and natural influences evolve rapidly and unpredictably. Elevated environmental dynamism signifies frequent and substantial changes, necessitating organizations to exhibit adaptability and responsiveness. The comprehension of environmental dynamism assumes critical importance in literature reviews, offering insights into the dynamic challenges and opportunities confronting organizations. It significantly informs decision-making processes, strategic planning, and overall adaptability within this. (Jill R. Hough, 2003) The study investigates the most dynamic environmental variables influencing firms, focusing on competition, demand, consumer motivation, and technological resources. Utilizing a sample of firms in the Canary Islands (Spain) for the years 2000 and 2003, the research employs the cognitive perspective, considering managerial perceptions. The Rasch model and rack and stack analyses are applied for measurement, revealing insights into firms' perceptions of environmental dynamism and the perception of individual items. Results indicate a perceived increase in dynamism from 2000 to 2003, with competition, demand, consumer motivation, and technological resources identified as the most dynamic variables. (Juan Ramon Oreja-Rodriguez, 2010) The research proposes a longitudinal method for environmental scanning, encompassing both firm and environmental variables, contributing to the literature by applying the Rasch model to environmental scanning. In another study, the focus shifts to environmental dynamism's impacton firms' sustainability, exploring the mediating role of the innovation process, strategic flexibility, and human resource development. Using confirmatory factor analysis and structuralequation modeling (SEM) on survey data from 513 Greek firms, the study establishes that environmental dynamism drives firms toward sustainability. (Kafetzopoulos, 2022) The mediating effect of innovation process, strategic flexibility, and human resource development is confirmed, emphasizing their critical role in achieving sustainability. The research delves into three organizational factors and suggests future exploration of additional topics affecting sustainability, including digital capability and ambidextrous sustainability. In the context of pandemic outbreaks, efficiency assessments of healthcare supply chains (SCs) prove essential in identifying inefficiencies and mitigating disruptions. The study underscores the importanceof swift and resolute actions across different stages of the healthcare SC, including suppliers, hospitals, and pharmacists. (Syed Imran Zaman, 2023) Optimal resource utilization, waste reduction, timely services, and efficient cost management are advocated for an effective healthcare system. Developing advanced performance evaluation methods is proposed to enhance disaster management in healthcare. The sustainability of healthcare supply chains becomes a critical concern in light of unprecedented global challenges, with supply chain ambidexterity emerging as a strategic approach to address disruptions and ensure the availability and reliability of healthcare supplies and services. Conclusively, environmental dynamism directly impacts supply chain sustainability, necessitating flexible and responsive strategies in healthcare organizations to ensure quality care delivery amidst changing conditions. These imperative underscores the need for proactive measures and strategic approaches to navigate the complexities posed by dynamic environments in healthcare supply chains. (Miroslav MANDEL, 2022).

2.3. Supply chain ambidexterity

Supply chain ambidexterity is a broad term which covers the dual focus on the managing supplychain balancing and requirement to achieved the goals of flexibility in the situation of uncertainty and operational management. Supply chain ambidexterity is a strategic approach that acknowledges the need for a simultaneous focus on both exploitation and exploration within supply chains. The concept has gained prominence in the business world as organizations seek to balance efficiency and innovation. In the context of healthcare supply chains, this approach becomes particularly relevant. (Mehmet G. Yalcin, 2019)

Exploitation refers to the optimization of existing resources and processes to achieve operational efficiency and cost-effectiveness. In the healthcare context, exploitation is essential for ensuring the stable and continuous delivery of healthcare services. This dimension of supply chain ambidexterity is crucial for maintaining consistent access to essential medical products, reducing costs, and ensuring reliability. (ShrivastavaR Saurabh, 2017) Exploration focuses oninnovation, adaptability, and the ability to pivot swiftly in response to changing market conditions or unforeseen crises. In healthcare supply chains, exploration entails the capacity to introduce new products, technologies, and supply chain strategies to address emerging healthcare challenges. This could include the rapid deployment of new diagnostic tests,treatments, or distribution models during a pandemic. (Kevin A. Clauson, 2018)

The hierarchical structure and factor classification based on impact and dependence offer a framework to enhance the comprehension of Small and Medium Enterprises (SMEs) managersand owners. This gave a framework aims to facilitate the improvement of supply chain performance by systematically eliminating barriers across the supply chain. Ambidexterity, in this context, involves the cultivation of competencies to excel concurrently in both exploration and exploitation dimensions. Notably, there is a paucity of literature discussing ambidexteritywithin the specific context of supply chains. The presented research addresses this gap, shedding light on barriers that warrant attention in the implementation of an ambidextrous supply chain strategy within SMEs. To discern the relationship structure among these variables, the research employs the Interpretive Structural Modelling (ISM) technique. Additionally, the Impact Matrix Cross-Reference Multiplication Applied to Classification (MICMAC) approach is utilized to calculate the impact and dependency of variables. The iterative nature of the ISMalgorithm proves to be superior to large-scale generic questionnaire-based studies, as it unveilsnuanced issues that might be challenging to identify through other methods. The research contends that SMEs in India, under considerable pressure to excel in both exploration and exploitation dimensions, stand to derive significant benefits from the proposed framework. The hierarchy-based structure, coupled with the systematic classification of factors based on their impact and dependence, is positioned as a valuable tool to enhance the understanding of SMEmanagers and owners. The ultimate goal is to drive improvements in supply chain performance by methodically dismantling barriers and effectively implementing an ambidextrous strategy throughout the supply chain. This approach aligns with the imperative for SMEs to navigate challenges and achieve operational excellence in the dynamic landscape of supply chain management. (M. Faisal, 2020)

2.4. Incentive governance

Incentive governance, the establishment and implementation of policies, procedures, and mechanisms that ensure the efficient and ethical management of an organization or system. It involves the strategic alignment of decision-making processes, accountability structures, and communication channels to achieve organizational goals while adhering to legal and ethical standards. Effective governance encompasses transparency, accountability, and responsiveness to stakeholders, fostering a framework that promotes responsible and sustainable practices. In the literature review of various studies, the concept of effective governance is crucial for understanding how organizational structures, leadership strategies, and decision-making frameworks contribute to overall performance, risk management, and the achievement of long- term objectives within professional and technical domains. (Madelyn Flammia, 2014) Supplier

assessment and collaboration with suppliers, both mechanisms have a positive and synergisticeffect on environmental performance. One of the key challenges for firms is to manage sustainability along the supply chain. To extend sustainability to suppliers, organizations have developed different governance mechanisms. The aim is to analyze the effectiveness of two different mechanisms (i.e., supplier assessment and collaboration with suppliers) to improve one dimension of sustainability: environmental performance. Structural Equation Modeling and cluster analysis were used to analyze the relationships between supplier assessment, collaboration with suppliers, and environmental performance. The results suggest that (1) bothmechanisms, supplier assessment and collaboration with suppliers, have a positive and synergistic effect on environmental performance, and (2) assessment acts as an enabler of collaboration. Finally, the paper also contributes to the literature by providing a framework of sustainability governance mechanisms. (Cristina Gimenez, 2013)

The establishment of effective governance mechanisms is imperative to harmonize the interests of diverse stakeholders within healthcare supply chains, encompassing healthcare providers, manufacturers, regulators, and patients. These stakeholders, with inherently varied priorities, necessitate strategic alignment through incentive structures, regulations, and ethical guidelines. The interplay of these elements significantly influences the conduct of stakeholders and, consequently, the overall performance of the healthcare supply chain. Stakeholders in healthcare supply chains inherently harbor distinct and occasionally conflicting interests. Healthcare providers strive to ensure the uninterrupted availability of crucial medical products and services, while manufacturers are oriented towards profitability. Simultaneously, regulators prioritize safety and compliance, and patients assert their needs for accessibility and affordability. Navigating these disparate interests requires a comprehensive governance framework that promotes collaboration and synergy among stakeholders, ensuring the resilience and sustainability of the healthcare supply chain (Matthew Reaney, 2015). Effective governance mechanisms serve as the linchpin in aligning these diverse interests towards a shared objective: the development of a healthcare supply chain that is not only robust but alsosustainable over the long term. In this context, incentive structures emerge as pivotal tools in shaping stakeholder behavior. Financial incentives, for instance, can act as catalysts encouraging manufacturers to optimize the production of essential medical products, fostering efficiency. Concurrently, regulatory incentives assume a crucial role by compelling stakeholders to adhere to established safety and compliance standards, thereby fortifying the overall integrity of the healthcare supply chain (Matthew Reaney, 2015).

2.5. Digital Quality management system

The best digital supplier in DSC may improve the product and service quality. A Digital Quality Management System (DQMS) is referring to a comprehensive and integrated framework leveraging digital technologies for the systematic control, monitoring, and improvement of quality-related processes within an organization. It involves the utilization of digital tools, data analytics, and automation to enhance the efficiency, traceability, and effectiveness of quality management practices. (Victor A. Vasiliev, 2020) DQMS integrates quality-related activities across the entire product or service lifecycle, facilitating real-time data analysis, streamlined workflows, and proactive identification of quality issues. The concept of a Digital Quality Management System is instrumental in understanding how digitalization contributes to quality assurance, compliance, and continuous improvement in professional and technical domains. It represents a technological evolution in quality management, emphasizing precision, agility, and data-driven decision-making for organizations aiming to achieve and sustain high-qualitystandards. The geographic dispersion of physical facilities in traditional supply chains necessitates a paradigm shift toward digital supply chains (DSCs). The transition to DSCs introduces heightened complexity in decision-making, particularly as manufacturing firms increase in size. To optimize their processes for delivering advanced products and services, manufacturing firms must establish robust supply chain quality management (SCQM) systems (Priyanka Singh, 2012). In the development of SCQM, the role of the digital supplier assumes paramount significance, as these entities have the potential to enhance a firm's performance by revitalizing its quality management systems (QMS). The focus of this research is twofold: firstly, to investigate the factors influencing the selection of digital suppliers, and secondly, toassess alternatives for identifying the most suitable supplier that contributes to the advancement of QMS in the context of DSCs. The decision-making process related to digital supplier selection (DSS) is inherently intricate, prompting the utilization of integrated SWARA-WASPAS methods for critical evaluation. The stepwise weight assessment ratio analysis (SWARA) method is applied to discern the weightage of factors influencing the selection process. Subsequently, the weighted aggregated sum product assessment (WASPAS) method is employed to evaluate digital suppliers comprehensively, aiming to identify the optimal alternative that enhances QMS within the realm of DSCs (Manu Sharma, 2020). This approachensures a systematic and informed decision-making process in the selection of digital suppliers, aligning with the strategic imperatives of manufacturing firms transitioning to digital supply chains. The contemporary healthcare industry is experiencing a rapid transformation, marked by a growing emphasis on sustainability, efficiency, and adaptability. As healthcare organizations navigate the complex challenges of the modern era, the integration of cutting- edge strategies becomes crucial. (Faisal Hameed, 2023) It explores the integration of a digitalquality management system within the healthcare supply chain, coupled with the application of supply chain ambidexterity, to address these intricate challenges effectively. The implementation of a digital quality management system within the healthcare supply chain is poised to revolutionize the way healthcare logistics operates. (Faisal Hameed, 2023) This innovative approach harnesses digital technologies to optimize quality control and efficiency in healthcare supply chains, with the ultimate goal of ensuring the timely and secure delivery of vital medical resources. Furthermore, it seeks to minimize waste and reduce the environmental impact associated with healthcare logistics operations. Such a strategy represents a paradigm shift in how healthcare organizations can simultaneously enhance quality, efficiency, and sustainability. (Taik Gun Hwang, 2011)

The adoption of a digital quality management system offers healthcare organizations a transformative tool to optimize the quality and efficiency of their supply chain operations. This digital framework enables real-time monitoring, analysis, and management of supply chain processes. Through digital quality management, organizations can enhance quality control, reducing the risk of errors and ensuring the consistent delivery of high-quality medical resources. (Giovanni, 2020) One of the primary objectives of integrating a digital quality management system is to ensure the timely and secure delivery of vital medical resources. Real-time monitoring and data-driven decision-making enable healthcare organizations to track the movement of critical resources through the supply chain. This not only prevents delays butalso enhances security, reducing the risk of theft or mishandling. (Muluneh Imru, 2004)

2.6. Technophilia

In the digital age, where technology is evolving at an unprecedented pace, the term "technophilia" has gained prominence. It denotes a deep enthusiasm for technology and technological advancements. (Mohini Singh, 2014) Organizations that aim to thrive and adapt to changing conditions must prioritize technological innovation and research.

Staying relevant and seizing market opportunities necessitates a continuous focus on technological advancements. This delves into the concept of technophilia and its implications for organizations. It explores how cultivation theory, proposed by George Gerbner in the 1960s, aligns with technophilia, and how the combination of these two concepts can influence an organization's approach to technology adoption. (D.M. Macri, 2017) Technophilia, a term derived from the Greek language, encapsulates a profound enthusiasm for technology and technological advancements. In today's fast-paced world, organizations must foster an environment of technophilia to remain competitive and relevant. A technophilic approach entails embracing and driving technological innovations. (Kimberly Walker, 2022) For an organization to not only survive but thrive, it must focus on technology and innovation. Technophiles within an organization play a crucial role in keeping the company unique and adaptable. Their enthusiasm for technological advancements can drive the organization to seize market shifts, making them more agile and responsive to changing conditions. (Diane McGarry, 2005) Cultivation theory, as proposed by George Gerbner, is a prominent theory in the field of media and communication. It posits that individuals exposed to consistent and repetitive portrayals of specific themes or ideas in the media are more likely to adopt those views as their own. (Ruddock, 2018) This theory offers a sophisticated perspective on the impact of media and technology on individuals and society. Cultivation theory suggests that prolonged exposureto media content can shape perceptions and beliefs, ultimately influencing behavior. The repetitive portrayal of certain themes in media can lead individuals to perceive those themes as the norm. This theory highlights the powerful role of media in shaping our collective understanding of the world. (Joseph Erba, 2022) In which represents an ardent love or enthusiasm for technology, cultivation theory is particularly relevant. The continuous consumption of media content that portrays technology in a positive light can cultivate a deep-seated fascination and reliance on technological devices and innovations. Technophilia, therefore, can be nurtured and reinforced by media's portrayal of technology. For organizations, embracing technophilia means not just observing technological advancements but actively participating in technological experiments and adaptations. (Oliver, 2011) Technophiles within the organization can play a pivotal role in experimenting with new technologies, adapting them to organizational needs, and providing valuable insights into the potential benefits and limitations of these innovations. Supply chain ambidexterity, a concept we discussed earlier, emphasizes the need for organizations to balance the efficient use of existing supply chain resources with the exploration of new and innovative approaches. In the context of technophilia, organizations driven by technological enthusiasm are more likely to embrace supply chain ambidexterity. (Rajesh Jain, 2020) The pursuit of technological advancements aligns with the innovative exploration dimension of ambidexterity. Technophiles within the organization drive the exploration of technological innovations that can enhance sustainability. These innovations may include eco-friendly logistics solutions, energy-efficient transportation, or sustainable sourcing practices. Sustainability is increasingly viewed as a strategic imperative for organizations. In the context of technophilia, organizations are more inclined to consider sustainability not as an add-on but as an integral part of their business strategy. This shift in mindset results in more sustainable practices and greater responsibility for the environmental impact of supply chain operations. (Ho, 2014)

For the effective and sustainable implementation of ecological restoration initiatives, community support is imperative. However, contemporary society exhibits a pervasive inclination towards artificial constructs and electronic technology, indicative of technophilia, where technology dominates individuals' interests. This trend has engendered a perceived disconnection between humans and the natural environment. The inquiry here revolves aroundthe potential utilization of such technology as a facilitator of connection to the environment, counteracting its conventional role as a catalyst for detachment. To illustrate this concept, we examine the case of a widely embraced mobile augmented reality smartphone game, "Ingress."This example serves to demonstrate how gaming technology can function as a catalyst, generating excitement among individuals about nature. The transformative potential lies in leveraging such technology to rekindle individuals' inherent biophilia— an innate affinity for nature— and accentuate the significance of ecological restoration in their day-to-day lives. This perspective seeks to reposition technology not merely as a driver of detachment from nature but as an agent fostering a renewed connection to the environment (J. Buettel, 2016).

2.7. Block chain Technology Adoption

Blockchain technology adoption involves the strategic integration and implementation of blockchain-based solutions within organizational frameworks to enhance various aspects of business processes. Blockchain is a decentralized and distributed ledger system that ensures secure, transparent, and tamper-resistant recording of transactions across a network of computers. The blockchain adoption includes the incorporation of this technology to improve data security, transparency, and efficiency in diverse industries such as finance, supply chain, healthcare, and more. The literature review of various studies exploring blockchain technology adoption is essential for understanding how organizations leverage this decentralized ledger system to optimize processes, enhance trust in transactions, and address specific industry challenges through the utilization of smart contracts, consensus mechanisms, and cryptographic principles. (Ajay B Gadicha, 2022) The recently developed blockchain technology uses a peer-to-peer network to distribute data to all participants for storage. This method enhances data safety, reliability, integrity, and transparency. To successfully introduce blockchain technology to medical data management, it is essential to obtain consent from medical doctors and patients. (Yong Sauk Hau, 2019) Supply chain ambidexterity, the ability to simultaneously exploit existing capabilities and explore new opportunities, is pivotal for sustainability. Blockchain facilitates this by providing decentralized transparency. Through smart contracts and real- time data visibility, healthcare supply chains can efficiently adapt to changing demands while maintaining operational stability, thus fostering ambidextrous capabilities. (Sabeen Bhatti, 2021) Blockchain's patient-centric data management paradigm is transformative in healthcare. Patients gain control over their medical data, allowing seamless and secure transfer between healthcare providers. This not only improves patient outcomes but also aligns with sustainability goals by reducing redundancies in medical procedures, thus lowering healthcare costs and environmental impact. (Deepak Kumar Mishra, 2023) The growing significance of blockchain technology adoption in the pursuit of sustainability within the healthcare supply chain. By addressing the challenges posed by environmental dynamism, fostering supply chain ambidexterity, and enhancing incentive governance, blockchain emerges as a transformative force. Future research should delve deeper into the specific applications and implications of blockchain in healthcare supply chain sustainability, paving the way for innovative solutions and best practices in this critical domain. (Kevin A. Clauson, 2018)

3. Conceptual Framework & Research Methodology

3.1. Methodology:

The current study delves into the complex dynamics surrounding the exploration of the interplay between environmental dynamism, supply chain ambidexterity, and incentive governance in the pursuit of sustainability within the healthcare supply chain. Setting the tone for this investigation are the influential factors of technophilia and blockchain technology adoption, which serve as pivotal components shaping the contemporary landscape of healthcare supply chain management. A meticulous methodology has been crafted to align with the objectives of this study. A focused analysis of blockchain technology adoption within select healthcare supply chains will be undertaken. This will involve a thorough examination of the technological infrastructure, security protocols, and outcomes associated with the integration of blockchain. Insights gained from this analysis will contribute to understanding the transformative potential of blockchain in healthcare sustainability.

3.2. Sampling technique:

In conducting the observational-based study centered on healthcare supply chain managers, a purposive sampling technique was employed to select participants who possess the specific knowledge and experience relevant to the research objectives. The target population comprised healthcare supply chain managers from diverse organizational settings. The sampling process involved the distribution of a questionnaire through Google Forms, designed to elicit insights into the interplay of environmental dynamism, supply chain ambidexterity, incentive governance, and the influence of technophilia and blockchain technology adoption on sustainability within the healthcare supply chain.

The purposive sampling approach allowed for the deliberate selection of participants with a nuanced understanding of the intricate dynamics within healthcare supply chains. By focusingon individuals in managerial roles within these supply chains, the study aimed to capture insights from those directly involved in decision-making processes and strategic planning related to sustainability initiatives. The questionnaire, disseminated through Google Forms, served as a convenient and efficient means of collecting responses, enabling the research teamto gather valuable data from a targeted and knowledgeable participant pool. This sampling strategy was deemed optimal for obtaining in-depth and contextually rich information from healthcare supply chain managers, contributing to a thorough exploration of the research objectives.

3.3. Theoretical Framework

The research will be guided by a conceptual framework that integrates environmental dynamism, supply chain ambidexterity, incentive governance, and the adoption of blockchain technology within the healthcare supply chain. This framework will serve as the basis for exploring the relationships and interactions between these key variables.

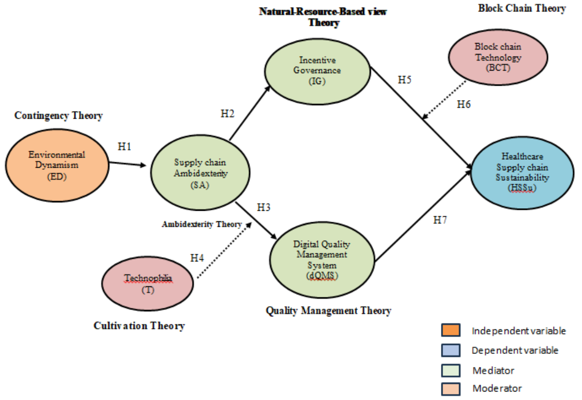

Figure 1: Theoretical Framework

3.4. Sample size

The sample size for this study was determined using the following formula:

$$n = \left(\frac{Z^{\frac{\alpha}{2}}}{d}\right)^2 p(1-p)$$

(Takashi Sozu, 2015)

Where:

- n represents the required sample size
- Z is the Z-score corresponding to the desired level of confidence (e.g., 95% confidence level, Z = 1.96)
- p is the estimated how much the healthcare supply chain sustainability be impacted by other variables (if unknown, assumed to be 0.5 for maximum sample size).

- d is the desired margin of error or precision

3.5. Hypothesis Development:

3.5.1. Hypothesis # 01

This study recognizes the multifaceted nature of healthcare supply chains, acknowledging the intricate balance required for sustainability amidst dynamic environmental conditions. Hypothesis 1 introduces the concept that the positive association between environmental dynamism and supply chain ambidexterity. This suggests that organizations in healthcare need to possess a certain level of flexibility and adaptability in their supply chain practices to effectively navigate dynamic environmental conditions. Moreover, in simple words, hypothesis H1 proposes that there is a meaningful and positive association between the dynamic nature of the business environment and the supply chain's ability to simultaneously explore new opportunities and exploit existing capabilities. This relationship is expected to be more than what could be attributed to random variations.

H1: There is a significant positive relationship between **Environmental Dynamism** and **Supply chain ambidexterity**

3.5.2. Hypothesis # 02

Hypothesis 2 posits that Supply chain ambidexterity serves as a critical positive impact on Incentive governance. This implies that aligning incentives within the supply chain can be a pivotal factor in achieving sustainability goals. hypothesis H2 proposes that there is a statistically significant and positive association between the supply chain's ability to balance exploration and exploitation activities (ambidexterity) and the governance mechanisms related to incentives within the organization. The hypothesis implies that a more ambidextrous supply chain is associated with stronger incentive governance.

H2: There is a significant positive relationship between **Supply chain ambidexterity** and

Incentive governance

3.5.3. Hypothesis # 03

Hypothesis 3 posits that Supply chain ambidexterity serves as a critical positive impact on Digital Quality management system. This implies that aligning incentives within the supply chain can be a pivotal factor in achieving sustainability goals. hypothesis H3 proposes that there is a statistically significant and positive association between the supply chain's ability to balance exploration and exploitation activities (ambidexterity) and the digital quality management system within the organization. The hypothesis implies that a more ambidextrous supply chain exploration is associated with stronger adoption of digital quality management system.

H3: There is a significant positive relationship between Supply chain ambidexterity and Digtal Quality Management system

3.5.4. Hypothesis # 04

In this hypothesis, we explore the potential connection between the supply chain's ability to balance exploration and exploitation activities (Supply Chain Ambidexterity) and the implementation of a Digital Quality Management System. The hypothesis suggests that as the supply chain becomes more ambidextrous, there will be a positive relationship with the adoption and effectiveness of a Digital Quality Management System. Moreover, the moderation aspect introduces the influence of Technolophilia. Technolophilia refers to a strong enthusiasm or affinity for technology. In the context of the hypothesis, it implies that individuals or organizations with a higher inclination towards embracing and adopting technology (Technolophilia) may experience a more pronounced positive relationship between supply chain ambidexterity and the effectiveness of the Digital Quality Management System. In essence, the hypothesis proposes that not only is there an intrinsic positive relationship between supply chain ambidexterity and a Digital Quality Management System, but this relationship is also influenced and moderated by the level of Technolophilia within the organization or among the individuals involved.

H4: There is a significant positive relationship between Supply chain ambidexterity and Digtal Quality Management system which is moderately by Technolophilia

3.5.5. Hypothesis # 05

In this hypothesis aims to investigate the potential correlation between the effectiveness of Incentive Governance mechanisms within the healthcare sector and the sustainability of the healthcare supply chain. It posits that as incentive governance practices become more robust, aligned with organizational objectives, and effectively implemented within the healthcare supply chain, there will be a meaningful and positive association with the sustainability of the entire healthcare supply chain. The term "significant positive relationship" indicates that the hypothesis suggests a systematic and non-random connection between Incentive Governance and Healthcare Supply Chain Sustainability. This implies that healthcare organizations with well-designed incentive governance structures may be more likely to develop and maintain sustainable practices within their supply chain operations. H5 proposes that a strong system of incentive governance in the healthcare sector is linked to the sustainability of the healthcare supply chain. This suggests that organizations with effective incentive governance mechanisms are more likely to create and maintain sustainable practices within their supply chain operations, contributing to the long-term viability and resilience of healthcare supply chains.

H5: There is a significant positive relationship between Incentive governance and Healthcare supply chain Sustainability.

3.5.6. Hypothesis # 06

In this hypothesis aims to examine the potential correlation between the effectiveness of Incentive Governance mechanisms and the sustainability of a healthcare supply chain. Specifically, it proposes that as the governance practices related to incentives in the healthcare sector become more robust and aligned with organizational goals, there will be a positive association with the sustainability of the supply chain. The term "significant positive relationship" signifies that the hypothesis posits a meaningful and systematic connection between Incentive Governance and Healthcare Supply Chain Sustainability, indicating that this association is not likely due to random chance. Furthermore, the hypothesis introduces the concept of moderation, suggesting that the relationship between Incentive Governance and Healthcare Supply Chain Sustainability is influenced by the presence of Blockchain Technology. Blockchain, known for its decentralized and secure nature, is posited to moderate or enhance the positive relationship between incentive governance and sustainability within the healthcare supply chain. This implies that organizations employing Blockchain Technology may experience a more pronounced positive impact of incentive governance on the sustainability of their healthcare supply chain. H6 proposes that effective Incentive Governance, especially when moderated by Blockchain Technology, is positively associated with the sustainability of the healthcare supply chain. It suggests that a combination of strong governance practices and advanced technological solutions can contribute to a more sustainable and resilient healthcare supply chain.

H6: There is a significant positive relationship between Incentive governance and Healthcare supply chain sustainability which is moderately by Block chain technology.

3.5.7. Hypothesis # 07

In this hypothesis seeks to explore the potential correlation between the adoption and efficacy of Digital Quality Management Systems in healthcare and the overall sustainability of the healthcare supply chain. It posits that as healthcare organizations integrate and optimize Digital Quality Management Systems, there will be a meaningful and positive association with the sustainability of the entire healthcare supply chain. The term "significant positive relationship" emphasizes that the hypothesis proposes a systematic and non-random connection between Digital Quality Management Systems and Healthcare Supply Chain Sustainability. This implies that healthcare organizations employing robust digital quality management practices may be more likely to foster sustainability within their supply chain operations. In essence, H7 suggests that the implementation of advanced digital quality management systems in healthcare operations contributes positively to the development and maintenance of a sustainable healthcare supply chain. This hypothesis underscores the potential synergy between advanced quality management practices facilitated by digital systems and the broader sustainability goals of healthcare supply chains.

H7: There is a significant positive relationship between Digital Quality Management system and Healthcare supply chain Sustainability

3.6.

3.7. Inclusion criteria

The inclusion criteria encompassed healthcare professionals directly involved in supply chain management within the healthcare sector, including supply chain managers, logistics coordinators, and procurement specialists. Participants were required to have a minimum of one years of experience in healthcare supply chain roles to ensure a comprehensive understanding of the dynamic industry.

3.8. Exclusion criteria:

Exclusion criteria were established to maintain the focus on individuals with managerial rolesdirectly related to the healthcare supply chain. Consequently, individuals lacking substantial experience or decision-making authority within the healthcare supply chain context were excluded. The criteria aimed to exclude participants whose roles did not align with the specific objectives of the research, ensuring that insights garnered from the study were highly relevant to the interplay between environmental dynamism, supply chain ambidexterity, incentive governance, and sustainability within healthcare supply chains.

3.9. Data collection tool:

The data collection tool employed for this observational-based study involved a carefully crafted questionnaire distributed through Google Forms. The questionnaire was designed to elicit responses from healthcare supply chain managers, targeting individuals with specific knowledge and experience pertinent to the research focus on the interplay of environmental dynamism, supply chain ambidexterity, incentive governance, and the influence of technophiliaand blockchain technology adoption on sustainability within the healthcare supply chain.

3.10. Questionnaire development

For questionnaire development, all the items were adapted from earlier studies. Table 3.1 listsall the items used for operationalizing constructs with their sources. An online questionnaire was created using

Google Forms for the collection of responses. The questionnaire had two sections. The first section comprised demographic questions about the respondents, whereas the second section comprised the items related to six study variables having total 39 items, which contain 9 items of Supply chain ambidexterity (SA), 9 items of Environmental dynamism (ED), 3 items of Incentive Governance (IG), 5 items of Technophilia (T), 4 items ofBlock Chain Technology Adoption (BTA) and 9 items of Healthcare Supply chain Sustainability (HsS) and 5 items of Digital Quality management system (DQMS). All these items in the second part were anchored on a five points Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). Table 3.1 shows the references for all the selected items in the research questionnaire all the selected items were validated by the literature.

3.11. Respondents:

As we intended to investigate the factors about the supply chain in health care sector. Questionnaire link of google form were shared in different health care managers having proper supply chain and having knowledge of whole operations of organization. They requested their contacts to share the link to their colleagues and contacts. Moreover, a group of working professionals in a tertiary care hospital were also included in this study. Efforts were made to get a good mix of respondents from a variety of positions from mid-level to top management. The data collection process continued for two months (August to October 2023). In total, 124 responses were received, from which 16 were rejected for being incomplete. Thus, 108 responses were considered for further analysis.

3.12. Statistical analysis:

We used SPSS 26.0 to analyses demographic measures. Average variance test to rule out the presence of multicollinearity was also performed using SPSS 26.0. Calculate factor loadings, and test the dimensionality of constructs, convergent validity, and discriminant validity. Also used different tests for hypothesis testing by using Hay's regression model.

4. Results & Discussion

Data collection was conducted based on the research question and constructed hypotheses. After a successful collection of data, different statistical analysis was performed to specify the most productive results. Initially, a descriptive analysis was conducted followed by model validation, hypotheses testing, mediation effects and total effects. All of these results are presented and discussed in this chapter.

4.1. Demographics of respondents:

We considered one dichotomous variable, i.e., gender (male and female) in the demographic section. The other variables were age (<25 years, 26–30 years, 31-35 years, 36-40 years and more than 40 years), education level (bachelor, master, doctorate and post doctorate and above),experience in organization size (less than 50 employee, 50 to 500 employee, more than 500 employee and multinational corporations) and designation or management levels (Entry-level / First-level management, mid-level management, Top-level management and Executive / DXOs) of the professionals. Of 108 respondents, 85 (78.7%) were males, and 23 (21.3%) were females. Moreover, 9 (8.3%) respondents were under 30 years of age, 78 (72.2%) between 30 and 35 years, 16 (14.9%) between 35 to 40 and only 5 were more than 40 years. Furthermore, the qualifications of respondents among 81 were holding bachelor/Graduation (75.1%), 18 were holding master / M.Phil. (16.7), 8 were PhDs (7.4%) and only 1 were post doctorate scholar (0.9%). Furthermore, the organization size of respondents was, 11 respondents working in the organization having employee size <50 (10.2%), 55 respondents working in the organization having employee size 50 - 500 (50.1%), 40 respondents working in the organization having employee size >500 (36.6%) and only 3 employee from multinational corporation (2.1%). Furthermore the 42-respondent holding the designation of Entry level / first line management (38.9%), 61 were holding the designation of mid-level management (56.5%), 4 were top level management (3.7%) and only 1 were executive (0.9%) contributed fairly equally to this survey.

Table 1 : Demographic representation

Demographic Items	Sub categories	Frequency	Percentage
Gender	Male	85	78.7%
	Female	23	21.3
Age	<30 (Years)	9	8.3%
	30 - 35 (Years)	78	72.2%
	35 - 40 (Years)	16	14.9%
	>40 (Years)	5	4.6%
Qualification	Bachelor / Graduation	81	75.1%
	Masters / M.Phil.	18	16.7%
	Doctorate / PhD	8	7.4%
	Post Doctorate and above	1	0.9%
Organization Size	Small Organization (Employee less than 50)	11	10.2%
	Medium-sized Organization (Employee 50 - 500)	55	50.1%
	Large Organization (Employee greater than 500)	40	36.6 %
	Multinational Corporation	3	2.1%
Designation Level	Entry-level / First-level management	42	38.9%
	Mid-level management	61	56.5%
	Top-level management	4	3.7%
	Executive / DXOs	1	0.9%

The total population we targeted the Lahore healthcare service sector especially the departmentof supply chain. However, after excluding the two organization where the supply chain department was not established yet about twelve different healthcare organizations were participated for this study. Hence, the questionnaires were forwarded through google questionnaire form in the different healthcare official groups and their colleagues to next colleagues. After these 108 responses are obtained which meets the minimum criteria of sample size which was ninety-eight. (Yong Sauk Hau, 2019).

4.2. Model Validation

The first step towards model validation was the assessment of convergent validity through AVE as well as the assessment of composite reliability. Factor loading for each of the items were included in the analysis. As a common criterion, an item with a loading 0.7 or above is acceptable while factor having a value between 0.5-0.7 is susceptible to be dropped only if it affects the values of AVE and CR; causing them to be lower than their threshold values (Hair et al., 2014). Further, the threshold value for AVE is 0.5 for each of the item and a value below 0.5 affects the validity of the data negatively. Moreover, the effect of composite reliability is calculated with a threshold value of 0.7 which indicates that the data for collected research is reliable if the value for each of the item is above 0.7 while in another case if the value drops down than the data is not reliable for the results to be calculated. Results for convergent validity and composite reliability (CR) for current research are presented in **table 4.2**. The findings indicate that none of the factors had a loading below 0.7 therefore, each of them was retained for the final analysis. In addition, the CR scores throughout the data for all of the factors were above 0.7 which provided proof of a reliable data source for our research. Moreover, the AVE scores for all of the data were above the threshold 0.5 which confirmed the validity of the datathrough convergent validity.

Table 2: Data of convergent validity and composite reliability

Factor	Item	Factor Loading (>0.7)	Composite Reliability (CR)	Average Variance Extracted (AVE)
Supply Chain Ambidexterity	SCA1	0.859	0.985	0.865
	SCA2	0.73		
	SCA3	0.987		
	SCA4	0.823		
	SCA5	0.742		
	SCA6	0.725		
	SCA7	0.823		
	SCA8	0.733		
	SCA9	0.904		
Environmental Dynamism	ED1	0.785	0.975	0.892
	ED2	0.881		
	ED3	0.729		
	ED4	0.943		
	ED5	0.739		
	ED6	0.978		
	ED7	0.851		
	ED8	0.942		
	ED9	0.762		
Incentive Governance	IG1	0.868	0.873	0.814
	IG2	0.721		
	IG3	0.828		
Technophilia	TC1	0.966	0.951	0.839
	TC2	0.877		
	TC3	0.976		
	TC4	0.831		
	TC5	0.767		
Blockchain Technology Adaptation	BCT1	0.949	0.911	0.973
	BCT2	0.993		
	BCT3	0.888		
	BCT4	0.914		
	HSS1	0.764		
	HSS2	0.833		
	HSS3	0.968		
	HSS4	0.9712		
	HSS5	0.906		
	HSS6	0.822		

	HSS7	**0.959**		
	HSS8	**0.903**		
	HSS9	**0.899**		
	DQMS1	**0.752**		
	DQMS2	**0.881**		
	DQMS3	**0.888**		
	DQMS4	**0.787**		
	DQMS5	**0.806**		

Factor: These are latent constructs or variables that are not directly observable but are inferredfrom a set of observed variables. In our study, the factors include Supply Chain Ambidexterity (SCA), Environmental Dynamism (ED), Incentive Governance (IG), Technophilia (TC), Blockchain Technology Adaptation (BCT), Healthcare Supply Chain Sustainability (HSS), and Digital Quality Management System (DQMS). Items: These are the individual observed variables or items that are used to measure the latent constructs or factors. For example, SCA1,SCA2, ..., DQMS5. Factor Loading: This represents the strength and direction of the relationship between each item and its corresponding latent factor. Factor loadings range from -1 to 1, where higher values indicate a stronger relationship. For example, BCT2 has a factor loading of 0.993. Composite Reliability (CR): This is a measure of the internal consistency or reliability of the items in measuring the latent factor. It is similar to Cronbach's alpha but can be more appropriate for SEM. It ranges from 0 to 1, where higher values indicate greater reliability. For example, SCA1 has a composite reliability of 0.985. Average Variance Extracted (AVE): This is a measure of the amount of variance captured by the latent factor inrelation to the measurement error. It ranges from 0 to 1, and higher values indicate better convergent validity. For example, BCT has an AVE of 0.973898. The meticulous application of these validation techniques serves to fortify the methodological integrity of the study.

The adherence to established benchmarks and criteria recommended by leading scholars in thefield, such as (Hair et al. 2017), (Mahmud et al. 2017), and (Henseler et al. 2015), ensures a rigorous and thorough validation process. These results engender confidence in the reliability and validity of the measurement instruments employed in the study, laying a robust foundationfor subsequent statistical analyses and interpretations. Researchers and practitioners can rely on these findings with assurance, as they reflect a comprehensive and meticulous approach to ensuring the soundness of the research measures in capturing the intricacies of the investigatedconstructs.

4.3. Discriminant Validity

Proceeding further, after the successful model validation through convergent validity, another assessment of model validation was made. This assessment is known as the discriminant validity which is usually confirmed through the Fornell-Larcker criterion and factor cross loading data. The basic phenomenon behind the discriminant validity assessment is the item loading of each item for the construct of their own variable as well as the construct of other variables. The stronger a variable load on the construct of its own, the greater the discriminant validity of the data. Results for Fornell-Larcker criterion are presented in table 3. It is eminent from the findings that each of the variable had a stronger loading on its own construct as compared to the constructs of other variables. This phenomenon remainsthe same for all of the variables under consideration. Another important assessment for the discriminant validity is the factor cross loading which works adjacent to the Fornell-Larcker criterion to confirm thediscriminant validity of the data. The co-variables used in this data set also showed strong factor loadingfor the variables they were referring to. These results from both the convergent validity and discriminant validity confirms the valid nature of our data while the composite reliability proves that our data is reliable for further analysis.

Table 4: Fornell-Larcker criterion results for discriminate validity

	SCA	**ED**	**IG**	**TC**	**BCT**	**DQM**	**HSS**
SCA	0.982						
ED	.644**	0.910					
IG	.891**	.970**	0.844				
TC	.919**	.846**	.960**	0.963			
BCT	.878**	.902**	.982**	.816**	0.911		
HSS	.862**	.936**	.779**	.821**	.983**	0.984	
DQM	.950**	.913**	.897**	.714**	.965**	.833**	.834**

The table showing the pairwise correlations between different constructs or variables. Each row and column represent a specific construct, and the values in the cells indicate the correlation coefficients between those constructs. The values along the diagonal (from top leftto bottom right) represent the correlation of each construct with itself, which is always 1. Theseare often shown as blanks or dashes because they are redundant information. The off-diagonalvalues represent the pairwise correlations between different constructs. For example, the 0.682. The notation "**" often indicates statistical significance, suggesting that the correlation coefficients are statistically different from zero. A few observations based on the correlation matrix: Positive Correlations: For instance, there are positive correlations between Supply Chain Ambidexterity (SC) and other constructs like Environmental Dynamism (ED), Incentive Governance (IG), Technophilia (TC), Blockchain Technology Adaptation (BCT), Healthcare Supply Chain Sustainability (HSS), and Digital Quality Management System (DQM). Strength of Correlations: The strength of the correlations can vary, and values closer to 1 or -1 indicatea stronger relationship. For instance, the correlation between Technophilia (TC) and Blockchain Technology Adaptation (BCT) is 0.663, suggesting a relatively strong positive correlation. Correlation does not imply causation, but it does indicate the strength and directionof linear relationships between variables. (Kennaway, 2020) correlation between Supply Chain Ambidexterity (SC) and Environmental Dynamism (ED) is Another important assessment for the discriminant validity is the factor cross loading which works adjacent to the Fornell-Larcker criterion to confirm the discriminant validity of the data. The co-variables used in this data set also showed strong factor loading for the variables they were referring to. These results from both the convergent validity and discriminant validity confirms the valid nature of our data while the composite reliability proves that our data is reliable for further analysis. Results for factor cross loadings are presented in **table 4.4**. factorcross-loading data indicates that observed variables are influenced by more than one latent factor. It is need to carefully consider the implications of cross-loading for the theoretical interpretation of the underlying factors and may employ various techniques, such as rotation, to better understand and interpret the structure of the factors.

Table 5: Factor Cross Loading

Variable	**Environmental Dynamism (ED)**	**Supply chain ambidexterity(SCA)**	**Incentive Governance(IG)**	**Digital Quality ManagementSystem (DQM)**	**Technophilia(T)**	**Blockchain Technology(BCT)**	**Healthcare Supply chain Sustainability(HsS)**
Items							
ED1	**0.701**	0.548	0.853	0.700	0.629	0.502	0.679
ED2	**0.933**	0.759	0.981	0.749	0.843	0.913	0.865
ED3	**0.946**	0.812	0.803	0.922	0.465	0.775	0.739
ED4	**0.718**	0.644	0.501	0.671	0.696	0.573	0.547

ED5	**0.898**	0.742	0.745	0.851	0.836	0.741	0.671
ED6	**0.853**	0.765	0.789	0.745	0.673	0.788	0.791
ED7	**0.949**	0.886	0.862	0.886	0.886	0.875	0.878
ED8	**0.627**	0.615	0.567	0.528	0.503	-0.426	0.53
ED9	**0.902**	0.807	0.881	0.831	0.784	0.835	0.813
SCA1	0.834	**0.886**	0.803	0.844	0.704	0.702	0.806
SCA2	0.779	**0.813**	0.812	0.756	0.758	0.772	0.702
SCA3	0.818	**0.919**	0.822	0.869	0.741	0.838	0.908
SCA4	0.884	**0.924**	0.851	0.875	0.783	0.805	.906
SCA5	0.579	**0.675**	0.627	0.602	0.619	0.632	0.525
SCA6	0.802	**0.864**	0.825	0.793	0.744	0.745	0.826
SCA7	0.904	**0.922**	0.879	0.859	0.817	0.906	0845
SCA8	0.816	**0.865**	0.822	0.867	0.824	0.818	0.861
IG1	0.745	**0.707**	0.752	0.564	0.573	0.742	0.721
IG2	0.912	**0.978**	0.948	0.937	0.921	0.934	0.918
IG3	0.1	**0.805**	0.833	0.729	0.738	0.813	0.776
TC1	0.821	**0.762**	0.815	0.818	0.759	0.738	0.803
TC2	0.864	**0.923**	0.938	0.943	0.893	0.936	0.906
TC3	0.845	**0.908**	0.904	0.929	0.809	0.869	0.911
TC4	0.949	**0.843**	0.923	0.964	0.959	0.939	0.896
TC5	0.724	**0.814**	0.748	0.831	0.802	0.919	0.826
BCT1	0.924	**0.974**	0.948	0.858	0.992	0.951	0.846
BCT2	0.801	**0.834**	0.847	0.881	0.887	0.859	0.792
BCT3	0.689	**0.699**	0.709	0.668	0.724	0.689	0.718
BCT4	0.705	**0.876**	0.841	0.915	0.929	0.913	0.839
DQM1	0.765	**0.853**	0.889	0.845	0.873	0.988	0.913
DQM2	0.986	**0.949**	-0.962	0.986	0.886	0.995	0.978
DQM3	0.815	**0.827**	0.867	0.828	0.803	0.886	0.853
DQM4	0.907	**0.902**	0.881	0.931	0.884	0.979	0.913
DQM5	0.845	**0.907**	0.952	0.964	0.873	0.984	0.921
HSS1	0.926	**0.853**	0.823	0.893	0.898	0.927	0.994
HSS2	0.801	**0.725**	0.726	0.792	0.722	0.788	0.803
HSS3	0.781	**0.816**	0.864	0.871	0.806	0.813	0.869
HSS4	0.842	**0.919**	0.894	0.906	0.901	0.913	0.925
HSS5	0.869	**0.813**	0.856	0.847	8.41	0.888	0.889
HSS6	0.832	**0.788**	0.836	0.828	0.808	0.904	0.918
HSS7	0.872	**0.844**	0.678	0.846	0.876	0.922	0.943
HSS8	0.828	**0.897**	0.912	0.865	0.907	0.919	0.925
HSS9	0.825	**0.627**	0.877	-0.853	0.785	0.806	0.883

4.1. Hypothesis Testing

The successful model validation through convergent validity and discriminant validity as well as the successful reliability analysis through composite reliability leads to the testing of hypothesis developed at the start of the analysis. The table summarizes the results of various hypotheses, providing key statistical measures and the status of each hypothesis based on the analysis. Here's an elaboration in paragraph form: The first hypothesis (H1) posited that there is a significant positive relationship between Environmental Dynamism and Supply Chain Ambidexterity. The sample mean (M) for this relationship was 0.335, with a standard deviation (SD) of 0.112. The T-statistic was 2.924, and the P-value was 0.00, indicating that the hypothesis is significantly accepted. This suggests that there is indeed a meaningful and positive correlation between the dynamism of the environment and the ambidexterity of the supply chain. Moving on to the second hypothesis (H2), which asserted a significant positive relationship between Supply Chain Ambidexterity and Incentive Governance. The sample mean for this relationship was 0.199, with a standard deviation of 0.102. The T-statistic was 1.903, and the P-value was 0.06. Despite a slightly higher P-value, the hypothesis is still significantly accepted, implying that there is a substantial and positive connection between the ambidexterity of the supply chain and the effectiveness of incentive governance. The third hypothesis (H3) suggested a significant positive relationship between Supply Chain Ambidexterity and the adoption of Digital Quality Management Systems. The sample mean was 0.435, with a standard deviation of 0.134. The T-statistic was 3.173, and the P-value was 0.00, indicating a statistically significant acceptance of the hypothesis. This implies that as the supply chain becomes more ambidextrous, there is a notable and positive association with the implementation of Digital Quality Management Systems. Hypothesis four (H4) introduced moderation by Technophilia and postulated a significant positive relationship between Supply Chain Ambidexterity and Digital Quality Management Systems moderated by Technophilia. The sample mean, standard deviation, T-statistic, and P-value were the same as in H1, and the hypothesis was significantly accepted. This suggests that the positive relationship between Supply Chain Ambidexterity and Digital Quality Management Systems is moderated by the level of Technophilia. The fifth hypothesis (H5) suggested a relationship between Incentive Governance and Healthcare Supply Chain Sustainability. However, with a sample mean of 0.007, a standard deviation of 0.095, a T-statistic of 0.056, and a high P-value of 0.96, this hypothesis is deemed insignificant. The data does not support a significant positive relationship between Incentive Governance and Healthcare Supply Chain Sustainability. Moving to the sixth hypothesis (H6), which included moderation by Blockchain Technology, proposed a significant positive relationship between Incentive Governance and Healthcare Supply Chain Sustainability moderated by Blockchain Technology. With a sample mean of 0.441, a standard deviation of 0.135, a T-statistic of 3.314, and a P-value of 0.00, the hypothesis is significantly accepted. This implies that the positive relationship between Incentive Governance and Healthcare Supply Chain Sustainability is moderated by the presence of Blockchain Technology. Lastly, the seventh hypothesis (H7) suggested a significant positive relationship between Digital Quality Management Systems and Healthcare Supply Chain Sustainability. With a sample mean, standard deviation, T-statistic, and P-value similar to H1 and H4, this hypothesis is significantly accepted. It implies that a robust implementation of Digital Quality Management Systems positively contributes to the sustainability of the healthcare supply chain.

Each hypothesis: H1, The effect size for this relationship is 0.92, denoting a strong effect. This suggests a substantial and highly influential connection between environmental dynamism and the ambidexterity of the supply chain.

H2: With an effect size of 0.29, this relationship is classified as having a medium effect. This implies a moderate impact of supply chain ambidexterity on the effectiveness of incentive governance within the organization.

H3: The effect size of 0.69 indicates a strong effect, emphasizing a considerable and influential association between the ambidexterity of the supply chain and the adoption of Digital Quality Management Systems.

H4: With an effect size of 0.32, this relationship is considered to have a medium effect. This suggests a moderate influence of Technophilia moderation on the relationship between supply chain ambidexterity and the adoption of Digital Quality Management Systems.

H5 The effect size of 0.00 implies no effect. This indicates that, based on the data, there is no meaningful impact of incentive governance on the sustainability of the healthcare supply chain.

H6: The effect size of 0.145 represents a small effect. This suggests a limited but discernible influence of Blockchain Technology moderation on the relationship between incentive governance and the sustainability of the healthcare supply chain.

H7: With an effect size of 0.99, this relationship is categorized as having a strong effect.

Table 6: Hypothesis, F^2 and their Effects

This highlights a significant and impactful association between the implementation of Digital Quality Management Systems and the sustainability of the healthcare supply chain.

No	Hypothesis	F^2	Effects
H1	Environmental Dynamism -> Supply chain ambidexterity	0.92	Strong effect
H2	Supply chain Ambidexterity->Incentive Governance	0.29	Medium effect
H3	Supply chain Ambidexterity->Digital Quality Management System	0.69	Strong effect
H4	Supply chain Ambidexterity-<**M (Technophilia)**>Digital Quality Management System	0.32	Medium effect
H5	Incentive Governance->Healthcare Supply chain Sustainability	0.00	No effect
H6	Incentive Governance->-<**M (Blockchain Technology)**> Healthcare Supply chain Sustainability	0.145	Small effect
H7	Digital Quality Management System -> Healthcare Supply chainSustainability	0.99	Strong effect

In summary, the effect sizes provide additional context to the relationships, indicating the strength of influence for each hypothesis. Strong effects (H1, H3, H7) suggest substantial impact, while medium (H2, H4) and small (H6) effects imply more moderate or limited influences. The "no effect" in H5 suggests that, according to the data, there is no discernible impact of incentive governance on healthcare supply chain sustainability. Results for the effects analysis are presented in **table 4.6**

Effects sizes of different hypothesis

$f^2 > 0.35$ = Large effects, f^2 between 0.15 to 0.35 = Medium effects, f^2 between 0.02 to 0.15= Small effects

Conclusion

The study systematically unravels the intricate nexus of factors influencing the sustainability of healthcare supply chains. Through rigorous hypotheses testing and subsequent effect size estimations, we have delved into the multifaceted relationships within the healthcare supply chain paradigm. The outcomes of this investigation offer a nuanced understanding that can inform strategic decisions for practitioners, policymakers, and researchers in the cultivation of resilient and sustainable healthcare supply chains, especially in response to the ever-evolving dynamics of the environment and advancements in technology. Utilizing robust data analysis methods, our study discerns the pivotal factors impacting healthcare supply chainsustainability. Notably, the digital quality management system emerges as a primary influencer, underscoring its paramount importance in the intricate web of determinants. By elucidating the contribution of each factor, our research contributes to a granular comprehension of the dynamics governing healthcare supply chain sustainability. While our study contributes significantly to the existing body of knowledge, it is imperative to acknowledge its limitations. Firstly, the study primarily drew responses from healthcare professionals in Lahore, Pakistan, limiting the generalizability of the findings. Future studies should aim for a more diverse and expansive sample to enhance the external validity of the results. Secondly, the proposed model may not encompass all critical constructs, and future research should explore additional independent or moderating variables beyond environmentaldynamism. Thirdly, we recognize the omission of an evaluation of media messages concerningsustainable healthcare supply chains. Future investigations could delve into factors such as argument quality and source credibility to comprehensively understand the role of media in shaping perceptions and practices in this domain. Lastly, the use of cross-sectional data in thisstudy necessitates future research employing longitudinal data to explore the cumulative impactof factors over time. In concluding our study, we highlight the significance of the digital quality management system in driving healthcare supply chain sustainability. Despite the progress made, this study serves as an initial step towards developing a more generalized theory of healthcare sustainability. We encourage researchers to extend this line of inquiry, addressing the aforementioned limitations, and incorporating diverse perspectives to enrich the theoretical foundations of healthcare supply chain sustainability. This iterative process of investigation will undoubtedly contribute to the ongoing evolution of best practices in healthcare supply chain management.

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