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**THE IMPACT OF INFORMATION SYSTEMS ON
COMPETITIVENESS IN THE FOOD SECTOR'S SUPPLY
CHAIN IN JORDAN**

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IMPACT OF INFORMATION SYSTEMS ON COMPETITIVENESS IN THE SUPPLY CHAIN

The aim of this dissertation is to obtain a doctoral (PhD) degree in the scientific field of
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INTRODUCTION

Background

The relentless pressure for efficiency, resilience, and transparency has positioned supply chain competitiveness as a definitive factor for firm survival and growth in the global market (GAMMELGAARD & NOWICKA, 2024). This strategic importance is magnified within the food industry, where challenges of product perishability, traceability, and complex logistics make robust supply chain management (SCM) not just a competitive concern, rather a matter of public trust and economic stability, particularly in emerging economies like Jordan.

Within this context, digital transformation, driven by the adoption and integration of Information Systems (IS) has become fundamental to modern SCM, providing the real-time visibility, data analytics, and coordination capabilities necessary to manage complex networks. Scholars and practitioners posit that technologies such as Enterprise Resource Planning (ERP), Internet of Things (IoT), and advanced analytics platforms are fundamental to building agile, visible, and efficient supply networks (BÜYÜKÖZKAN & GÖÇER, 2018). While the operational benefits of these technologies are well established, there is a pressing need to move beyond efficiency gains and understand precisely how they translate into sustainable competitive advantage in the marketplace. Furthermore, global pressures have made sustainability a critical dimension of supply chain (SC) strategy, where companies are increasingly responsible for the ethical and environmental footprint of their operations (GURZAWSKA, 2020).

Therefore, this research investigates the junction of these three core elements: information systems, competitiveness, and sustainability. It posits that these elements are not separate goals but are intrinsically linked within a digitally transforming SC. The study seeks to unravel how IS adoption serves as a platform, enabling both the dynamic organizational capabilities for market responsiveness and the measurable sustainability outcomes that modern markets demand, and how this synergy determines competitive competitiveness in the context of Jordan's food SC. In this study, supply chain competitiveness is defined as the set of operational capabilities through which a firm competes in its market – namely delivery reliability, cost efficiency, responsiveness to demand, order accuracy, and service flexibility. This conceptualization follows the way

competitiveness is operationalized in the SC literature, where it is captured through measurable capabilities such as cost, delivery dependability, quality, and flexibility (LI et al., 2006). It is distinct from competitive advantage, which denotes the defensible market position these capabilities can produce, and from SC performance, which refers to operational outcomes more broadly.

SCM has emerged as a critical function in business operations, enabling companies to optimize their processes, reduce costs, and improve customer satisfaction. As the global economy becomes increasingly interconnected, SCM has become an essential component of business strategy. A model of the SC is illustrated below in Figure 1 where different phenomena vary in different global settings. In today's fast-paced and competitive marketplace, companies must be able to effectively manage their SCs to remain profitable and competitive.

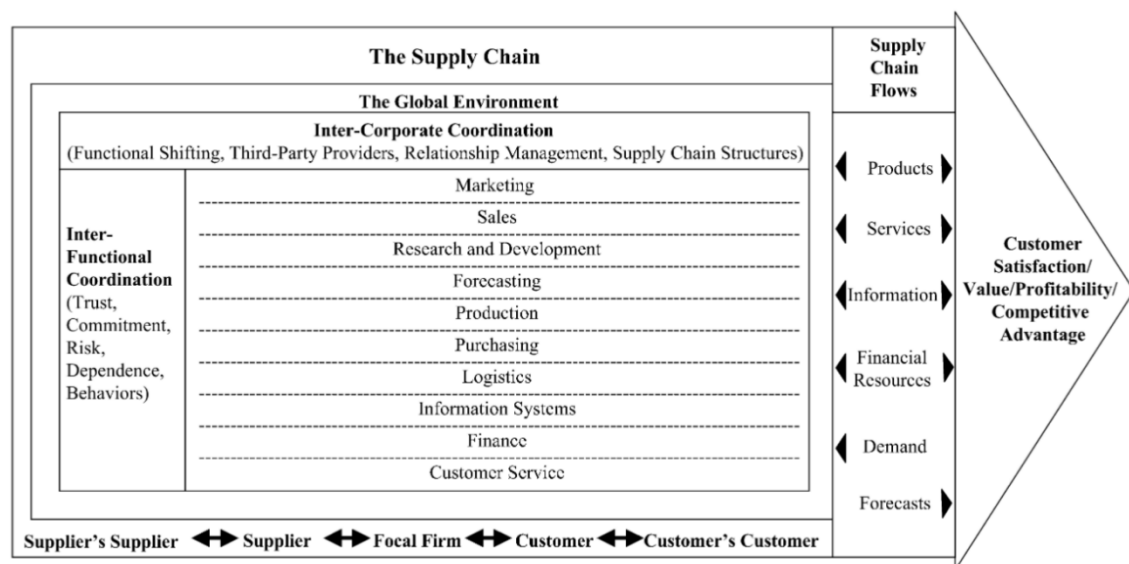


Figure 1: A Model of Supply Chain Management

(Source: MENTZER et al., 2001 p. 19)

The use of information systems (IS) has become an essential component of SCM, providing stakeholders with real-time visibility and control over their operations (WU et al., 2017). IS enables SC stakeholders to efficiently track and manage their resources, identify and mitigate risks, and reduce waste and inefficiencies. While the benefits of IS in SCM are well-documented, there is a growing need to understand how these systems impact competitiveness in the marketplace.

In addition to competitiveness, sustainability has become a critical issue in SCM. With increasing concern for the environment and social responsibility, companies are under pressure to ensure that their SCs are sustainable and ethically managed (ORSDEMIR et al., 2019). Information systems can play a crucial role in promoting sustainability in SCM by enabling stakeholders to track and monitor their environmental impact, reduce waste, and ensure compliance with ethical and legal standards. The thesis will also investigate the extent to which IS benefits SC sustainability and how this affects competitiveness. This thesis seeks to provide a thorough understanding of the role of information systems in developing more ethical and sustainable SCs by examining the relationship between sustainability and competitiveness in SCM. In this study the relationship is treated directionally: IS-enabled sustainability practices are positioned as a driver of SCC (Supply Chain Competitiveness) rather than as a separate or competing objective, a relationship tested empirically in the upcoming hypotheses.

Research Contexts

Food Supply Chain in Jordan

This study is situated within the empirical context of Jordan's food SC, a sector of critical importance to the nation's economy and food security. The Hashemite Kingdom of Jordan is a developing country on the East Bank of the Jordan River in Western Asia. Jordan consists of 12 governments, with Amman as the capital as depicted in Figure 2.

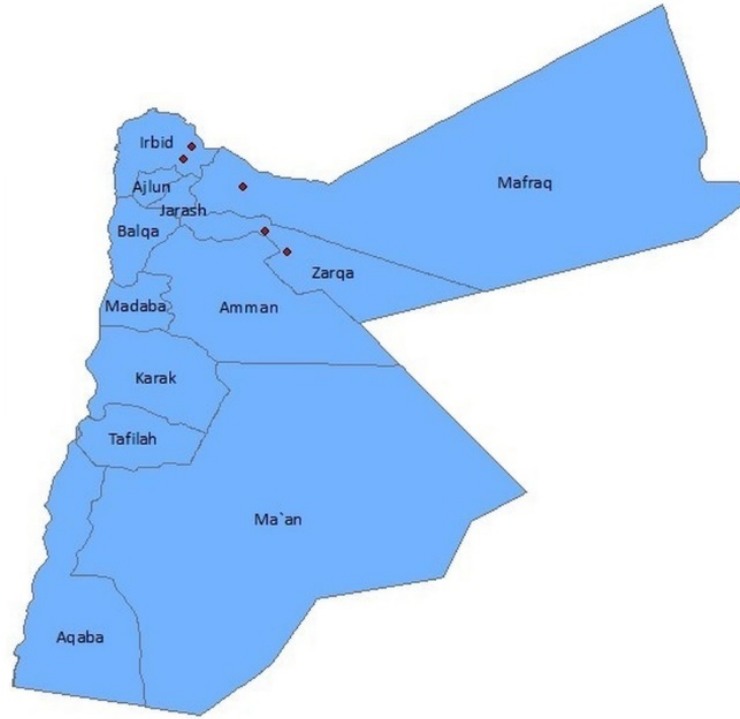


Figure 2: Map of Jordan

(Source: DoS, 2026)

Characterized by a skilled workforce and a modern, liberal economic model that has attracted foreign investment despite its limited natural resources and the socioeconomic pressure of hosting a large refugee population (BECKER & EL-SAID, 2013; DoS, 2018). With a population approximately twelve million and a status as an upper-middle-income economy, Jordan faces the dual challenge of fostering economic growth while ensuring resource sustainability (DoS, 2026). According to the Department of Statistics in Jordan, the GDP growth is 2.8% as of 2025 (DoS, 2026). The Central Bank of Jordan in coordination with the Ministry of Industry, Trade and Supply monitors the availability of essential food items. The CBJ closely monitors the consumer price index (CPI) to measure the impact of food retail. As of late 2025, inflation has remained relatively stable, approximately 1,7% - 1,9% annually, suggesting that the retail SC has not experienced severe disruptions that lead to high food inflation (CBJ, 2026). Based on reports from the Jordan Chamber of Industry (JCI) and local data for 2025 the Gross Value Added in Jordan for the food industries sector is estimated to be approximately 1.8 to 2 billion JOD's (2.5 – 2.8 USD) annually (JCI, 2026; DoS, 2026).

The Jordanian food sector is undergoing significant transformation, driven by urbanization, population growth, and evolving market demands. This has led to the rapid expansion and modernization of retail and logistics networks, particularly in urban centers like the capital, Amman (ORABI, 2016; MoPIC, 2025). Within this dynamic landscape, SCC is not only a commercial concern but a strategic priority for national development. The Jordanian government, through various ministries and in alignment with international frameworks, has explicitly prioritized initiatives that enhance logistical efficiency, technological adoption, and environmental stewardship within key sectors, including agriculture and food logistics (MoA, 2025).

However, the pathway to achieving this enhanced competitiveness through digital means is complex. Firms within the Jordanian food SC operate under unique constraints, including infrastructural variability, regulatory evolving frameworks, and the high relative cost of technological investments (LUTFI et al., 2022). While there is a recognized imperative to adopt information systems (IS) to improve visibility, reduce waste, and meet both national and international market standards, the specific drivers and barriers influencing successful digital transformation are not well-documented in extant literature (FEROZ et al., 2021).

In 2025, the Ministry of Digital Economy and Entrepreneurship (MoDEE) significantly advanced Jordan's digital landscape, highlighting the conclusion of its 2021-2025 strategy with over 80% of government services digitized (MoDEE, 2026). Key achievements included launching the National Council for Future Technology and implementing a national e-invoicing system (MoDEE, 2026). Despite these developments, substantial progress is still needed to enhance the integration and application of technology throughout the SC in Jordan. The success of the 2021-2015 strategy paved the way for the newly approved 2026-2028 Digital Transformation Strategy which focuses on sovereignty and advanced technology adoption and application (MoDEE, 2026).

This context makes Jordan a compelling and relevant setting for this investigation, as findings will contribute directly to an understanding of digitalization in an emerging market environment where such transitions are both urgently needed and fraught with distinctive challenges. Consequently, this research focuses on firms operating within this vital sector, from producers and processors to logistics providers and distributors, to capture a holistic view of the IS-competitiveness nexus in Jordan's market

Sustainable Development in Jordan

Jordan has demonstrated a proactive commitment to sustainable development by formally adopting the United Nations Sustainable Development Goals (SDGs) into its national policy architecture (DoS, 2026; MoPIC, 2025; MoA, 2025). This strategic integration reflects a deliberate alignment of national growth objectives with global sustainability imperatives. The government has institutionalized this agenda through multi-stakeholder governance mechanisms. These coordinated working groups unite public, private, and civil society actors under a framework that prioritizes integrated social, economic, and environmental outcomes (MoPIC, 2025; DoS, 2026). Jordan's policy emphasis on sustainability and innovation creates a strategic environment were investigating the role of IS as a competitive advantage. The UN Joint SDG Fund is providing support to bolster Jordan's financial ecosystem for sustainable development (DoS, 2026). The study's examination of how digital transformation influences SC performance aligns with national priorities, offering insights that are both academically significant and policy-relevant within Jordan's developmental trajectory.

Rationale for the Research

While many literatures consider IS as an enhancing tool for improving SC performance, but there is still a lack of empirical data regarding the process by which IS-enabled capabilities contribute to sustainable competitiveness in emerging economy environments (GROVER & KOHLI, 2012). Prior studies often examine technological adoption, organizational agility, or sustainability in isolation, neglecting their synergistic interactions within an integrated framework (WARNER & WÄGER, 2019). In addition, practitioners and policymakers in Jordan lack an evidence-based hierarchy of strategic priorities for digital investment, leading to fragmented and potentially inefficient resource allocation. Furthermore, the discourse on digital transformation predominantly emphasizes technological assets, often overlooking the pivotal role of organizational capacity in leveraging these assets (HANELT et al., 2021). This oversight extends to the role of implementation challenges, which are frequently framed as definitive barriers rather than as potential obstacles that resilient firms can overcome. Therefore, this studies rationally justified as it seeks to fill this empirical and theoretical void, providing a context specific blueprint for strategic action in order to develop and empirically validate an integrated model that identifies and explain the influence of IS-enabled capabilities on SCC.

Significance of the Research

This research holds significant value for both academic and practical SCM. Theoretically, it will contribute to refining and extending the Dynamic Capabilities View (DCV) within the domain of SC digitalization. By empirically testing the DCV against the Resource-Based View (RBV) in a specific context, the study will provide evidence on the hierarchy of capabilities necessary for competitiveness, addressing a key debate in strategic management (LINDE et al., 2021). Furthermore, it will advance green IS literature by quantitatively linking IS-enabled sustainability practices directly to competitive competitiveness, transforming this concern into a strategic driver.

Practically, the findings will provide actionable intelligence for key stakeholders. For SC managers and executives in Jordan and similar markets, the validated model will offer a clear prioritization framework for digital investment, highlighting whether to focus resources on technology acquisition, agility development, or sustainability integration. For national policymakers, the insights will inform the design of more effective support programs, such as incentives for capability-building over mere technology procurement, fostering a more resilient and competitive national logistics ecosystem. Ultimately, the research intends to translate academic insight into a strategic toolkit for enhancing the performance and sustainability of a sector critical to Jordan's economic and food security.

Research Aim and Questions

For decades now, the relationship between information systems (IS) and competitiveness has been the subject of much debate. However, there is growing evidence that the integration of IS into SCM can have a significant impact on competitiveness. As a result, there is increasing interest in exploring the potential benefits and practical challenges of digital implementation with SCs. This study intends to examine these challenges and potentials, with a specific focus on the impact of IS on SCC and sustainability. Therefore, *the objective of this research is to develop and empirically validate an integrated model that identifies and explains the influence of IS-enabled capabilities on supply chain competitiveness.*

This study is therefore driven by the need to resolve this uncertainty. It moves beyond asking if IS impacts competitiveness to investigate how, and through which specific mechanisms, this impact materializes. Hence, with regards to analyzing the literature and the research scope, the following key research question (RQ) is addressed:

(RQ): “What are the key determinants of supply chain competitiveness in the Jordanian food industry, and what is the role of information systems in shaping this competitiveness?”

- a- To what extent do technological factors, the adoption of information systems (ISA) and the development of IS-enabled dynamic capabilities, directly influence supply chain competitiveness?
- b- How does the strategic use of information systems for sustainability initiatives contribute to competitive advantage in the supply chain?
- c- What is the relative importance of possessing valuable resources versus measuring performance effectively when compared to these digital and adaptive factors?
- d- Do the challenges of implementation fundamentally mediate success, or can they be absorbed by resilient organizations?

The main research question (RQ) will provide the opportunity to explore the different types of practices in the industry of a developing country as the study will be conducted in the developing country of Jordan to understand the critical barriers that face different firms when they turn into IS, identifying the critical barriers and challenges and understanding their rule in hindering the adoption of IS and sustainability. The sub research questions will lead to identifying the different challenges and barriers of the implementation and will try to address the suitable ways to mitigate these challenges for improved performance and efficiency.

By pursuing these questions, this research aims to identify not only the drivers of SCC but also the specific barriers that may hinder the translation of digital investment into market success. The ultimate objective is to provide managers, policymakers, and scholars with a blueprint for navigating the digital transformation of a SC that is essential to Jordan’s economic and food security.

1. LITERATURE REVIEW

This chapter consists of the literature review of this thesis. It offers intuitive information about the details that are integrated into the supply chain along with the information systems. It is vital to realize that by recounting the inherent details of both these elements, informative and general details regarding information systems and supply chain entirely may be brought out (PUTRO et al., 2022). This chapter includes the selection of distinct secondary data which has been done on the basis of full-text relevant features in an effort to justify this particular literature review issue to reach a decisive point. The study concentrates on supply chains in Jordan to provide the study a specific context. The thesis reviews the literature review with emphasis on the developing countries. The focus provides a unique chance to learn about the practical implications of adopting sophisticated IS and sustainability practices in contexts that may not have the solid infrastructure, resources and regulatory structures of wealthy countries. The material from this chapter will help identify the significant barriers and problems relevant to a developing country's context. It will also provide a roadmap to companies who want to improve their performance and efficiency by the implementation of IS and practices.

1.1. Background Literature Review of Supply Chain

1.1.1. Supply Chain Management: Concepts and Competitive Development

A supply chain (SC) is made up of a number of businesses that buy raw materials, transform them into intermediate goods, and then distribute the final goods to clients through distribution networks (CARTER & EASTON, 2011). In this chain, three important factors are covered: procurement, production, and distribution (BRANDENBURG et al., 2019). As firms and experts experimented with strategic alliances with their immediate suppliers, the supply chain management (SCM) concept arose. SCM is defined by CHRISTOPHER (1999, p.13) as: “*a network of organizations that are involved, through upstream and downstream linkages in the different processes and activities that produce value in the form of products and services in the hand of the ultimate consumer.*” According to the prior definition, the objective of SCM is customer satisfaction, and all procedures and actions along the SC must be structured to satisfy consumers' expectations.

SCM constructs an entity that integrates manufacturing, distribution, and procurement with the goal of managing operations effectively and efficiently across the entire network (WIELAND & DURACH, 2021). SCM's short-term objective is to increase productivity, minimize cycle time, and reduce inventory, while the long-term objectives are to increase market share, customer loyalty, and the revenues of the SC members (CARTER & EASTON, 2011). According to the literature by SPANAKI et al., (2018), there are three main factors for the formation of the SC: (i) reducing the inventory investment in the chain. (ii) increasing customer service. and (iii) helping to build a competitive advantage.

Another current trend in the SC is digitalization, which led to the Supply Chain 4.0 (IVANOV et al., 2019). Supply Chain 4.0 is the term given to the integration of Industry 4.0 technologies including Internet of Things (IoT), blockchain, artificial intelligence (AI), big data analysis, and cloud computing into SC processes (BÜYÜKÖZKAN & GÖÇER, 2018). These technologies have transformed SC operations to real-time visibility, predictive analytics, automation, and data-driven decision making. The current digital SCs are more customer-oriented, reactive and adaptive, and speedier in operation (QUEIROZ et al., 2021). However, NING & YAO, (2023) believe that digital transformation is unequal, especially in low- and middle-income nations, where disparities in infrastructure, skills and investment hinder digital adoption.

The relationship between information and competitiveness of SC has also been explored in the Jordanian agri-food sector. Information sharing was linked to export performance. Higher performing producer-exporter linkages were discovered in a study of Jordanian export chains. Conversely, lower-performance partnerships were characterized by more individualistic motives and a smaller and more short-term interchange of logistics-related information (SALAM & BHUTTA, 2013). These results are important because they place information sharing as something more than an operational activity: its contribution to competitiveness seems to be conditioned by the nature of the connections through which the information is transmitted.

The development of resilience is another important factor that has recently surface, and became a concern following the COVID-19 pandemic. However, it has also become an issue during the climate-related disruptions, and geopolitical conflicts. These situations have emphasized the importance of resilience, which implies the capacity of a SC to resist, absorb, and

recover from disruptions (PETTIT et al., 2010). Modern resilient SCs combine flexibility, redundancy, visibility, and agility supported by IS tools (IVANOV & DAS, 2020).

Accordingly, the evolution of SCM from the integration of procurement, manufacturing and distribution to digitally enabled and interconnected SC networks provides a framework for examining competitiveness at the level of the SC rather than the individual firm. The evidence from Jordanian studies demonstrates that information sharing, analytics capability, digital collaboration, and information systems are associated with SC capabilities and competitive outcomes.

1.1.2. Dimensions of Supply Chain Performance

An efficient SC is a critical determinant of organizational success; there are several significances of SC.

Enhanced Agility & Market Responsiveness. In today's volatile markets, a SC's capacity for agility is crucial. Beyond only speed, this skill reflects a firm's ability to rapidly reorganize its resources, procedures, and partner networks in response to changing demand trends and competitive environments. Agility is operationalized through strategies such as flexible manufacturing cells and real-time analytics that sense and shape market signals. This makes it possible for organizations to profitably serve specific markets, capitalize on short lived trends, and significantly reduce the risk of low inventory levels and lost opportunities. As demonstrated by GLIGOR et al., (2016), this state can only be achieved by engaging in a strategic orientation that transforms market volatility from a threat into an advantage by integrating flexibility into the core design of SC operations.

Customer Service Enhancement. With the assistance in the form of product quantity and assortment, the SC ensures that customer service is improved and that customers receive the right products at the right time. Moreover, the SC ensures that the right products are available at the right location within the required timeframe, hence customer satisfaction is not compromised when replacements or repairs are needed. SC makes sure that sales support and delivery times are accurately displayed so that all customers can be informed when their products will be available. This outlines how the entire SC can help in getting products to customers within a timely manner

without losing any credentials or getting misplaced between the ordering and outreach process (BÄCKSTRAND & FREDRIKSSON, 2022).

Strategic Risk Mitigation & Resilience. Modern SCM has changed the definition of risk from an operational variable to a core strategic issue and resilience has become a key corporate competency. A resilient SC is designed to (i) foresee probable disruptions, (ii) withstand initial shocks without catastrophic failure, (iii) adapt its operations to new limitations, and (iv) return to a target performance state (WIELAND, 2021). It means going past the lean, single-source efficiency to designing networks with strategic redundancy, diversified sourcing and buffer capacity at important points. As indicated by IVANOV (2021), digital instruments such as SC control towers and digital twins increasingly enable resilience thru proactive scenario modeling and rapid, data-driven reconfiguration. The combination of these structural and analytical capacities makes a firm's SC a strategic asset that secures income, preserves its brand image, and assures company continuity when faced with unforeseen impediments.

Financial Boost. FREIJE et al., (2022) suggests that the advantages of SC are immensely found in the financial aspects as it ensures that all the financial dimensions of a company are boosted up with the help of proper management of SC within a company. As well as ALZOUBI (2018), noted that innovations in the reengineering of business processes innovate the financial dimensions of SCM. Hence, all the financial dimensions are inclusively incorporated around the SC aspects of a company is associated with financial balance that is to be maintained within an organization, hence this balance ensures that the SC operates profitably, which in turn drives the initiation and management of all related operations (FREIJE et al., 2022). The advantages of SC in ensuring that all the SC managers can seemingly help control the overall cost is sufficiently beneficial in ensuring that dramatic increase in the profits of a firm is ensured. Moreover, fixed assets are also decreased as far as proper management of SC takes place in a company. This is to ensure that any usage of different kind of fix assets warehouses, plants, and transportation vehicles highly used in a company are properly executed and operating in such a way so that flexible timing and any kind of major causes can be reduced, so that any kind of waste expenses is reduced to bare minimum (ALSHURIDEH et al., 2022).

Organizational Learning and Knowledge Integration. A sophisticated SC is an important conduit for organizational learning, providing a continuous flow of external knowledge that helps to stimulate creativity and build capabilities. The deep partnerships with suppliers, logistics providers and technology partners allow opportunities to learn new technical skills, process improvements and unforeseen market intelligence. In the well managed firm, this knowledge integration enables the assimilation and reintegration of external knowledge, therefore strengthening the dynamic capabilities of the organization. The SC is therefore a fundamental engine for creating the adaptive intelligence necessary for long-term strategic renewal in high-performing buyer-supplier interactions (SHAMSOLLAHI et al., 2021).

1.2. Food Supply Chain Management in Jordan

Food Supply Chain Management (FSCM) represents a critical nexus of agricultural production, logistics, regulatory compliance, and consumer demand, all of which converge to the efficient and safe distribution of food from farm to fork (VAN DER VORST et al., 2007). Unlike conventional SCs, FSCM must contend with unique challenges such as perishability, stringent safety regulations, and ethical sourcing considerations (MENON & RAVI, 2021). The growing complexity of globalized food networks, compounded by climate uncertainties and geopolitical disruptions, has further underscored the need for resilient and transparent SC strategies (FAO, 2021).

Scholars stress that FSCM is not merely a logistical operation but a multidisciplinary field that overlaps with agribusiness, sustainability science, and policy governance (AUNG & CHANG, 2014; MANNING & SOON, 2016). Therefore, theoretical foundations in FSCM have been developing along with these practical developments.

This subject is of special importance for FSCM in Jordan. In the food processing business in Jordan, ALSHAWABKEH et al., (2024) conducted a study involving 200 managers and discovered that analytics capabilities have a favorable influence on digital collaboration and SC visibility, and that digital collaboration has a substantial effect on SC velocity and flexibility. Another data from food enterprises in Jordan also suggests a direct association between information systems and competitive advantage. Similarly, ALTARAWNEH (2019) discovered a

significant association between marketing information systems and competitive advantage for FSCs. The literature shows that the competitiveness of FSCM is not due to logistical efficiency but due to the complex interrelationships between suppliers, buyers, intermediaries and other SC actors to ensure that perishable food products are able to reach consumers safely, efficiently and with the required quality.

1.3. Levels of Food Supply Chain

1.3.1. Actors

The food SC is a complicated web of interdependent players, each playing different but interwoven roles in delivering items from farm to fork. It is a network that centers on a focal firm, usually a large retailer or processor, that coordinates the actions of upstream and downstream partners (GEREFFI et al., 2005). This focal actor interacts directly with end customers, and coordinates with a variety of SC actors such as farmers, input suppliers, processors, and distributors (AHI & SEARCY, 2015). The focal company's strategic position enables it to influence production standards, pricing mechanisms and adoption of innovation along the network (BESKE et al., 2014). However, this type of centralized governance structure sometimes leads to power asymmetries as smaller entities are pressured to satisfy the requirements of the focal firm (HINGLEY et al., 2015).

From tiny family farms to massive agribusiness operations, upstream agricultural producers are the backbone of the food system (LOWDER et al., 2021). These producers face different challenges from climate variability, resource scarcity, and also the dependence on major input suppliers who control access to seeds, fertilizers, and machinery (CLAPP, 2021). Processors play a critical midstream role, transforming raw materials into value-added products while simultaneously managing quality and safety standards (BARRETT et al., 2022). In order to maximize production efficiency and reduce waste, their operations have become more technologically complex, utilizing automation and data analytics (BÉNÉ et al., 2019). Downstream, retailers and food service providers have the main interaction with consumers, who use their market position to set terms for suppliers while responding to shifting consumer preferences (REARDON et al., 2019). Figure 3 illustrates a typical upstream and downstream SC.

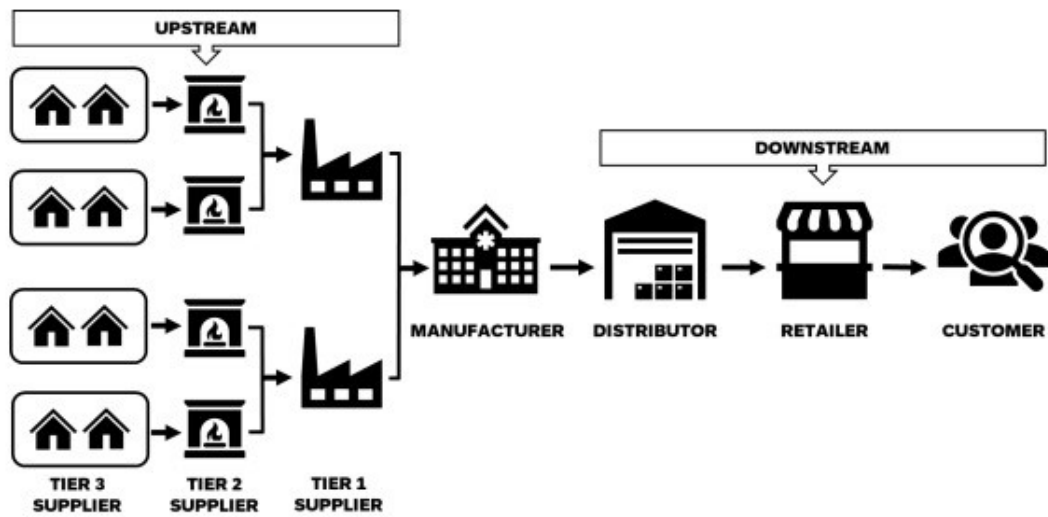


Figure 3: Upstream and Downstream Supply Chain

(Source: SANTHI & MUTHUSWAMY, 2022, p.4)

In recent decades, the relationships among these actors have grown significantly, with more integrated and cooperative arrangements replacing traditional transactions (HAZEN et al., 2021). Long-term partnerships, information sharing, and cooperative problem-solving are key components of modern SC that improves responsiveness and reduces risk (AHI & SEARCY, 2015). However, these cooperative models coexist with persistent tensions, particularly around profit distribution and decision-making authority (HINGLEY et al., 2015). By facilitating more transparency and traceability throughout supply networks, emerging technologies like blockchain and IoT are further reshaping actor interactions (KSHETRI, 2021). Developing more sustainable and equitable SC models requires an awareness of the changing roles, relationships, and power dynamics among these diverse actors as the food system continuous to grow.

1.3.2. Dyads (Relationships)

Dyadic connections are the basic building blocks in the complex structure of food SC that link diverse actors into an integrated system (BEN-DAYA et al., 2019). Such bilateral relationships are not just transactional exchanges but they are strategic alliances affecting the supply network's overall efficiency, resilience, and capacity for innovation (VILLENA & GIOIA, 2018). Due to the perishable nature of products, tight safety requirements and volatile customer

demand patterns (BESKE et al., 2014), the quality of inter-firm relationships has been identified as crucial for competitive success in the food business. Basically, these dyads presented deeper levels of engagement, from simple coordination of information flows to resource sharing for cooperation and finally reaching full collaboration thru cooperative value creation initiatives (CAO & ZHANG, 2011; FLYNN et al., 2020).

The vertical relationships are based on the traditional farm-to-fork path, establishing interdependencies between actors at successive SC levels (BARRETT et al., 2012). Critical pairs can include the normal contentious relationships between farmers and their supply providers, often characterized by power asymmetries in access to seeds, fertilizers, and agricultural technologies, creating dependency dynamics (CLAPP, 2021). Also essential are the contractual links between agricultural farmers and food processors, which range from short-term market transactions to long-term partnership agreements with tight quality criteria (BELLEMARE & NOVAK, 2017). Further downstream, manufacturers and distributors' dyads face the challenges of inventory synchronization and cold chain management. Retailer-consumer interfaces increasingly include digital platforms that change traditional buyer-seller interactions (GREWAL et al., 2020).

Horizontal relationships add additional layer of complexity thru coalitions among similar firms at the same SC level (BIJMAN et al., 2012). Competitive processors sometimes enter into technology-sharing partnerships to build industry norms for food safety and traceability, and retail consortia may work together to develop shared logistics infrastructure to save distribution costs (HINGLEY et al., 2015; PAN et al., 2019). These lateral links often operate as critical counterbalances to the vertical power structures that shape modern food systems.

The structure of effective SC dyads depends on a set of relational pillars recorded in the literature (ROEHRICH et al., 2017). Trust verification procedures and commitment measurement systems from the psychological basis of these relationships, which require continuous investment in communication and conflict resolution protocols (NYAGA et al., 2010). The operational elements include processes of goal congruence alignment, tactics for maintaining power equilibrium and systems of performance benchmarking that allow reciprocal benefit (LAMBERT et al., 2004; VILLENA & DIOIA, 2018). More practical are indicators of the intensity of structural connection, standards for technology interoperability, and investments that increase mutual

reliance (WILLIAMSON, 2000). To address environmental and ethical challenges in today's food SC, advanced information exchange frameworks and fair risk/reward distribution models are also needed (TRIENEKENS, 2011). The latter stages consist of cooperative value engineering efforts like blockchain enabled traceability systems to improve transparency, followed by continual relationship renewal procedures that adapt collaboration to changing market situations and regulatory settings (KSHETRI, 2021).

Dyadic management in food SCs encounter both challenges and opportunities in today's society (HANDLEY & ANGST, 2015). Traditional relationships have been disrupted by digital platform intermediation, which allows farmers and consumers to communicate directly without the use of conventional intermediaries (HASSOUN et al., 2023). Simultaneously, pandemic-driven supply disruptions have drastically changed risk assessment standards for all partnership types, and sustainability constraints demand new forms of cross-dyadic accountability for environmental and social implications (HOBBS, 2021).

1.3.3. Networks

SC networks are the network of entities involved in the transformation of agricultural goods into food for customers. KANO et al., (2020) described these networks as all actors in relevant industry sectors that operate collectively adding value to consumers. The retail sector is especially well placed in food systems as it is directly connected to end consumers, hence having a major influence on network dynamics (GREWAL et al., 2020). However, the retailer's perspective has been somewhat disregarded in SCM research in academia, but their role in driving structural changes and market-oriented approaches is expanding (PAGELL & SHEVCHENKO, 2014). Figure 4 shows the SC network topology between the focal company and its interactions with other layers of the SC (LAMBERT et al., 1998).

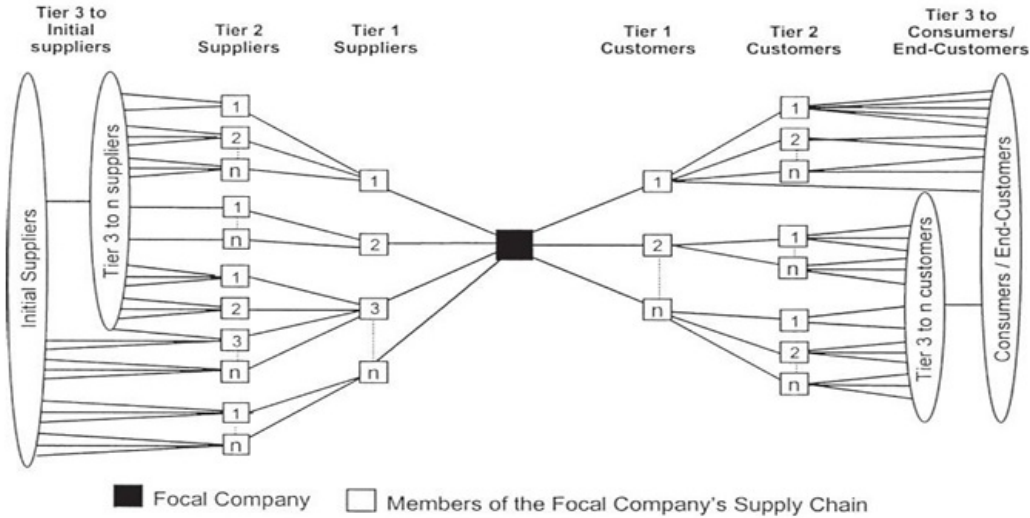


Figure 4: Supply Chain Network

(Source: LAMBERT et al., 1998, p.3)

The food supply network architecture has two basic aspects (AMMIRATO et al., 2021; GREWAL et al., 2017). Vertical linkages connect the stages of production and distribution from primary producers to processors to merchants. Meanwhile horizontal links are created among actors operating on the same level of the SC (AMMIRATO et al., 2021). The trend in the industry is toward leaner networks in which organizations strategically reduce the number of their suppliers to build better relationships with their selected partners (PAUL et al., 2021).

The extent of collaboration depends on the network linkages. Some ties need close coordination and some work well with loose ties (TANSKANEN, 2015). Well-structured networks have a competitive advantage by transforming raw materials into goods that meet customer demand in an efficient manner (LEÃO & DA SILVA, 2021).

Food retailers are a special type of network orchestrator connecting upstream suppliers and downstream consumers (SON et al., 2016). The perishability of food goods makes the network administration more challenging since they require precise temperature control and produce a big amount of waste (BESKE et al., 2014). New digital solutions, such as traceability technology, provide new capabilities to enhance network visibility and coordination (KSHETRI, 2021).

1.4. Sustainable Supply Chain Management

1.4.1. Sustainability

Due to the growing concerns about resource overuse, environmental degradation, and social exclusion, businesses have been encouraged to achieve the goals of sustainable economic growth (GILLAN et al., 2021). In recent years, scientific research has given greater attention to the concepts of sustainability and sustainable development. The idea of sustainability was initially presented in 1987 by the United Nations World Commission on Environment and Development, the commission have defined sustainability as *“an economic development model that allows meeting the needs of the present generation without compromising the ability of future ones to meet their own needs”*. Sustainable development (SD), according to AXELSSON et al., (2011), is more of a collaborative societal process involving a variety of stakeholders with varying levels of importance and authority, while sustainability is defined as a societal policy concept with the primary goal of preventing natural resource depletion. While SD and sustainability are frequently treated as one approach, different researchers (RUGGERIO, 2021; HAHN & TAMPE, 2021) view them differently depending on the application field. However, it has been established from the literature that SD is the objective that must be carried out through sustainability (FAZEY et al., 2020). Hence, the process of accomplishing the SD objective is sustainability.

Triple Bottom Line (TBL) and Sustainability

The Triple Bottom Line (TBL), established by ELKINGTON in 1999, offers a framework for evaluating the performance of the business and the success of the organization using the three lines: economic, social, and environment. TBL aligns with and represents sustainability by balancing environmental, social, and economics factors (ROSATI & FARIA, 2019). Hence, these three lines of sustainability must be balanced in importance to achieve the objectives of SD (PURVIS & ROBINSON, 2019). ELKINGTON (1999) described the three lines as profit, people, and the planet. TBL symbolizes the expansion of the environmental movement in a way that is both economically and socially conscious. ALHADDI (2015) asserts that the research lacks a rigid framework for sustainability given that some studies focused on just one line while others incorporated two or more lines. Regarding the economic line, few studies have considered it independently or with the combination of the other two lines (HÖRISCH et al., 2020).

Incorporating the social component entails evaluating a company's impact on its workforce and the local social structure. In assessing the environmental dimension, companies must take into account both the qualitative and quantitative effects they have on resources at the local, national, and global levels. The economic dimensions include a company's financial success, capital flow, and role in economic participation within society, which are crucial considerations (HUSSAIN et al., 2018). Figure 5 below illustrates the TBL view of sustainability.

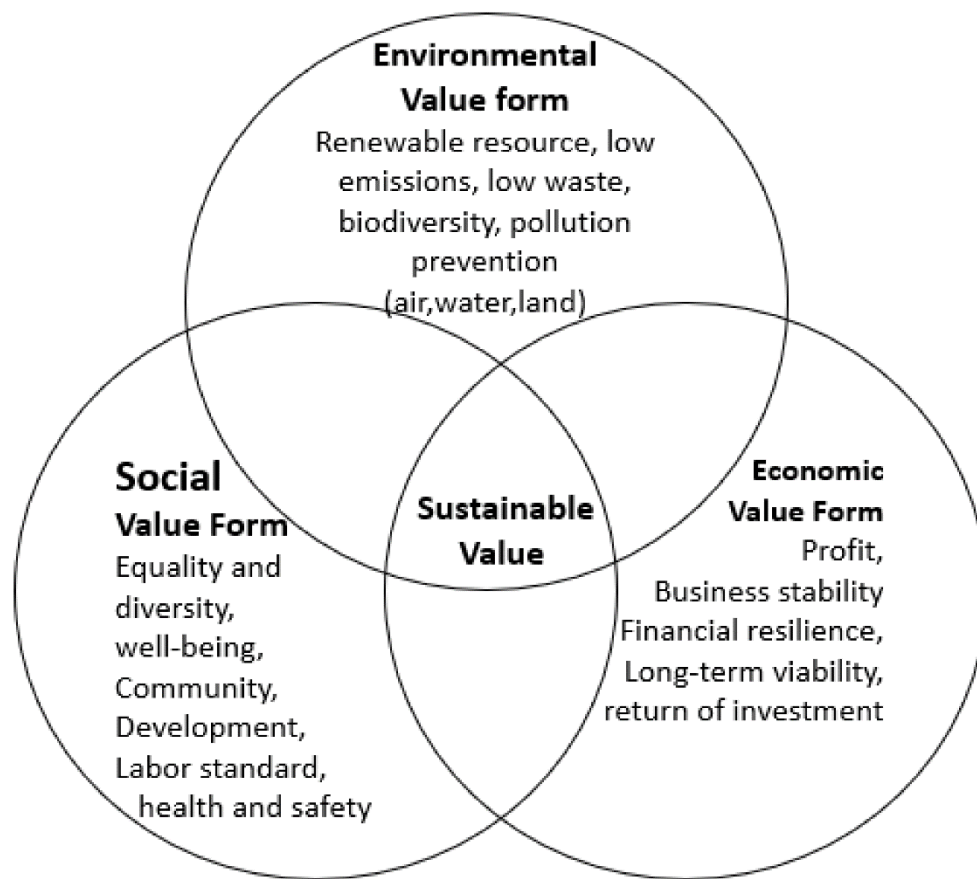


Figure 5: The Triple Bottom Line

(Source: EVANS et al., 2017, p. 600)

The environmental dimension of sustainability endeavors to mitigate the utilization of hazardous resources and prioritize the employment of naturally renewable resources to decrease the production of undesirable emissions that could potentially harm the environment

(GEISSDOERFER et al., 2020). Several scholars emphasized that environmental elements, such as air and water, are integral components of our environment and must be protected as they are insufficient (MANDLE et al., 2021; COLDING & BARTHEL, 2019; DÍAZ et al., 2018). This is accomplished by means such as recycling, reuse, reduction, redesign, remanufacture, and other methods that are intended to prevent resource depletion and minimize waste (RUGGIERI et al., 2016).

The social dimension TBL is based on guaranteeing a safe and equitable work environment of responsibility and standards, with regular communication to stakeholders and the public on the status of work (MANI et al., 2018). This means paying taxes for any environmental damage created by the organization and taking steps for a clean-up (GLAVIČ & LUKMAN, 2007). It also emphasizes the social well-being of the people thru the balancing of individual demands and societal needs (equity), increasing public awareness and cohesiveness, and encouraging the use and involvement of local labor and company (OLAWUMI & CHAN, 2018).

The economic aspect of sustainability is concerned with the way an organization affects the financial position of its stakeholders and the local, national and worldwide economic systems. (BOWERS, 2010) This dimension refers to the strategy that an organization takes to create value while balancing costs and revenues in the production and distribution of goods and services (RAMDANI et al., 2019; BANSAL, 2005). In view of the most effective use of resources to maximize operational profit and market value.

Sustainable Development Goals (SDGs)

In its final session, they released a zero-draft proposal and in 2015, where the United Nations accepted the Sustainable Development Goals (SDGs). The SDGs have six dimensions: dignity, people, planet, prosperity, justice, and partnership. The fundamental goal of the SDGs is to commit and carry out the idea of SD while guaranteeing that the reduction of poverty and economic progress do not happen at the expense of the environment (STAFFORD-SMITH et al., 2017). A road map of 17 goals and 169 targets was devised to promote SD in developing and developed countries including economic growth, social inclusion and environmental protection (RUDRA & KURIAN, 2018), with the goal to achieve the SDGs by 2030 (UNITED NATIONS,

2015). Therefore, the SD goals have been incorporated into the research missions of the worldwide institutes (ABAD-SEGURA & GONZÁLEZ-ZAMAR, 2021; BETTENCOURT & KAUR, 2011).

Jordan has demonstrated a proactive commitment to SD by formally adopting the United Nations Sustainable Development Goals (SDGs) into its national policy architecture (DoS, 2026; MoPIC, 2025; MoA, 2025). The UN Joint SDG Fund is providing support to bolster Jordan's financial ecosystem for sustainable development (DoS, 2026).

1.4.2. Sustainable Supply Chain Management

Sustainable supply chain management (SSCM) is the *“Involvement of the planning and management of sourcing, procurement, conversion and logistics activities involved during pre-manufacturing, manufacturing, use and post-use stages in the life cycle in closed-loop through multiple life-cycles with seamless information sharing about all product life-cycle stages between companies by explicitly considering the social and environmental implications to achieve a shared vision”* (BADURDEEN et al., 2009, p. 57). SSCM is an innovative method that manufacturing companies in developing nations are using to address their environmental responsibilities. However, for emerging markets, one of the most critical challenges has been achieving sustainable production in a SSCM framework, since economic advantages may not be gained (ESFAHBODI et al., 2016).

Enterprises are pressured to shift their priority from traditional economic goals to the triple bottom line (TBL) approach (GIMENEZ et al., 2012). Manufacturing firms in developing countries, such as Jordan, have recently given greater importance to incorporating green practices into their SCM initiatives (MoA, 2025). This shift has been driven by the implementation of stricter environmental regulations by governments, heightened societal awareness, and increasing competitive pressure from both national and international markets (GOVINDAN et al., 2014). As a result, manufacturers in developing markets are increasingly adopting SSCM practices, such as eco-design and green purchasing, to reduce the environmental effects of their activities (TSENG & CHIU, 2013).

HASSINI et al., (2012) introduced a conceptual model of the sustainable SC, represented as a wheel comprising six integral components, each symbolizing a core function within the SCS.

These six functions include sourcing, transformation, delivery, value proposition, customer and product utilization, along with the three R's (reduce, reuse, recycle) (see Figure 6). The six functions of a sustainable SC are as follows: 1) Sourcing and 2) Transformation, which are essential functions in SSCM. A significant facet of a SSCS is the application of 'green procurement practices' (VARNÄS et al., 2009). Their focal actors oblige the upstream suppliers to adopt or adapt changes, which conclude in environmentally friendly sources, ethical practices, and minimal environmental impact. 3) The Delivery function encompasses a number of operational processes including location, choice of transportation, choice of inventory management policy and timely, cost-effective, and efficient product delivery. 4) The Value Proposition is not usually taken into account. Businesses that sell sustainable and eco-friendly goods typically face higher expenses; as a result, the cost is passed on to customers in the form of increased product prices. 5) The Customers and Product use is usually not considered in detail. 6) When a product reaches the end of its useful life after being used by the consumer, it is either recycled, reused, discarded in landfills, or refurbished for people to use. The three R's indicated that the product will be disassembled and its components recycled, remanufactured, or used as raw materials. Actors within the SC are driven by different internal and external pressuring to implement sustainable operations.

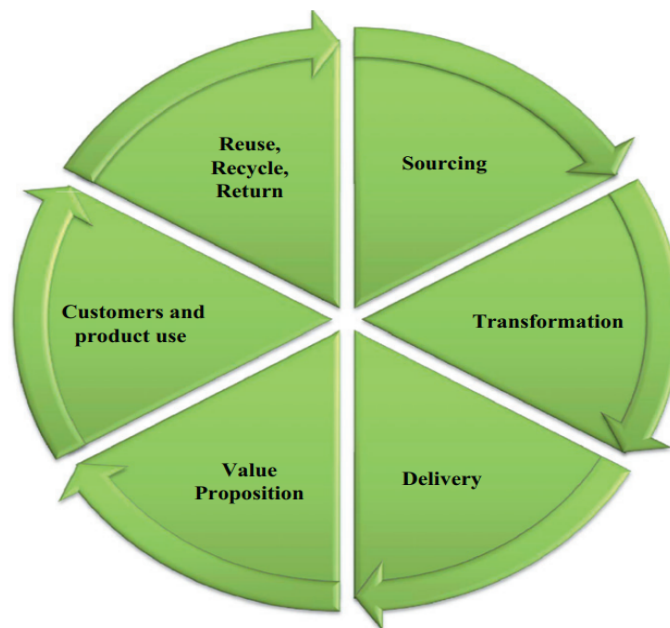


Figure 6: Framework for Sustainable Supply Chains

(Source: *HASSINI et al., 2012, p. 73*)

Sustainability performance represents a strategic approach adopted by SC stakeholders to assess their social, environmental, and economic impacts (QORRI, et al., 2018). However, researchers have trouble with constructing a comprehensive set of criteria and metrics for evaluating sustainability performance, particularly in the context of developing countries (ESFAHBODI et al., 2016). Growing consumer demand for eco-friendly, socially responsible, and cost-efficient value-added products leads empirical research to highlight the need for deeper understanding of improving sustainability performance within SCs (GUALANDRIS et al., 2014).

1.5. Background Literature Review of Information System

As stated by KOIVISTO & HAMARI (2019) access to knowledge has continued to improve how businesses attempt to incorporate success into their operations. To guarantee that overall market power can be gathered, every company must have accessibility to the most current and precise information. It is essential to acknowledge that in the modern world, every organization operates in a data-intensive environment and thus requires a suitable Information System (IS) to accomplish articulated goals linked to corporate objectives. IS are a creditable collection of many different information resources which are utilized to gather, accurately process, store, and segregate information to be utilized by organizations in order to gain a competitive advantage (RAINER & PRINCE (2021), be more cost-effective while enhancing the speed and quality of decision-making processes (NGUYEN et al. (2022). ALTARAWNEH (2019) also argued that IS contributes to competitiveness in Jordan's food sector.

GIANNAKIS et al. (2019) suggests that IS were seen as providing infrastructural support to the value chain as well as having an indirect influence on a product's competitiveness. As stated by de CAMARGO & JABBOUR (2017) SC integration should progress from internal logistics process integration to external logistics process integration with suppliers and customers, and this internal and external integration can be achieved through continuous automation and standardization of each internal logistics function, as well as efficient information sharing and strategic linkage with suppliers and customers. DE REUVER et al. 2018 and KOHLI & MELVILLE, 2019 argue that IS must have the potential to be a strategic weapon in at least one of the following four ways: (1) to gain competitive advantage; (2) to improve productivity and

performance; (3) to enable new ways of managing and organizing; and (4) to develop new businesses.

FU et al. (2022) suggest that the IS as the notion itself is just a method or a process through which proper information is made available to the managers in order to ensure that all aspects and factors that are important for the managers to know are completely provided to them in an easy process. The role of IS is provided below in Figure 7.

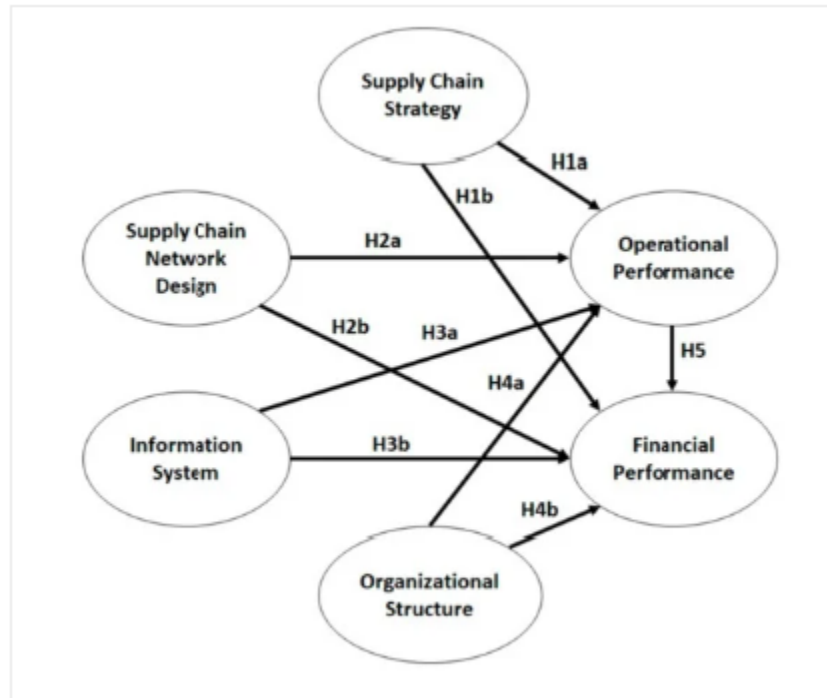


Figure 7: Information System

(Source: FU et al., 2022, p. 4)

GOFWAN (2022) and ALTARAWNEH (2019) suggest that IS is a significant combination of hardware, software, and different types of telecommunication networks to ensure that all data is collected, sorted, and stored in a business farm to be able to enhance productivity and efficiency throughout an organization.

1.5.1. Significance of Information Systems

Modernized SC technology influences business performance through both direct and indirect pathways, delivering benefits that are both obvious and subtle but nevertheless helpful (ALSHAWABKEH et al. 2024; HUO et al., 2023; BADER, 2022). WAMBA et al. (2020) identify five significant advantages that emerge from technology integration in SCM. The first of these is improved information access. SC technologies capture network-wide data on operational demands, logistical disruptions, and customer purchasing patterns, providing firms with a comprehensive view of their entire ecosystem. Second, these systems deliver enhanced analytical insight. The decision support capabilities embedded within modern SC technologies enable organizations to process complex data rapidly, derive meaningful conclusions, and make more informed judgments with greater confidence (SONI et al., 2022).

Third, incorporation of technology leads to more organizational adaptability. Real-time data and predictive analytics equip executives to recognize problems before they materialize and to devise preventative solutions. Fourth, technology allows for more collaboration across the supply network. Systems that provide a constant and reliable flow of information between individuals, teams and partner organizations are critical for successful cooperation enabling shared analysis and coordinated decision-making. Fifth, SC technology will play a key role in creating and retaining consumer loyalty. In today's omnichannel retail environment, success requires the visibility, precision and agility to ensure that the right inventory is in the right place in physical stores, as well as fulfilling online orders, capabilities that remain out of reach without a strong technology infrastructure (KUMAR & TING, 2019). The food business in Jordan can improve the flexibility and performance of the SC using IS (BADER, 2022). ALSHAWABKEH et al. (2024) discusses how digital technology, data analytics, IS can assist in the Jordanian food business to make their SCs more resilient.

1.5.2. Challenges in Implementing Information System

IS help firms to have better coordination, openness and responsiveness (DUBEY et al., 2021). Nevertheless, the successful deployment and efficient usage of IS are typically affected by a number of difficulties that stem from technological, organizational and environmental domains. The challenges of deploying such systems are increasingly seen as strategic issues, as they can

have a considerable effect on how IS investments result in competitive advantage (MIKALEF & KROGSTIE, 2020). AL-ODEH & ALTARAZI (2019) identified poor SCM IS-implementation in the Jordanian IS setting with main problems related to integration with diverse members in the SC, resistance to change and lack of retailer support.

In the context of SC, IS challenges refer to any internal or external barriers that inhibit the adoption, integration, effective use, or strategic alignment of IS in SC processes (KAMBLE et al., 2020). These challenges are multidimensional and can be grouped into three major groups: technological, organizational, and environmental challenges.

(i) Technological Challenges

The technological IS difficulties are the issues associated directly with the hardware, software, infrastructure, and architecture of the IS itself (YIGITCANLAR & CUGURULLO, 2020). These problems tend to be the most evident and to occur early in the phases of IS installation and integration. AL-ODEH & ALTARAZI (2019) showed that the overall deployment of SCM IS in Jordan was relatively weak and faced many important technological hurdles. The specific issues identified in literature are:

- **Outdated or Incompatible Systems:** KUMAR et al. (2017) indicated that many organizations, especially in developing economies, use legacy systems. These systems normally do not interface with newer technologies such as cloud computing, RFID, IoT or blockchain. This leads to fragmented information flows and delayed processing throughout the SC (KUMAR et al., 2017).
- **Lack of Standardization:** this issue is observed when SC partners such as manufacturers and suppliers use different platforms, data formats, and communication protocols. As illustrated by GAL & RUBINFELD (2019), the absence of uniform standards is a key technological barrier that impedes system integration and leads to high data translation costs and inefficiencies.
- **Integration Issues:** Research has demonstrated that integration of IS with other enterprise systems such as enterprise resource planning (ERP), customer relationship management (CRM), or logistics systems remains a major challenge (GUNASEKARAN et al., 2017).

Poor system integration often results in duplication of data, loss of information fidelity, and poor synchronization of SC activities.

- **Scalability Limitations:** considering the dynamic business environment coupled with rapid technological advancement, IS should be scalable to accommodate future changes and growth in transaction volumes, users, or functional requirements. However, GUPTA et al., (2019) research has indicated that in many cases, firms implement systems that cannot adapt to expansion or changes in business processes, which limit long-term competitiveness.
- **Cybersecurity Threats:** as suggested by SUNDRAM et al., (2020), cybersecurity threats are a growing concern in IS operations. With IS becoming more interconnected, vulnerabilities increase. Cyber threats such as hacking, data theft, ransomware, and denial-of-service (DoS) attacks can compromise the integrity and confidentiality of SC data, causing severe reputational and operational risks.

(ii) Organizational Challenges

Organizational challenges come as a result of internal dynamics, human factors, leadership, and strategic alignment within the business. According to QRUNFLEH & TARAFDAR (2013), these challenges are mostly underrated, but they are typically more difficult to overcome than technical issues. This is because they involve people, culture, and institutional inertia that are the core drivers of a business enterprise. In the Jordan context, organizational challenges are also faced (AL-ODEH & ALTARAZI 2019). From review of literature, the following study limitations were highlighted:

- **User Resistance:** these challenges occur when employees may be resistant to change, especially when new systems alter established workflows, which usually may introduce uncertainty about job roles. As suggested by GKINKO & ELBANNA (2022) and HENDRICKS et al., (2007), this resistance is an emotional and adaptive process that can result in the underutilization or outright rejection of new technologies.
- **Lack of Top Management Support:** top management must support any IS initiative for it to be successful. According to SIRISOMBOONSUK et al., (2018) IS implementation

requires leadership commitment and strategic prioritization, which are essential for securing resources and guiding the organization. Without active support from senior executives, IS projects are often poorly funded, inconsistently monitored, and easily derailed by organizational politics.

- **Insufficient Training and Skill Gaps:** another critical challenge that affects IS in companies is lack of skills and technical knowledge. Employees must be adequately trained to operate new systems (KAMBLE et al., 2020). Many organizations neglect post-implementation training, leading to ineffective use, errors, and low system adoption rates. This is especially problematic in the food SC, where staff may lack even basic digital literacy (ABIDEEN et al., 2021).
- **Internal Power Struggles:** in most business, adoption and installation of IS means restructuring the operations of the business. ALI & MILLER (2017) argues that IS can disrupt internal hierarchies and decision-making authority, particularly when they automate or redistribute control over data. This can result in passive resistance or even significant levels of sabotage from departments that feel threatened.
- **Misalignment Between IT and Business Strategy:** particularly a lack of coordination with SC units, prevents IS projects from delivering operational value. Studies on digital transformation find that strategic co development is essential to avoid creating systems that are disconnected from business realities (CÔRTE-REAL et al., 2017).

(iii) Environmental Challenges

Environmental challenges refer to external forces and institutional conditions that have a significant influence on the broader context in which IS is adopted and implemented (BÜYÜKÖZKAN & GÖÇER, 2018). These challenges are more important in developing countries, or businesses that operate under fragmented SCs (TIAN, 2017). Within the Jordanian context, a developing country, environmental challenges continue to pose significant challenges to SCM IS implementation (AL-ODEH & ALTARAZI 2019). Major environmental challenges as emphasized by literature include:

- **Regulatory Constraints:** inferring from HALLIKAS et al., (2021), the presence of complex, ambiguous, or outdated regulations governing the IS process interfere with IS adoption. These regulations majorly include data privacy, information sharing, or cross-border data flows, which are usually experienced when a company is carrying out businesses in different countries. In many contexts, regulatory compliance is costly or unclear, which could discourage innovation (ABU-SHANAB, 2014).
- **Supply Chain Partner Readiness:** A major barrier in multi-tiered SCs is that not all actors are equally digitally mature. For instance, while a distributor may have an ERP system, small-scale farmers or vendors may rely on manual processes, creating disjoints in data flow and visibility (KUMAR et al., 2017).
- **Market Turbulence and Uncertainty:** sometimes, unpredictable market acts as a hindrance to successful adoption and integration of IS. GUNASEKARAN et al. (2017a) argues that volatile market conditions, such as price instability, demand shocks, or political instability, can discourage long-term IS investments. Firms may be reluctant to invest in IS when short-term survival is the priority.
- **Infrastructure Limitations:** this is a challenge majorly experienced in developing regions. In less developed countries, as illustrated by DÍAZ-ARANCIBIA et al., (2024) IS adoption is usually hindered by poor internet connectivity, inconsistent electricity supply, and lack of local technical support. Research has demonstrated that in such regions, without a stable infrastructure backbone, even well-designed systems may fail to function as intended.

1.6. Information System in the Supply Chain

With globalization, organizations have changed their communication strategies, adopted technology advancements, diversified business operations and simplified processes to improve performance thru IT driven applications with their SC networks (VARMA & KHAN, 2014). The SC complexity is increasing, and so are the problems of data and uncertainty management, thus raising the possibility of electronic risks (e-risks) in these complicated networks (ABDEL-BASSET et al., 2019). Hence, the integration of upstream and downstream components in the SC

network is essential to achieve the main goals of SCM. An IT-enabled SCM framework helps efficiently manage information flow with critical business processes, materials and financial resources within and beyond corporate networks (MISHRA et al., 2018). This synergy will result in higher profitability, improved product quality, easier coordination and lesser transactional risks.

Numerous researches have studied the complex interaction between IT and SCM. For instance, WAMBA et al., (2017) emphasized that the internet promotes communication richness, which in turn leads to higher involvement between enterprises and customers. AZADEGAN & DOOLEY (2021) considered IT as a solution for bullwhip impact in SCs. As ZAMANI et al., (2023) states, the use of IT in SCM results in lower cycle times, lower inventories, the reduction of the bullwhip effect and better efficiency of the distribution channel. Also, IS in the SCM could be a source of competitive advantage in the Jordanian context, as it helps in cost reduction, improvement of production cycle, data quality, continuous improvement and customer service (SMADI, 2016). Further Radio Frequency Identification (RFID) uses in SCs was studied by TAN & SIDHU, (2022) and successful SCM was highlighted by de ALMEIDA et al., (2015) as sophisticated information and manufacturing technologies. As BRUQUE CAMARA et al. (2015) stated, IT is important to ensure information availability and accessibility, making it possible to take decisions based on whole SC data. The benefits of Electronic Data Interchange (EDI) have been studied by Ngai & GUNASEKARAN (2004), and the absence of firms without strong IT systems is pointed out by CICHOSZ et al., (2020).

YU et al., (2016) discussed the transformative impact of e-commerce applications, and KRETSCHMER & KHASHABI, (2020) emphasized how inter-organizational systems facilitate greater information sharing within and across organizations. HENDERIKX & STOFFERS, (2022) noted that IT is intricately linked to process changes, with benefits often overlapping and interdependent. Further advancements included enterprise-wide IS WAMBA-TAGUIMDJE et al., (2020), mobile agent technology in e-commerce (Patel & Garg, 2004), collaborative planning forecast and replenish (CPFR) (FILDES et al., 2022), and online ordering (ISHFAQ et al., 2022).

Research has indicated the relevance of IT in SCs on the impact of big data analysis on SC coordination, integration and management of uncertainty and variability (SREEDEVI & SARANGA, 2017). Furthermore, the evolution of procurement as mentioned by

STROUMPOULIS & KOPANAKI, (2022), elaborate the transition from manual systems to AI-driven vendor management and e-procurement platforms, and SC risk management (SCRM) for risk mitigation. Tummala & Schoenherr (2011) pointed out the dependence of e-commerce on strong information infrastructure and telecommunications. BARENJI et al., (2014) examined the use of RFID and software agents in e-supply chains. The organizations realized that there is no way to have successful and efficient SCs without a strong, integrated enterprise-wide IS (GAMMELGAARD & NOWICKA, 2024).

The rapid expansion of IT has converted old, paper-based communication into smooth digital exchanges boosting operating efficiency across SC network. Barcoding technology is known for its accuracy and cost-efficiency, lowers human errors, dependency on paperwork and optimizes customer service and used by used by SC partners (ZHONG et al., 2017). By boosting data accuracy and availability in real-time, barcodes help organizations make educated decisions in product and inventory management. Moreover, they permit automatic replenishment and vendor-managed inventory systems to maintain product availability at the proper location and time to satisfy demand efficiently (WANG et al., 2020).

Information helps the managerial hierarchy to make the decisions regarding the movements of the products within the SC, based on the information of the stock of products, inventory control, information regarding all the transactional operations within the chain (KOUHIZADEH et al., 2021; COLICCHIA et al, 2019). The managers rely on this information to make sure that the movement of the products and services happens in a smooth manner within the SC.

1.6.1. Knowledge Work System

The knowledge work system is a specialized system of information which is employed within the SCs to bring in fresh and updated information so that the companies can bring about the necessary modifications and alterations within the chain to ensure the proper service of the SC (DELL'ACQUA et al., 2023). The integration of this knowledge within the SC helps in removing the inefficiencies of the old system and helps in installing the new features within the SC and facilitate a complete overhaul of the business process (KIANTO et al., 2019). The Knowledge work system also involves a variety of techniques which helps in gathering and synthesizing new pieces of information and using the results of that same analysis of the information making the

system work better. The Knowledge work system is also an ideal IS for the SCs due to the existing applications of artificial intelligence. With the emergence of industry 4.0 the companies of the world are aiming on digitizing their respective SCs (HAHN, 2020). One keyway in which they are aiming to do is by using artificial intelligence (AI) to oversee the logistics. Using the AI based knowledge work system, the SC will have an abundance of information which enables the managers to make the informed and rational decision regarding the goods and services (IVANOV et al., 2022).

1.6.2. Transactional and Automation Systems

With the current SC dynamics, companies across the world have the feature of automation. With the help of algorithms based on artificial intelligence help automate the entire SC process (DASH et al., 2019). Warehouse management, tracking of the goods and services over long distance transits, inventory control, maintaining databases of the products and stocks on hand all are done automatically through various digital processes and innovations. As a result, the organizations' automation system is an ideal IS which can be used in SCs as this system enables the SC to document and record the pertinent data and store it in reliable locations with appropriate access to the designated personnel (WINKELHAUS & GROSSE, 2020). Another system of information which can be used within the SC is the transaction processing system. This type of IS deals with quality and maintaining various transactions and protecting the authenticity of the information and work done within the organization within the SC (HELO et al., 2019). Numerous transactions take place of goods, services, and money within the SC so that they can be used in the future in case of losses and claims can be filed and obtained so it keeps the entire SC honest and attributes accountability and total transparency within the system (KOUHIZADEH et al., 2021).

1.6.3. Contemporary Progress in Supply Chain Management and Information Systems

The “information system” is becoming more delegated amongst various departments of an organization so that different components of SCM can be handled efficiently. According to SAYIN (2020), in contemporary circumstances, the physical form of information is generally separated from the online one, which can lead to reduction of errors simultaneously. There is usually a recognition of the factors which lead to the critical form of success and accordingly different information is utilized. As mentioned by GIGANTI et al. (2024), the analytics in the present era

are found to be more advanced and incorporate more complex computational structures. Due to the improvement in the analytics, most of the decisions are found to be driven by data. This allows the enterprises to keep track of negative issues effectively. Additionally, NAIM AND ALQAHTANI (2021) suggests that the applications of distinctive IS are transaction processing systems (TPS), office automation systems (OAS), knowledge work systems (KWS), management information systems (MIS) and decision support systems (DSS), and executive support systems (ESS). It is valuable to note that, in this reference, KWS and OAS are found to work primarily on the knowledge level, whereas TPS is the IS that businesses implement on the operational level. However, it is valuable to point out that ESS is specifically for the strategic level, whereas DSS and MIS are found to work at the managerial level (NAIM & ALQAHTANI, 2021). NAMBISAN et al. (2017) stated that all of these applications related to IS are organized or created in such a way that, when used collectively, every detail at the organizational level can be accomplished with ease. Figure 8 below shows the integration of IS and SCM.

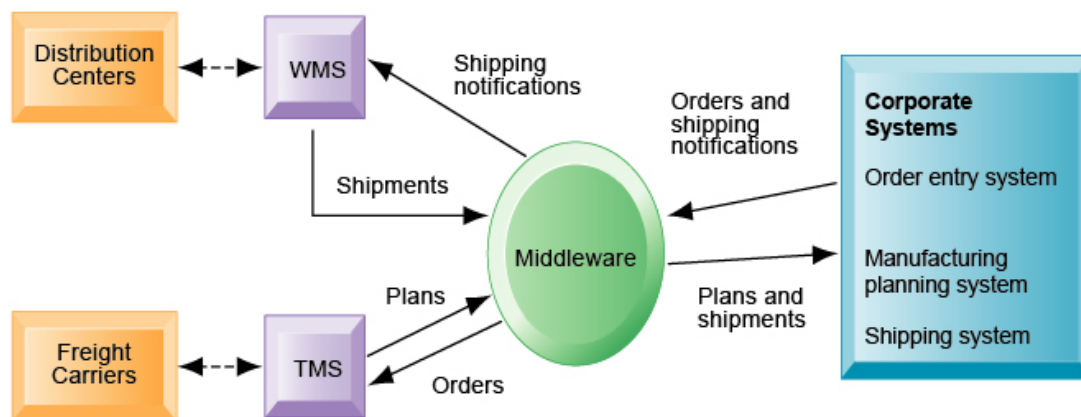


Figure 8: Integration of Information System and Supply Chain Management

**TMS: Transportation Management System and *WMS: Warehouse Management System respectively*

(Source: PAGINAS, 2023)

There is often a prevalence of “end-to-end technology” when it comes to managing various aspects of supply related operations. Due to the prevalence of automation, there is a rising demand for delivery in the last miles. As stated by NÚÑEZ-MERINO et al., (2020), this indicates that the majority of the enterprises are resorting to avenues which help in providing the materials to the

customers right at their places of residence. Cyber-security is something that has been emphasized by all enterprises. Therefore, SCM and aspects of “information systems” have become more combinatorial (CHAU et al., 2021). More prominence is given to the centrism towards customers because of which different avenues are implemented to cut back on costs.

1.6.4. Aspects of Information System and Supply Chain Management

According to DEHGANI & NAVIMIPOUR (2019), there is more implementation of flexibility because the majority of the operations with regard to SCM do not rely on manual efforts. Several technologies are implemented in order to enhance the communication so that there is a reduced chance for failure among the enterprises. CHAU et al., (2021) stated that blockchain has become the driving factor for both the IS and different components of supply in all enterprises. Alterations which were brought forth due to digital prospects led to the reformation of SCM. This is why the standards established through Industry 4.0 have become an integral aspect of the “Information System”.

According to GIGANTI et al., (2024), the incorporation of “Information Systems” allows the enterprises to consider the strategies that dictate the success or demerit of the former. However, one of the aspects that need to be taken note of, is the infrastructure. Incorporation of the technology instruments of it requires the prevalence of infrastructure which can often be not as effective in terms of cost (NÚÑEZ-MERINO et al., 2020). “Information Systems” often call for complete centralization of various operations which can often provide too much power to just one participant in SCM (SAYIN, 2020). This can cause security related issues and can hinder the general flow of business in various enterprises.

QU & LIU (2022) suggest that IS and SC work hand in hand because it makes sure that all the probable information that is incorporate into a company is maintained in a fine balance within the corporate institution. This is to ensure that it not only progresses, initiates, and amplifies but also through which the overall intensity of the corporations is dealt with by maintaining the competitiveness. It is quite important to realize that SCM and IS are the procedures through which all the aspects of a business are operated in a distinctive manner (HELO & HAO, 2022). Therefore, any kind of errors that are committed can be initially and constantly solved so that the errors are not at all kept for the future in order to impact or hamper the sustainability of a company (QU &

LIU, 2022). Information technology when incorporated into SCM reduces the cost of operations in a company by enhancing the process and its efficiency because incorporation of technology is easily deployed and adopted within the SC along with the logistic areas that are eminently offering immense benefits to the company (LIN, 2022).

1.6.5. Challenges of Information Systems Integration in Supply Chain Management

Despite the numerous benefits of integrating information systems (IS) into supply chain management (SCM), a significant body of literature identifies various challenges that can hinder successful implementation and long-term performance (ZAMAN, 2024; PREINDL et al., 2020). These challenges are not merely technical but are often deeply rooted in organizational, strategic, and contextual factors. The major challenges are discussed in the following subsections.

(i) Technological and Infrastructural Barriers

Research has shown that the implementation of advanced IS, is significantly influenced by technology and infrastructure (MD ZAINI et al., 2019). Technologies such as those related to Industry 4.0 and blockchain, is often hampered by their inherent complexity and the need for sophisticated computational structures (FRANK et al., 2019). According to MÜLLER et al., (2018) a lack of qualified employees and professional training can be a significant barrier for firms attempting to implement and manage these systems. Furthermore, the integration of new technologies requires substantial infrastructure investment, which can be prohibitively costly for many organizations, especially smaller firms or those in developing economies. This financial and technological barrier can widen the digital divide between large, resource-rich corporations and smaller firms, creating an unequal competitive landscape.

(ii) Organizational and Managerial Challenges

The organizational and managerial obstacles related to IS integration are among the prime challenges. ZAMAN (2024) has shown that trust is a crucial moderator of successful SC integration and collaborations. This demonstrates that the human factor is just as important as the technology itself. Literature also shows that IS projects can fail to deliver desired advantages without effective strategic planning and management buy-in (MD ZAINI et al., 2019). It is an ideal system for its AI applications. But it must be integrated well so as to remove inefficiencies that

exist in older systems and to permit a comprehensive revamp of business processes. Furthermore, a centralized IS, although it seems efficient, may offer too much power to one player in SCM, which may cause security problems and obstruct the general business flow, as some researchers suggest (DWIVEDI et al., 2021).

(iii) Data and Security Vulnerabilities

As SCM grows more and more dependent on digital exchanges, the potential for electronic vulnerabilities and cybersecurity threats will increase with the development of technology and the gained experience. BARYANNIS et al., (2019) state that the reliance on the continuous flow of information from the upstream partners to the downstream partners implies that any breach or disruption can create a cascading effect across the whole network. The literature stresses that while IS can enhance data accuracy and availability in real time, the additional connectivity can also create new dangers to the SC. ZONG & GUAN, (2025) pointed out that there are advantages of a decentralized IS employing blockchain for SCM. However, the lack of structure can cause these systems to be disorganized and ineffective. This indicates the necessity for a semi-structured structure that provides guidance, but is not restrictive, enabling the agility required to respond to rapid change, which is a major challenge for organizations.

(iv) Contextual and Environmental Challenges

Contextual and environmental challenges, according to GARCIA & YOU, (2015), also determine how successful IS will be adopted in a company's SC process. The challenges of IS integration are particularly pronounced in certain contexts. For instance, QUEIROZ et al., (2020) argues that in high-velocity markets, previous knowledge and established IS routines can sometimes be a disadvantage, as managers may incorrectly apply past experiences to new and fundamentally different circumstances. This makes sustaining dynamic capabilities particularly challenging in these environments. In developing countries, firms often face difficulties in adopting new initiatives due to a lack of internal resource capabilities and a less mature institutional environment. As ZAMAN (2024) found, a lack of a clear and unified framework for sustainability and its measurement adds to the complexity of implementing IS to support these goals.

1.7. Resource-Based View & Dynamic Capabilities

Modern research continues to deepen our knowledge of why some organizations continually outperform others, whilst old theories give the bases (KARIMI & WALTER, 2015). Scholars have approached this through three complementary viewpoints: scanning the external environment for opportunities and hazards (JIN et al., 2025), exploring the firm's distinctive strengths and flaws (KESSLER & ZIPPER-WEBER, 2023), and examining the strategic fit between internal and external aspects. Recent research has stressed the power of external forces in an unpredictable competitive landscape (HANNAH & EISENHARDT, 2018). Although this perspective is based on the assumptions that competitors are substantially similar in resources and strategies (NGUYEN & HA, 2023), and that resource inequalities are temporary because strategically valuable resources can readily be purchased and traded on open markets (TEECE, 2020).

This viewpoint, however, leaves little room for the idea that lasting advantage can spring from the unique and difficult to copy resources a firm possess internally. This is precisely where the resource-based view (RBV) of the firm presents a powerful alternative. It starts from the premise that firms are often profoundly heterogenous, meaning their bundles of resources and capabilities vary significantly, leading directly to differences in performance (KARIM et al., 2022). Furthermore, it argues that the most strategically valuable resources are often difficult to be transferred between firms, which allows these performance differences to persist over time (YAHIAMARZOUK & JIN, 2022). By focusing on these principles of heterogeneity and immobility, the RBV provides a fundamentally different explanation for competitive advantage, one that looks inside the firm rather than solely at the industry surrounding it.

1.7.1. Resource-Based View

The Resource-Based View (RBV) of the company is a foundational theoretical framework for studying how firms establish and retain a competitive edge in dynamic marketplaces (GUELER & SCHNEIDER, 2021). As opposed to conventional strategic views that emphasize on industry structure and market positioning as key determinants of competitive advantage (WENZEL et al., 2021), RBV shifts the focus internally, claiming that a firm's internal resources and capabilities are the basis of its strategic advantage.

At the core of RBV lies the assumption that firms can be conceptualized as unique bundles of resources, which are unevenly distributed across organizations and can maintain their distinctiveness over time (KAUR & KUMAR, 2024). Building on this premise, scholars argue that firms possessing resources characterized by value, rarity, inimitability, and non-substitutability (commonly referred to as the VRIN criteria) are positioned to secure a sustainable competitive advantage (LIN & WU, 2014). Breaking down VRIN criteria, Value, implies that resources hold strategic value when they empower an organization to formulate and execute strategies that enhance both operational efficiency and overall effectiveness. The conventional strengths-weaknesses-opportunities-threats (SWOT) framework for firm performance posits that organizations can achieve superior performance when their strategic initiatives leverage available opportunities or mitigate external threats (NAMUGENYI et al., 2016). While certain firm attributes may exhibit qualities such as rarity, inimitability, and non-substitutability -considering them potential competitive advantage- whereas, these attributes only qualify as strategic valuable resources when they actively contribute to capitalizing on opportunities or counteracting threats within the firm's external environment.

In addition, a resource cannot be a source of competitive advantage if it is easily available to all current or potential rivals. A firm secures an advantage by implementing a value creating strategy that is not already being employed by many other rival firms in the industry. However, even when few firms within an industry share possession of a particular valuable resource, they may still be able to secure a competitive advantage. Broadly speaking, as long as the number of firms that control a given valuable resource remains lower than the threshold required to induce perfect competition within the industry (LINDE et al., 2021), that resource retains the potential to create a competitive advantage.

Valuable and rare organizational resources can become the basis for sustainable competitive advantage only if they are not obtainable or replicable by rival enterprises. These resources are deemed to be "imperfectly imitable" as stated by numerous scholars (KUMP et al., 2019; ENGELMANN, 2024). The inimitability of firm resources can be derived from one or a combination of three factors: (a) the acquisition of a resource depends on distinctive historical circumstances, (b) the causal relationship between a firm's resources and its sustained competitive

advantage is “casually ambiguous”, thus difficult to replicate, or (c) the resource that generates a firm’s advantage is “*socially complex*” (KUMP et al., 2019; ENGELMANN, 2024).

The perspective of historical circumstances emphasizes that firms are fundamentally historical and social constructs, with their ability to acquire and utilize certain resources being reliant on their specific position in time and space. Once a particular moment in history has passed, firms that do not already possess these time- and space-dependent resources are unable to obtain them, making such resources imperfectly imitable (HELFAT & RAUBITSCHKE, 2018). Contemporary research confirms that a firm’s current success is not just a function of its present market but is also a historical trajectory that led it to its current position. When a firm acquires valuable and rare resources as a result of its distinctive historical journey, it gains the ability to leverage these resources in crafting value-generating strategies that remain inimitable by competitors (LOCKETT & WILD, 2013).

Rival firms wanting to emulate the success of a high performing competitor may be able to identify some resources that the firm has. However, when there is causal ambiguity, it is not clear whether these identified resources are the major sources of the firm’s sustained competitive advantage or if that advantage is due to other, less visible resources (FREEMAN et al., 2021). In principle, competing businesses can also learn the relationship between a firm’s resources and its superior performance if the firm with a competitive advantage knows exactly how its resources are related to its superior performance. Thus, if rivals are not imperfectly inimitable, they can acquire the requisite resources and follow analogous techniques, thereby undermining the initial firm's advantage. In such a case competitive advantages cannot be preserved because they can be replicated.

Conversely, when a firm does not fully grasp the source of its own competitive advantage any more than its competitors do, that advantage may persist because it remains resistant to imitation (RYALL, 2009). Ironically, for *causal ambiguity* to function as a source of sustained competitive advantage, all competing firms must share an incomplete understanding of the link between the firm's resources and its superior performance. If even one competitor deciphers this relationship while others do not, this insight will inevitably spread throughout the industry over time, ultimately eliminating causal ambiguity and imperfect imitability it initially provided.

Another fundamental reason for the difficulty of imitating a firm's resources is their inherent complexity as social constructs, phenomena so complex that they cannot be systematically managed and directly manipulated (BRIDOUX & STOELHORST, 2016). This includes a wide array of firm resources. These include the quality of interpersonal interactions between managers, the organizational culture that affects behaviors and decision making, the reputation of the firm among suppliers and the trust developed with customers (COLBERT, 2004). The relationship between these resources and better company performance is pretty well understood. But the fact that a particular organizational culture or managerial dynamic is identified as conducive to efficiency and effectiveness does not indicate that organizations who do not possess them may consciously create them thru strategic intervention. In many circumstances, social engineering attempts may just be beyond the existing capability of most organizations (GIBSON et al., 2021). As long as these socially complicated resources are not directly controllable, they continue to be imperfectly imitable resources.

The final criterion for a firm resource to serve as a source of sustained competitive advantage is the absence of strategically equivalent substitutes that are either widely available or easily imitable. Substitutability can have a couple of forms, first, while an exact replication of another firm's resource may not be feasible, a competing firm may be able to develop a functionally similar resource that enables it to conceive and implement equivalent strategies. For instance, a firm attempting to replicate the competitive advantage of another firm by emulating its high-caliber executive team may find it impossible to duplicate the team identically (D'ORIA et al., 2021). However, it may be able to cultivate its own distinct top management team with comparable expertise and leadership capabilities. Despite inherent differences, such as variations in personnel, operational approaches, and corporate history, these management teams could serve as strategic equivalents (GANCO et al., 2020). If alternative top management teams are readily available or easily imitable, then having a high-quality executive team does not constitute a sustained competitive advantage, even though a particular firm's leadership may be valuable, rare, and difficult to imitate.

Second, entirely different firm resources can function as strategic substitutes. For example, in one firm, a clear organizational vision may stem from the presence of a charismatic leader. In contrast, competing firms may achieve the same clarity of vision through a structured,

organization-wide strategic planning process (SEDDON, 2014). From the perspective of ensuring managerial clarity about the company's future, both a charismatic leader and a well-defined strategic planning system can be strategically equivalent and, therefore, interchangeable. If a substantial number of rival firms possess a formal planning system that facilitates this shared vision, or if such planning processes are easily replicable, then companies relying on a visionary leader for strategic direction will not sustain a competitive advantage, despite the rarity and imperfect imitability of charismatic leadership as a firm resource (PORFÍRIO et al., 2021).

The degree to which firm resources are strategically substitutable is inherently variable. However, substitute resources do not need to yield identical organizational outcomes to be considered strategically equivalent in terms of enabling firms to formulate and execute similar strategies (FURNARI et al., 2021). From a strategic standpoint, if alternative resources allow firms to achieve comparable competitive positioning, they function as viable substitutes (SANCHEZ, 2009). If a sufficient number of firms possess these valuable alternative resources, meaning they are not rare, or if these resources can be readily acquired and replicated, then no firm, including those originally possessing the substituted resources, can anticipate sustaining a competitive advantage.

Moreover, if these strategic resources are part of interconnected and complementary activity systems, the ability to retain competitive advantage is strengthened by their cumulative impact (IYER et al., 2023). This interconnection strengthens the firm's ability to exploit synergies thereby building formidable barriers to imitation and enhancing its competitive position in the industry (HELFAT & RAUBITSCHKE, 2018).

1.7.2. Dynamic Capabilities Theory

The core principles of the RBV have been developed by researchers to better explain competitive advantage in dynamic marketplaces (WÓJCIK, 2015). The extension stems from the awareness that classic RBV has not adequately explained how and why certain firms sustain competitive advantage in the face of rapid and unpredictable change (TEECE, 2020). In such volatile environments, where competitive conditions are in constant flux, firms' ability to "integrate, build and reconfigure internal and external competencies to address rapidly changing environments" in response to these shifts emerges as the foundation of a sustained competitive

advantage (TEECE et al., 1997, pg. 516). The use of organizational information and the ability to adjust it effectively is essential for the competitiveness of the firm in volatile markets (MARTINEZ-CONESA et al., 2017).

These talents are not abstract notions but based in tangible mechanisms that create competitive advantage (KAMASAK et al., 2016). Therefore, they exhibit more equifinality, homogeneity and substitutability than conventionally envisaged in the RBV framework (KAUR, 2023). Third, the effectiveness and type of dynamic capacities depend on the degree of market dynamism. In markets that are relatively stable and relatively dynamic, the behavior of dynamic capabilities resembles that of standard organizational procedures. They are complicated, methodical and logical procedures that rely significantly on existing information, follow linear execution patterns, and eventually provide predictable results.

At the core of the Resource-Based View lie resources, which encompass tangible and intangible assets such as distinct physical, human, and organizational assets that facilitate the execution of value-generating strategies (TEECE, 2014). These resources include localized capabilities, or competencies, that serve as the foundation for a firm's competitive advantage. Fundamentally, resources structure the building blocks of distinctive, value-creating strategies and their corresponding activity systems, enabling firms to serve specific markets and customer segments uniquely, thereby fostering competitive advantage, core competencies, and lean production (TEECE, 2018a).

In contrast, dynamic capabilities serve as the precursors to competitive advantage, representing the organizational and strategic routines through which managers reconfigure their resource base to formulate new, value-generating strategies. As such, dynamic capabilities are the drives behind the transformation, evolution, and recombination of resources into new sources of sustained competitive advantage (BADRINARAYANAN et al., 2019). Dynamic capabilities as defined by EISENHARDT & MARTIN (2000), pg. 1107 is *“The firm's processes that use resources specifically the processes to integrate, reconfigure, gain and release resources to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die”*.

Some dynamic capabilities are centered on the integration of resources within a firm. A prime example is found in product innovation routines, where managers combine diverse technical skills, market knowledge, and functional expertise to design and deliver revenue-generating products and services (GUTIERREZ-GUTIERREZ et al., 2018). Similarly, strategic decision-making constitutes a dynamic capability wherein managers accumulate their business intellect, functional insights, and personal expertise to make pivotal choices that define the firm's strategic trajectory (OLIVA et al., 2019).

Other dynamic capabilities are concerned with reconfiguring resources within the organization. Knowledge transfer routines, for instance, are critical for systematically sharing, duplicating, and recombining expertise and other knowledge-based assets across different parts of the organization (SIAW & SARPONG, 2021). At a more structural level, corporate resource allocation routines play a crucial role in distributing scarce assets, such as financial capital and manufacturing infrastructure, from a central node to various projects and division, fundamentally shaping the firm's strategic portfolio. At a more strategic level, coevolutionary routines represents the set of routines through which managers revitalize and reconnect collaborative networks across different business units, thereby fostering novel and synergistic resource configurations that would not emerge otherwise (ZHANG et al., 2022). Additionally, certain dynamic capabilities are associated with the gain and loss of resources. Critical among these are knowledge creation routines, which enables managers and employees to generate and absorb new insights. This is especially vital in sectors like technology and life sciences, where competitive success hinges on continuous innovation. Furthermore, external sourcing routines act as key mechanisms for bringing critical external resources into the firm and embedding them within its existing operations (KHRAISHI et al., 2023).

In high velocity markets where change is non-linear and unpredictable, market boundaries become blurred, successful business models remain elusive, and key market players such as buyers, suppliers, competitors and complementors are in a constant state of ambiguity (KHANAGHA et al., 2018). In such fast-changing contexts, dynamic capacities should rely less on the current information and more on fast creation of new knowledge. Indeed, prior knowledge can be a disadvantage or troublesome at times since managers may apply past experiences wrongly to new and fundamentally different situations (FRANK et al., 2017).

In addition, these capabilities are less complex and more agile in high velocity situations, keeping managers focused on essential strategic priorities rather than rigid processes. They are simple, but not wholly unstructured or random in high velocity markets. Instead, they function in a semi-structured environment that provides adequate guidance for coordinated activity, while keeping the flexibility to respond to rapid market developments (RINGOV, 2017). The primary problem for organizations is therefore to maintain an ideal level of structure, giving enough guidance to managers but not so much as to reduce the flexibility needed for rapid adaptation. This structural obstacle, therefore, makes the development of dynamic capacities especially difficult in high velocity markets (BIRKINSHAW & GUPTA, 2013; LI et al., 2019).

1.7.3. Integration of Information Systems with RBV and DC

The Resource-Based View offers three key benefits that are particularly useful for IS (PARK & MITHAS, 2020). First, the RBV allows for precise classification of IS resources by defining a clear set of resource qualities. This hierarchical classification lays the basis for the identification of a complete and mutually exclusive set of IS assets and capabilities. Second, the RBV architecture facilitates systematic comparison of IS resources, by using the same set of resource qualities. More crucially, it allows comparisons between IS and non-IS resources, therefore promoting cross-functional research and a more holistic study of organizational assets outside the IS domain (RIALTI et al., 2019). Finally, the RBV offers a clear link between resources and SCA by establishing a distinct dependent variable. The link provides a strong methodological basis for analyzing the strategic value of IS resources, ensuring a systematic evaluation of their contribution to the performance of firms (MIKALEF et al., 2018).

However, substantial research has been devoted to the identification and characterization of IS resources as separate elements or as integrated sets of interrelated capabilities. For example, ROSS et al., (1996) conceived IS resources by classifying IT as three different asset kinds that with IT procedures led to the enhancement of business value. These asset categories were human assets, technological assets, and relationship assets. In addition, they described IT processes as planning proficiency, cost-efficient operations and support, and speedy service delivery (PORTILLO-TARRAGONA et al., 2018).

Similarly, Feeny and Willcocks (1998) identified nine core IS capabilities, which they grouped into four overlapping domains. These included business and IT vision (representing the integration of IT with broader organizational functions), IT architecture design (encompassing IT development expertise), IS service delivery (covering implementation, vendor and customer interactions), and a foundational set of capabilities, such as IS leadership and well-informed IT procurement.

Further refining this perspective, BHARADWAJ (2000) proposed and empirically validated a multi-dimensional framework for IT capability. Their model encompassed six key dimensions: IT-business partnerships, external IT linkages, strategic IT-business alignment, IT-enabled business process integration, IT management effectiveness, and IT infrastructure robustness. The reliability and validity of this framework were confirmed through rigorous psychometric testing conducted among a sample of senior IS executives, reinforcing its empirical robustness.

Contemporary strategic literature continues to affirm the critical distinction between technology-based assets and system-based capabilities. Research confirms that technological assets such as standardized IT infrastructure, remain highly prone to imitation, offering only temporary competitive benefits (MIKALEF & KROGSTIE, 2020). In contrast, empirical evidence increasingly shows that sustainable advantage is rooted in a firm's ability to orchestrate and deploy sophisticated, data-driven capabilities (DUBEY et al., 2020). From a modern resource-based perspective, this advantage stems from capabilities that are developed over time through complex learning paths, making them casually ambiguous and embedded within the organization's social fabric (KHIN & HO, 2019). Such capabilities may include specialized analytical expertise that is both highly skilled and firm specific, or DC that are difficult to imitate due to their reliance on unique organizational knowledge and adaptive processes (REMANE et al., 2017). Consequently, these higher order capabilities are consistently identified as fundamental drivers of superior firm performance and resilience in dynamic markets (BARRETO, 2010).

1.8. Information Systems in Food Supply Chain

The food supply chain (FSC), as argued by SUNMOLA et al. (2024) is one of the most complex and sensitive supply networks due to its perishable goods, stringent safety regulations, and global reach. Information systems (IS) play a pivotal role in enhancing the efficiency, transparency, and sustainability of the food SC, from farm to fork (AUNG & CHANG, 2014). Through technologies such as Enterprise Resource Planning (ERP), Geographic Information Systems (GIS), Blockchain, Internet of Things (IoT), and Warehouse Management Systems (WMS), IS has revolutionized how food is grown, processed, distributed, and consumed.

Several empirical studies underscore the transformative impact of IS in the food SC. Research conducted by PRASHAR et al., (2020) developed a blockchain-based system to trace agricultural products. Their study demonstrated improved consumer trust, enhanced product authentication, and reduced recall times during contamination events. Another significant study was conducted by SHAHLA & ZEYU (2025), where they conducted a case study in the dairy industry. Their study revealed how a robust WMS improved SC agility and integration by 34%, significantly lowering lead times and inventory discrepancies. In the Jordanian context, IS has a significant effect on SC agility positively (Abdallah & Ayoub, 2020). SHOJAEI & MIRGHADERI (2025) analyzed circularity in the food SC using big data and Einstein fuzzy logic. Their research highlighted the role of IS in enabling waste management, recycling, and strategic resource allocation. Additionally, FARAH et al. (2025) found that weak IS infrastructure in developing regions hinders the management of nutrition programs and food distribution, stressing the importance of government and donor support in deploying IS.

1.8.1. Key Technologies Driving FSCM Information Systems

The appropriate development and implementation of successful IS for the food industry is fueled by several cutting-edge technologies. These technologies work together to create an efficient SC that is more responsive and resilient. The major technologies include blockchain, internet of things (IoT), artificial intelligence and machine learning (BEN-DAYA et al., 2020; BURGESS et al., 2022):

- **Blockchain:** it is considered a vital technology, and a decentralized and immutable digital ledger (CROSBY et al., 2016). Additionally, blockchain technology offers unparalleled traceability and security ABDALLAH et al., (2021). Each transaction or event such as a product being harvested, processed, or shipped is recorded as a 'block' in the chain, creating a tamper-proof record (BURGESS et al., 2022). This technology makes it an ideal tool for preventing food fraud and ensuring the integrity of SC data. The IBM Food Trust network is a prime example of a successful blockchain implementation in the food industry, providing shared, trusted, and transparent information to its members.
- **Internet of Things (IoT):** IoT involves a network of physical devices embedded with sensors, software, and other technologies that collect and exchange data (GUBBI et al., 2013). In the food SC, IoT sensors monitor crucial conditions like temperature, humidity, and location throughout the entire journey (BEN-DAYA et al., 2020). These capabilities are particularly vital for maintaining the cold chain for perishable goods. If a temperature deviation occurs, the system sends a real-time alert, enabling swift corrective action and preventing spoilage. Another critical application is that IoT data can also be used for predictive maintenance of equipment, avoiding costly and disruptive breakdowns (FIRMANSYAH & SIAGIAN, 2022).
- **Artificial Intelligence (AI) and Machine Learning (ML):** AI and ML are other vital technologies in the food SC, where their algorithms are used to analyze vast amounts of data collected from various sources in order to provide actionable insights (MISRA et al., 2020). The various applications of AI and ML include Demand Forecasting, where AI systems analyze historical sales data alongside external variables such as weather patterns and social media trends to predict consumer demand with a high degree of accuracy which helps optimize production and inventory (BARDONE & SPALVĒNA, 2019). Furthermore, in Quality Control, AI-powered computer vision systems can perform automated visual inspections on a production line to detect defects or foreign objects in a product, ensuring consistency and safety (FIRMANSYAH & SIAGIAN, 2022). Logistics Optimization represents another critical domain, where AI can plan the most efficient delivery routes, considering real-time traffic and weather conditions to reduce fuel consumption and ensure timely deliveries (BURGESS et al., 2022).

1.8.2. The Role of Information Systems in the Food Supply Chain

1. Traceability and Transparency

TEREFE et al. (2025) affirms that IS tools provide real-time visibility into the movement and condition of food items across the SC. Additionally, IS solutions, particularly those using technologies like Radio Frequency Identification (RFID) and barcoding, enable the tracking of food products from production to consumption. Blockchain technology has been widely adopted to enhance traceability, reduce fraud, and ensure food safety by storing immutable records of transactions and product histories (LUO et al., 2025).

2. Inventory and Warehouse Management

Food products are often highly perishable, making effective inventory management critical (ABDALLAH et al., 2021). IS technologies such as warehouse management system (WMS) systems enable better control over perishable goods, minimizing spoilage and optimizing stock levels (ATIEH et al., 2016). Also, automation of SC process through IS reduces human errors, streamlines picking and packing processes, and ensures compliance with food storage standards.

3. Food Safety and Quality Assurance

Another role of adopting and implementing IS in the food SCM is to ensure food safety and quality assurance. As illustrated by BARDONE & SPALVĒNA (2019), IS monitor temperature, humidity, and contamination risks throughout the SC. Additionally, advanced systems trigger alerts and corrective actions when quality thresholds are breached (HASNAN et al., 2025).

4. Sustainability and Waste Reduction

Another critical role is that IS enables the implementation of circular SC models that minimize waste and promote recycling and reuse (SHOJAEI et al., 2025). This means that data from IS also helps stakeholders identify inefficiencies and optimize resource use across the FSC. As illustrated by BEN-DAYA et al., (2020), consumers today are increasingly concerned about the origin and safety of their food. IS allow companies to provide detailed information about a

product's journey, from farming methods to transportation conditions. This transparency builds consumer trust and brand loyalty.

5. Logistics and Distribution Optimization

Another role of IS includes ensuring there is effective logistic management and distribution optimization. According to BARDONE & SPALVĒNA, (2019), IS supports route optimization and cold chain management, ensuring timely delivery of fresh products. Further, GIS and GPS technologies allow logistics firms to monitor vehicle locations, traffic patterns, and delivery schedules in real-time (TEREFE et al., 2025).

1.9. Hypothesis Development and Conceptual Framework

1.9.1. Hypothesis Development

As previously defined, SCC refers to the operational capabilities through which a firm competes – delivery reliability, cost efficiency, responsiveness, accuracy, and service flexibility – and it is this construct that each hypothesis below relates to its proposed drivers. The hypothesis of this study was developed based on the ground of empirical findings from literature and supported by two dominant theoretical foundations. These theoretical bases are the Resource-Based View (RBV) and the Dynamic Capabilities Theory (DCT). This chapter presents the empirical basis for each hypothesized relationship between the study's constructs and SCC. The RBV framework argues that valuable, rare, inimitable, and non-substitutable resources such as IS capabilities can drive sustained competitive advantage (WADE & HULLAND, 2004). Meanwhile, the DCT highlights the role of sensing, integrating, and reconfiguring organizational resources enabled by IS in rapidly changing environments (TEECE, 2007). Although there is growing academic interest in digital transformation and IS deployment, there is limited research in the context of food SCs in developing countries, especially Jordan. This study addresses that empirical gap.

IS and Supply Chain Competitiveness

From a critical review of literature, the adoption of IS is considered to have a significant influence in enabling or improving SCC (AGUSTIAN et al., 2023; KAMBLE et al., 2020). It

allows firms to automate processes, enhance real-time visibility, reduce transaction costs, and improve coordination across SC partners. These arguments are supported by findings from various studies. For instance, a study by GUNASEKARAN et al., (2017) found that IS adoption improves SC responsiveness and customer satisfaction by streamlining operations and enhancing information flow. Another study conducted by SHAHLA & ZEYU (2025) demonstrated that the implementation of warehouse management systems (WMS) significantly enhanced SC agility and reduced lead times in the dairy industry. These claims are critical in showing the significant role played by IS in enhancing the performance of SC.

Another significant study was undertaken by KARIMI & RANANI (2025) whose findings emphasized the role of artificial intelligence and automation in e-commerce-driven SCs. They suggested a strong correlation between IS adoption and operational flexibility. Additionally, GANESAN & VINODH (2025) reported that small and medium-sized enterprises (SMEs) leveraging digital platforms saw a 40% increase in competitive capabilities, including agility, order accuracy, and inventory turnover. SOUSA et al., (2017) findings demonstrated that IS streamlines operations by automating routine tasks, which reduces manual errors and accelerates processes. Subsequently the following hypothesis was formulated:

***H1:** Information systems adoption has a significant positive influence on supply chain competitiveness.*

Dynamic Capabilities and Supply Chain Competitiveness

Research demonstrates that dynamic capabilities, particularly those enabled by IS, allow firms to adapt, integrate, and reconfigure SC processes in response to market changes (TEECE, 2020; HELFAT & RAUBITSCHKE, 2018). These include sensing market signals, learning, and reconfiguring operations—capabilities that directly affect competitiveness. TEECE (2007) and EISENHARDT & MARTIN (2017) define dynamic capabilities as essential to building competitive advantage in turbulent markets. Additionally, PAVLOU & EL SAWY (2011) empirically validated that IS-based capabilities such as knowledge integration and process reconfiguration increase innovation and speed. Gelashvili-Luik et al. (2025) extended DCT study in evaluating smart SCs. Their findings confirmed that automated data systems enhance firms' capacity to respond quickly and accurately to disruptions. In contrast KARIMI & RANANI (2025)

found that in AI-enabled SCs, firms with dynamic IS capabilities such as automated decision-making and real-time analytics, significantly outperformed peers on agility and resilience. Subsequently the following hypothesis was developed:

***H2:** IS enabled dynamic capabilities positively influence supply chain competitiveness.*

Sustainability and Supply Chain Competitiveness

In the current dynamic world, sustainability is increasingly viewed as a competitive advantage for most businesses (HAHN & TAMPE, 2021; GEISSDOERFER et al., 2020). In sectors such as the food SC where regulatory compliance, waste reduction, and transparency are paramount, sustainability is critical (GANESAN & VINODH, 2025). IS can enable sustainability by supporting data collection, reporting, and environmental decision-making. Research by KAMBLE et al., (2020) showed that green IS lead to reduced emissions and waste, directly contributing to competitive differentiation and efficiency. However, SHOJAEI & MIRGHADERI (2025) used fuzzy logic models and big data analytics to evaluate IS adoption in circular food SCs, finding that digital tools supported cost reduction, traceability, and environmental performance. SARPONG (2014) emphasized that food control systems, supported by IS, can track contamination sources and ensure safety, thereby improving competitiveness through quality assurance. Additionally, GANESAN & VINODH (2025) found that sustainable IS tools increased visibility in energy consumption and waste tracking, allowing better benchmarking and environmental reporting in food logistics firms. Accordingly, the following hypothesis was formulated:

***H3:** IS sustainability have a significant positive impact on supply chain competitiveness.*

RBV and Supply Chain Competitiveness

The RBV framework emphasizes that firm-specific resources such as IS capabilities can provide a sustained competitive advantage when they are valuable, rare, inimitable, and non-substitutable (VRIN) (DUBEY et al., 2017b; WADE & HULLAND, 2004). In the context of SCs, strategic IS capabilities such as data analytics, integration platforms, and custom ERP systems enhance performance through superior coordination and control (ALI & GOVINDAN, 2023). A study by Nguyen et al. (2021) found that IS-enabled resource integration contributes to operational

efficiency and strategic flexibility in logistics networks. KIM et al. (2020) demonstrated that IS resources embedded in business intelligence platforms increased customer responsiveness and supplier collaboration in Korean manufacturing firms. Nevertheless, WANG et al. (2015) showed that IS resources positively influence innovation and time-to-market speed, two crucial dimensions of competitiveness. Additionally, ALI & GOVINDAN (2023) reported that firms with mature IT governance and IS strategy alignment experience stronger SC resilience and market position. Subsequently the following hypothesis was developed:

***H4:** Resource-based views have significant and positive affect supply chain competitiveness.*

Key Performance Indicator Effectiveness and Supply Chain Competitiveness

Key Performance Indicators (KPIs) are essential tools for measuring, monitoring, and managing SC performance (KAMBLE & GUNASEKARAN, 2020; PRADO-PRADO et al., 2020). The effectiveness of KPIs depends on their alignment with strategic goals and the use of IS for real-time data analysis and feedback. Various researches suggest the relationship between KPI and SCC. GUNASEKARAN & KOBU (2007) introduced a widely accepted performance measurement framework highlighting how KPI monitoring via IS improves agility and responsiveness. Research has found that cloud-based KPI dashboards and related Industry 4.0 technologies lead to faster problem detection and resolution in complex SCs like those in fast-moving consumer goods (FMCG) (GUNASEKARAN et al., 2019). Nonetheless, STATON et al., (2025) showed that data visualization tools used for environmental KPIs improved decision-making speed and stakeholder accountability in agroforestry systems. Further, SANDERS & GANESHAN (2018) found that performance measurement systems integrated with predictive analytics enhance strategic planning and reduce demand forecast errors. Accordingly, the following hypothesis was formulated:

***H5:** Effectiveness of key performance indicators has significant and positive effect on supply chain competitiveness.*

Influence of Information Systems Challenges

IS challenges refer to barriers that obstruct the implementation, integration, and utility of IS in SCs (BAG et al., 2021; KHAN et al., 2021). These challenges can be technological such as legacy systems, cybersecurity risks; organizational such as user resistance, lack of leadership; or environmental such as infrastructure gaps, regulatory constraints (FARAH et al., 2025). According to a study by ALI & MILLER (2017), failure to address organizational IS challenges led to underutilization of technology and project failures. FARAH et al., (2025) highlighted that weak digital infrastructure and limited digital skills in Ethiopia reduced the effectiveness of IS in public nutrition SCs. KUMAR et al., (2017) documented that in SMEs, lack of IS integration and interoperability hinders cross-functional collaboration and responsiveness. Research by HASNAN et al., (2025) showed that regulatory uncertainty and lack of food IS standards reduce IS adoption in food SCs. Additionally, ALI & GOVINDAN (2023) findings reported that in export-focused agri-food systems, SCC was weakened when digital adoption lacked top-level strategic support. These studies suggest that IS challenges may mediate the effects of other constructs on competitiveness. Consequently, the following hypothesis was formulated:

***H6:** Information systems challenge significantly mediate the relationship between IS constructs and supply chain competitiveness.*

1.9.2. Conceptual Framework

The conceptual framework as displayed in Figure 9 was developed which demonstrates the relationship between the variables of the study. The conceptual framework is comprised of the following variables. The supply chain competitiveness (SCC) was the dependent variable and the information system challenges (ISC) was the moderating variable. In addition, there were five independent variables: information systems adoption (ISA), information systems and sustainability (ISS), information systems resource-based view (RBV), information systems dynamic capabilities (DC) and the key performance indicators effectiveness (KPIE).

The relationship between ISA and SCC comprised of the first hypothesis of the study, which hypothesized that ISA has a significant positive influence on SCC. The relationship between dynamic capabilities formed the second hypothesis of the study, which stated that IS enabled

dynamic capabilities positively influence SCC. The relationship between IS and sustainability and the SCC comprised of the third hypothesis of the study, which stated that IS sustainability have a significant positive impact SCC. The relationship between information system RBV and the SCC led to the development of the fourth hypothesis of the study, which stated that resource-based views have significant and positive affect SCC. The relationship between KPI effectiveness and SCC led to development of the fifth hypothesis, which stated that effectiveness of key performance indicators has significant and positive effect on SCC.

The relationship between the information system challenges and the SCC led to the development of the sixth hypothesis of the study. The hypothesis stated that information system challenges have a negative and significant influence on SCC. From this hypothesis, an extended idea will be studied, will IS challenges act as a mediation variable between the other variables and SCC? Stated as H7-a in Figure 9, it is suggested that ISC significantly mediate the relationship between IS constructs and SCC.

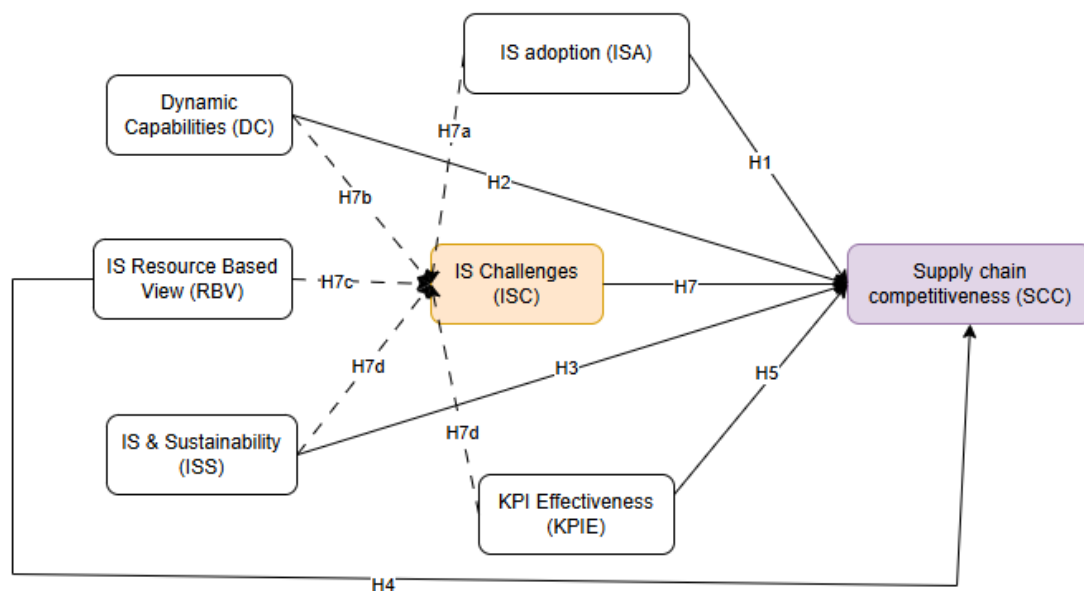


Figure 9: Conceptual Framework of the Study

(Source: Developed by Author)

Note: straight lines = direct relationship; dotted lines = mediation relationship

This chapter has provided a review of the topic and has formulated multiple hypotheses. The background literature review of supply chain management (SCM) and information systems (IS) were critically reviewed. The research identifies research gaps within existing literature. Therefore, the analysis of the literature review shows there is a lack of research on the topic, which led the present research to provide a conceptual framework as seen in Figure 9.

The next chapter, Chapter 3, will provide a rigorously designed methodology to investigate and statistically explain the subject at hand and questions under consideration.

2. MATERIAL AND METHODS

Research methodology encompasses the structured approach and techniques used to gather, process and interpret data, thereby facilitating a rigorous and coherent response to the research questions and providing solutions to the research problem (BRYMAN & BELL, 2015; YIN, 2018). The research philosophy, research design, and data analysis are addresses and justified in order to achieve the research aim, objectives and questions. The aim of this thesis is to develop and empirically validate an integrated model that identifies and explain the influence of IS-enabled capabilities on SCC. Figure 10 illustrates the key concepts of research, ensuring that the research philosophy, approach, strategy and methods are aligned.

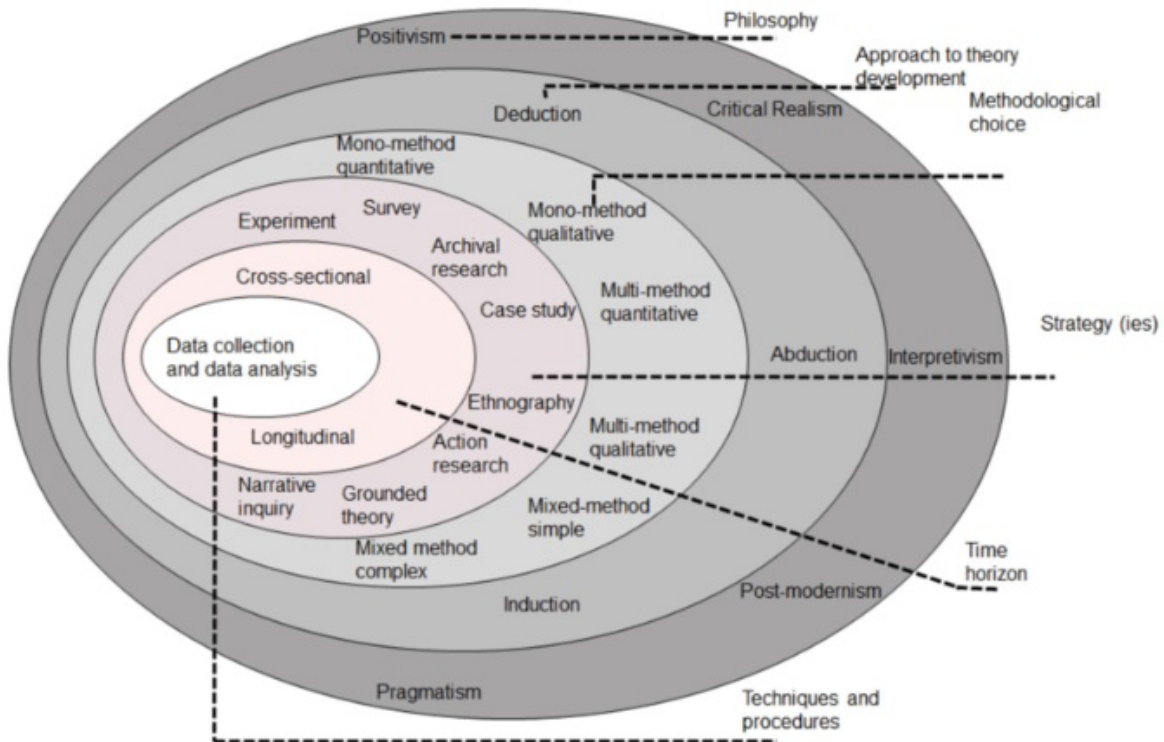


Figure 10: The Research Onion

(Source: SAUNDERS et al., 2020, p. 108)

2.1. Research Philosophy

Philosophy, in the context of research, pertains to the exploration and evolution of knowledge, as well as the intrinsic nature of that knowledge. The philosophical paradigm is of great importance in research as it is the fundamental belief system or worldview that underpins the research inquiry (ALHARAHSEH & PIUS, 2020). The development and comprehension of such knowledge are shaped by specific assumption according to our view of the world, which are articulated through different research paradigms. Furthermore, the research philosophy provides a structured framework, depicting the processes of data collection, data analysis, and interpretation, therefore ensuring methodological coherence (NOWELL et al., 2017).

A research paradigm is fundamentally linked to the principles of ontology, epistemology, and methodology, forming a cohesive framework that grounds any research inquiry (CUTHBERTSON et al., 2020). This framework comprises ontology, which concerns how the investigator perceives and defines truth and reality; epistemology, which addresses the process through which the author acquires knowledge of that truth and reality; and methodology, which pertains to the systematic approach employed in conducting the investigation (KAMAL, 2019). They also suggest that the responses to the inquiries about these three elements provide an interpretive framework that influences the strategies, procedures, and analysis of the entire research process. Ontology encompasses two contrasting perspectives: objectivism and constructionism. Within this framework, objectivism asserts that reality exists independently of human perception, while constructionism suggests that reality is shaped by social processes, representing two foundational ontological positions (AL-ABABNEH, 2020).

As stated by KANKAM (2019), positivism and interpretivism are types of epistemologies. The positivist paradigm for examining social reality is grounded in the philosophical principles of August Comte, a French philosopher. Comte highlighted that the preferable methods for understanding human behavior are observation and reasoning, and that knowledge is derived from sensory experience and may be acquired through systematic experimentation and observation. From an ontological perspective, positivists consider that reality is objective and exists independently of the researcher and the instruments used; in other words, knowledge is quantifiable and objective. Positivist scholars utilize scientific methodologies to structure the

process of knowledge creation. They utilize quantification to improve the accuracy in their descriptions of variables and their relationships. The core aim of positivism lies in uncovering truths and representing them through empirical evidence (ALIYU et al., 2014). The interpretive paradigm is rooted in observation and interpretation, where observation involves gathering information about events, and interpretation entails deriving meaning from that information by making inferences or evaluating its alignment with abstract patterns (DEPRAETERE et al., 2021). This paradigm seeks to understand phenomena through the meanings that individuals ascribe to them, focusing on the subjective lived experiences of participants (PHAM, 2018).

As Kankam (2019) indicates out, constructionism and objectivism are ontological views. For the bulk of the theoretical framework of qualitative research, a constructivist views reality as formed, interpreted and experienced by individuals thru their interactions with each other and with broad social systems (Peck & Mummery, 2018; Yilmaz, 2013). The paradigm emphasizes an interpretative approach to inquiry, with its main goal being to comprehend specific phenomena rather than generalizing findings to a larger population (TULI, 2010). Researchers operating within the interpretivist paradigm adopt a naturalistic stance, focusing on real-world contexts as they naturally evolve; non-manipulative and unobtrusive, prioritizing the authenticity of the study (YIN, 2018).

The present study follows post-positivism philosophy in order to develop and empirically validate an integrated model that identifies and explain the influence of IS-enabled capabilities on SCC. Where it employs a quantitative, hypothesis testing approach to examine casual relationships reflecting a pursuit of explaining phenomena. Concurrently, the careful acknowledgment of the study's limitations, demonstrates the post positivist recognition that our knowledge is always approximate and influenced by the research process itself.

2.2. Research Approach

The selection of a research approach provides the logical framework that connects a study's theoretical foundations to its empirical execution and, ultimately, to the derivation of its conclusions (YIN, 2018). For quantitative studies, this method essentially shapes the research design, hypothesis formulation, and analytical strategy by determining the order in which

reasoning advances from theory to data. In the social and management sciences, three primary reasoning approaches are distinguished: deductive, inductive, and abductive (SAUNDERS et al., 2020). Each offers a distinct pathway for knowledge generation, with significant implications for quantitative inquiry.

In quantitative research, deductive reasoning or deduction is typically utilized. A wide range of quantitative analytic approaches may be used, ranging from basic descriptive analysis of variables to advanced statistical modeling to demonstrate statistical correlations between variables (AHMAD et al., 2019). From this framework, specific testable hypotheses are logically derived. The research then involves the collection of quantitative data, which is subjected to statistical analysis to empirically test the posited relationships (HYDE, 2000). The objective is confirmation or falsification; this approach is dominant in hypothesis-testing research where the aim is to examine the predictive power and generalizability of established theories within a new context (FIFE & GOSSNER, 2024).

In contrast, the inductive approach is primarily concerned with theory-building rather than theory-testing. Here, the research begins with empirical observations, then analyzing quantitative data without being constrained by a pre-defined theoretical model aimed at prediction. The goal is to distill these observed patterns into broader conceptual categories or theoretical frameworks that explain the phenomena (MILES et al., 2020). This approach is valuable when investigating complex, poorly understood phenomena where existing theory is insufficient.

Bridging these two traditions is the abductive approach, where a theory is found or adjusted in a way to explain an unexpected result in the data. This involves going back and forth comparing the data with different theoretical ideas until the most reasonable explanation is developed (TAVORY & TIMMERMANS, 2014). Abduction acknowledges the complexity of social reality and allows for the refinement of theory in light of empirical evidence, making it highly suitable for applied research that seeks to solve problems while contributing to theoretical understanding. Table 1 portrays the different research approaches.

Therefore, this study employs a deductive research approach as it systematically derives hypotheses from established theory and tests them through quantitative data and statistical analysis. This approach supports the objective testing of causal relationships and enhances the

generalizability of findings, consistent with a positivist research philosophy (SAUNDERS et al., 2020). Deductive reasoning provides a structured pathway from theory to empirical evidence, which enhances the rigor and replicability of quantitative studies (YIN, 2018).

Table 1: Research Approaches

	Deduction	Induction	Abduction
Logic	In a deductive inference, when the premises are true, the conclusion must also be true	In an inductive inference, known premises are used to generate untested conclusions	In an abductive inference, known premises are used to generate testable conclusions
Generalizability	Generalizing from the general to the specific	Generalizing from the specific to the general	Generalizing from the interactions between the specific to the general
Use of data	Data collection is used to evaluate propositions or hypotheses related to an existing theory	Data collection is used to explore a phenomenon, identify themes and patterns and create a conceptual framework	Data collection is used to explore a phenomenon, identify themes and patterns, locate these in a conceptual framework and test this through subsequent data collection and so forth
Theory	Theory falsification or verification	Theory generation and building	Theory generation or modification; incorporating existing theory where appropriate, to build new theory or modify existing theory

(Source: SAUNDERS et al., 2020, p.153)

2.3. Research Methods and Strategy

2.3.1. Quantitative Methods

The main goal of any research study is to answer the research questions and test the hypothesis; research methods guide the design of a study, data collection and analysis of results (YIN, 2018). Several major research methods may have overlaps or differences in the approaches, such as quantitative, qualitative, mixed methods, arts-based research and community-based participatory research (DAWADI et al., 2021).

Quantitative research including experimental, semi-experimental, correlational or descriptive research designs is generally characterized by the collection of numerical data (GHANAD, 2023). Different from qualitative research involving a detailed exploration of phenomena, quantitative research uses standard research designs with the purpose of describing, explaining and forecasting phenomena, as well as probability sampling and larger sample sizes (MILES et al., 2020).

The qualitative research is often called interpretative research because its main purpose is to provide a better understanding of the phenomenon, differently from the quantitative research. The qualitative research is usually used to investigate people's personalities and behaviors, being, therefore, often applied in academic and social sciences (BAZEN et al., 2021; MILES et al., 2020). Given the goals of qualitative research, it employs different research designs, non-probability sampling, and smaller sample sizes, as well as different data gathering and analysis methods than quantitative research. Qualitative research is used to explore and examine a social phenomenon to gain a better understanding of its dimensions (DAWADI et al., 2021). Mixed methods involve using both the qualitative and quantitative approaches in the study where both data collection techniques and analysis procedures are used in the same research design (HAFSA, 2019). As a result of combining qualitative and quantitative data in a mixed-method study, it may result in a more comprehensive understanding of the topic under investigation.

Thus, the quantitative approach will be taken into consideration for this study as its primary objective is to test a predefined theoretical model comprising specific, hypothesized relationships between measurable constructs (BRYMAN & BELL, 2015). The research also aims not to explore

individual experiences but to objectively measure the frequency and strength of these relationships across the Jordanian food supply chain sector.

2.3.2. Research Design

The research design outlines the plan or approach to be taken in addressing the research question, drawing on the available knowledge in the research area (TIMANS et al., 2019). YIN (1994, p.19) defined research design as: *“is an action plan for getting from here to there, where here is maybe defined as the initial set of questions to be answered, and there is set of conclusions (answers).”* The following is a summarized plan for this study:

1. Research philosophy & approach: the adoption of a postpositivist philosophy and a deductive quantitative approach
2. Research strategy: A cross-sectional survey strategy across the target population
3. Data collection instrument: Development of a structured closed-ended questionnaire using the Likert scale
4. Population & sampling: Definition of the target population as professionals and managers within Jordan’s food supply chain sector
5. Data collection procedure: Administration of the survey, using both online and direct methods
6. Data analysis technique: An analytical procedure using Structural Factor Analysis (SEM)
7. Ethical consideration: Including informed consent, confidentiality, and anonymity of participants

2.4. Data Collection

2.4.1. Sampling Strategy

The virtue of quantitative research findings is fundamentally dependent upon a rigorously designed data collection and sampling strategy. *“Sampling is described as the act, process, or technique of selecting a representative sample of a population to observe and analyze the*

characteristics of the entire population” (RAHMAN et al., 2022, p.45). This approach follows a deliberate, sequential logic to ensure the resultant data is both representative of the broader phenomenon under investigation and amenable to robust statistical assumptions. The sample population, sample frame, sample techniques, sampling size and time horizon is discussed below.

The process begins with the definition of the **sample population**, a complete set of elements that share the characteristics central to the research question and to whom the study’s conclusions are intended to generalize (TAHERDOOST, 2022). Clearly depicting this population establishes the boundary for external validity, specifying which statistical findings may be projected. Following the decision of the sample population, a sampling frame must be identified, which is a practical list or database source representing this population, like an industry registry (MAKWANA ET AL., 2023). The alignment between the frame and the sample population is critical, as gaps coverage bias and threaten representativeness from the start, hence enhancing validity and reliability (LOHR, 2021). A comprehensive sample frame also enables future studies to replicate the research using the same frame, supporting reproducibility (TAHERDOOST, 2022). Therefore, the sampling population for this research are food supply chains (FSC) in Jordan.

To evaluate the efficiency and effectiveness of the **sampling frame**, the frame must be comprehensive by including all of the target population. Hence, the actors in the FSC are purposively chosen, they are: Producers/Manufacturers, Distributors/Wholesalers and Logistic Providers. The following criteria were applied for selecting the actors in the SC:

- Actors in the food supply chain;
- Actors have knowledge of information systems (IS);
- Actors have established or planning sustainable initiatives;
- Actors that have localized SC operations in Jordan;

With a defined sampling frame, the next step is the selection of a **sampling technique**. While probability sampling methods give every element a known, non-zero probability of selection and allow sampling error to be computed (ETIKAN & BALA, 2017; BHARDWAJ, 2019), they require a complete and accessible register of the target population. No such register of food-supply-

chain professionals exists in Jordan, and access depended on organizational gatekeepers. A non-probability approach — purposive, snowball, and convenience sampling — was therefore adopted, with the resulting constraints on generalizability acknowledged in Section 5.2.1. “*Non-probability sampling refers to sampling techniques in which units are selected from the population without using a known or equal chance of selection, which may limit the generalizability of findings to the wider population*” SAUNDERS et al., 2020, p. 313). Efforts were strategically directed toward involving relevant major companies within Jordan’s food supply chain. To reach professionals, multiple outreach methods were employed, including purposive sampling, snowball sampling and convenience sampling. Firstly, purposive sampling was carried out by deliberately choosing participants as they provided relevant and diverse information appropriate to the research questions (ETIKAN & BALA, 2017). Secondly, snowball sampling was also applied, where initial participants with desired characteristics helped identify further participants hence creating a network of participants (BHARDWAJ, 2019). Finally, convenience sampling was conducted by collecting data from the population who are conveniently available to the researcher yet met the criteria (BHARDWAJ, 2019; BLACKSTONE, 2012). Because the questionnaire was distributed internally within participating organizations — forwarded by managers and senior staff to their teams — the number of professionals who ultimately received it was not observable to the researcher, and a conventional response rate could not be reliably calculated. This is noted as a limitation of the distribution method rather than estimated from an incomplete denominator.

To be able to get a suitable statistical power an adequate **sample size** (SARSTEDT et al., 2023) has to be defined. The required size relies on the confidence level, the tolerated margin of error, the predicted variance within the population and the unique needs of the planned analytical procedures (SARSTEDT et al., 2021). CRESWELL & CRESWELL (2017, p. 158) argues that for quantitative surveys “the sample size should be based on the type of statistical analysis planned and the precision desired for estimates, not saturation of themes”. Sufficient sample size will reduce sampling error, improve reliability and promote statistical validity (HAIR et al., 2014). Several authors (SARSTEDT et al., 2023; HAIR et al., 2021; KLINE, 2016) recommended a sample size of about 200 or more for quantitative studies to achieve sufficient statistical power, robustness in structural equation modeling results and support generalizability; they also suggested that 200 or more is a common benchmark for SEM and similar analyzes. Therefore, this study

obtained a sample size of 200. No formal a-priori power analysis was performed; the sample size of 200 follows the standard sufficiency recommendation for SEM in terms of the number of indicators and parameters (Hair et al., 2021; Kline, 2016), and a power-based determination is suggested for future replication.

Finally, the **time horizon** for data gathering has to be defined. The majority of quantitative research in management and social science use a cross-sectional design, where data is collected from the sample at one moment in time, providing a snapshot of relationships and perspectives (SAUNDERS et al., 2020). This approach is efficient and well suited to explore correlations and to test theoretical models that relate constructs. In contrast, the longitudinal design, which collects data from the same or similar samples at different points in time, provides better evidence of causality assessment and temporal changes, although it is more resource-intensive and subject to participant depreciation (CARUANA et al., 2015). Thus, the cross-sectional method was used in this study and data were collected at one point in time to analyze the relations between the variables of interest.

2.4.2. Data Collection Strategy

Data in scholarly work can be classified as either primary or secondary, each with distinct characteristics and implications for research validity, reliability, richness and execution. **Secondary data**, collected and analyzed by others for purposes different from the current research (BRYMAN & BELL, 2015). This information can be quantitative or qualitative, such as published materials, organizational records, archival records, etc. On the other hand, “*primary data are data that are collected for the specific research problem at hand, using procedures that fit the research problem best*” HOX & BOEIJE (2005, p.593). Methods of primary data vary based on the research aim and questions. **Primary data** in quantitative studies consist of numerical information gathered directly from respondents using structured and standardized instruments, such as structured surveys, questionnaires, controlled experiments, and direct observations (SAUNDERS et al., 2020). This type of data is collected specifically to measure variables, test relationships and perform statistical analysis aligned with the objectives of the study (CRESWELL & CRESWELL, 2017). Therefore, this research utilizes both primary and secondary data.

The data was gathered specifically for this study through a structured questionnaire distributed to professionals within Jordan's food supply chain sector. This instrument was designed to measure the latent constructs of the theoretical model, including Information Systems Adoption, Dynamic Capabilities, and Supply Chain Competitiveness. The resulting dataset, formed the sole basis for the following statistical analyses, including the reliability tests, confirmatory factor analysis, and structural equation modeling that validated the research hypotheses. No pre-existing datasets, archival records, or secondary sources were used in the empirical testing phase, ensuring that the findings directly reflect the viewpoints and realities of the targeted contemporary context.

Questionnaires

A questionnaire serves as a standardized tool for collecting primary quantitative data, ensuring consistency and reliability across respondents (SAUNDERS et al., 2020). Questionnaires are designed to generate numerical data that can be statistically analyzed to measure variables, test hypotheses and examine relationships among constructs in quantitative research (BRYMAN & BELL, 2015). Data for this study were collected using a structured questionnaire designed to obtain quantitative information relevant to the research aim and objectives. The questionnaire consisted of closed-ended questions measured on a five-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree," to ensure consistency and facilitate statistical analysis. The five-point format was adopted because the questionnaire was administered in Arabic — translated from an English original and reviewed by bilingual scholars — where a compact, clearly anchored scale supports comprehension and cross-language equivalence, and because it balances response discrimination against respondent burden in line with its established use in IS and supply-chain survey research. The instrument was developed by drawing on established, validated constructs in the information-systems and supply-chain literature, adapted and contextualized for the food supply chain: information-systems capability — IT infrastructure, skills, and support (BHARADWAJ, 2000; BHATT & GROVER, 2005); dynamic capabilities in the sensing, seizing, and reconfiguring tradition (PAVLOU & EL SAWY, 2011); competitive capabilities — cost, delivery dependability, quality, and flexibility (LI et al., 2006); and green supply-chain and IS-enabled sustainability practices (ZHU, SARKIS & LAI, 2008). Items for KPI effectiveness and IS implementation challenges were developed for this study from the broader performance-

measurement and technology–organization–environment (TOE) literatures. Prior to full deployment, the questionnaire was pilot tested with a small group of respondents.

The questionnaire consisted of nine sections as shown in the Appendix. (i) Section 1: Personal Questions, (ii) Section 2: Demographics and Firm Characteristics, (iii) Section 3: Information Systems (IS) Adoption and Usage, (iv) Section 4: Supply Chain Competitiveness, (v) Section 5: IS and Sustainability, (vi) Section 6: Resource-Based View (RBV) Factors, (vii) Section 7: Dynamic Capabilities Theory (DCT) Factors, (viii) Section 8: Challenges & Moderating Factors, and (ix) Section 9: KPI Effectiveness. With a total of 62 questions. The sections reflect different theories relevant to the research aim and objectives.

Participation was voluntary. Prior to data collection, participants were provided a brief invitation and concise explanation of the study, informing them that their responses would be used solely for research purposes before they commenced the questionnaire. Participants were also guaranteed the anonymity and confidentiality of their responses. The questionnaire took approximately 15-20 minutes to complete. Consistent with a cross-sectional research design, the questionnaire distribution took place over four months from April to July 2025, with data collected at a single point in time from each participant.

The distribution of the questionnaire is an important stage in research and has a significant impact on the quality and quantity of the responses obtained (DAIKELER et al., 2020). This section discusses the research methodology used to distribute the survey in Jordan, the challenges encountered, and the measures taken to increase the participation rates.

Google Forms was the primary platform used to distribute the survey across Jordan. The questionnaire was first developed in English and then translated into Arabic to better accommodate the local linguistic environment and increase the accessibility of a wider range of participants. The translation was conducted by the bilingual author, in addition reviewed by other bilingual scholars. It is essential to preserve the meaning of the content, contextual significance and overall integrity of the questionnaire questions throughout the translation process (BAILEY, 2008). To create presence in the industry and encourage participation, the researcher used a combination of on-site visits to organizations, email correspondence and interactions on digital platforms. The approach was systematic and persistent in motivating participation and increasing the response rate. This

included personal follow-up, frequent reminders and ongoing communication to maintain the level of interest among potential participants and to facilitate a higher engagement rate with the questionnaire.

In the end, 200 completed responses were collected. These responses contributed significantly to the depth and quality of the data obtained for the research. Reaching 200 respondents allows more robust analyses in order to achieve statistical power, precision and generalizability (KLINE, 2016).

Pilot Test

A pilot study was conducted before the survey was fully deployed in order to assess the questionnaire's clarity, content validity, and reliability as well as to identify any potential ambiguities in the items' wording or structure (COHEN et al., 2013). A small sample group reflective of the main study's demographic was asked to complete the survey. The responses from this pilot group were analyzed to ensure the reliability of the survey. Following the analysis and comments from the pilot study, the researcher made modest adjustments to the wording and scale structure to the surveys' instrument to improve its validity (WADOOD et al., 2021). The final questionnaire was administered to the selected sample, and the resulting data were coded and analyzed using statistical software to test the proposed hypotheses.

2.5. Data Analysis Methods

2.5.1. Model Fitness Analysis

In this study, confirmatory factor analysis (CFA) is employed, where CFA serves as a theory-testing procedure, whereas the exploratory factor analysis (EFA) operates as a theory-generating technique (BANDALOS & FINNEY, 2018). CFA was the appropriate choice for this study because the analysis tests a pre-specified measurement structure derived from established theory, rather than exploring an unknown factor structure.

Before conducting the actual empirical analysis that evaluates the effects of the independent variables on the dependent variables, the study conducted a correlation analysis. The analysis showed that SCC has an average moderate relationship with the independent

variables; meaning that the SCC direction was influenced by other variables significantly. After the correlation analysis, CFA was evaluated using multiple fit indices as recommended in the literature (MCNEISH & WOLF, 2023; HU & BENTLER, 1999). Some of the indices are absolute fit (χ^2/df), PGFI, CFI, and RMSEA, which all were within acceptable range. In addition to the model fitness analysis, the study evaluated the reliability and validity of the study variables. The reliability was evaluated using two measures the Cronbach's alpha (α) and the composite reliability (CR), while the validity was evaluated using average variance extracted (AVE) and standardized beta (CHEUNG et al., 2024; HAIR et al., 2011). Discriminant validity was assessed using both the Fornell–Larcker criterion and the HTMT ratio. While Fornell–Larcker was borderline for a few conceptually related construct pairs, HTMT supported discriminant validity across the model, providing a sufficient basis for the structural analysis (Becker et al., 2023).

2.5.2. Structural Equation Modeling

In this study Structural Equation Modeling (SEM) was used, an advanced multivariate technique used to assess the degree to which the empirical data supports a proposed theoretical model (KLINE, 2023). It is concerned specifically with the relationships between latent constructs, intangible qualities inferred from the variables and observed variables. In conclusion, it is the use of hypothesis testing in SEM to validate the way groupings of variables build a construct and the relationships between the constructs, and to improve our understanding of complex multivariate relationships (CEPEDA-CARRION et al., 2019; LEI & WU, 2007). SEM is a versatile analytical technique that can be applied in various academic and professional systems. For example, it is often used in fields such as family science, sociology, education, and social policy. Importantly, SEM is also instrumental in examining economic phenomena, particularly within economics and market research, as well as in psychology, demography, biology, genetics, and medical science. In summary, due to its broad utility, the SEM framework can be effectively employed across a wide array of research domain (TARKA, 2018). Covariance-based SEM was selected because the study's aim is to test and assess the overall fit of a theory-driven model built on established constructs, which is the setting CB-SEM is designed for; PLS-SEM, by contrast, is oriented toward prediction and toward formative or small-sample contexts and would not provide the model-fit assessment central to this confirmatory study. A regression-based approach was not adopted because it cannot simultaneously estimate the measurement and structural components, nor the

mediation paths, which the integrated model requires. The reported correlations are Pearson coefficients, justified by the distributional diagnostics reported in Section 3.1. All analyses were conducted in IBM SPSS Statistics and IBM SPSS Amos, with model parameters estimated by maximum likelihood.

2.6. Reliability and Validity

Reliability refers to the consistence and stability of a measurement instrument over time, across different items, and among different observers (BRYMAN & BELL, 2015). A reliable instrument produces similar results under consistent conditions, minimizing random error. Reliability in quantitative research which utilizes questionnaires is frequently evaluated using internal consistency measures such as Cronbach's alpha and Composite Reliability (CR) (CRESWELL & CRESWELL, 2017), which were implemented in this study. High reliability is essential for ensuring that findings are replicable and reproducible across different samples (KARNIA, 2024; CRESWELL & CRESWELL, 2017).

Validity is the extent to which an instrument measures what it is supposed to measure (CRESWELL & CRESWELL, 2017). Significant types of validity are: construct validity, content validity, and criterion-related validity (KARNIA, 2024). Construct validity is the extent to which the instrument measures the theoretical construct it is meant to measure (KARNIA, 2024). Thus, this study ensures construct validity by using measurement instruments that have been validated in prior research (Average Variance Extracted (AVE) and Fornell-Larcker Criterion). Whereas the content validity ensured the instrument covers all relevant dimensions of the construct (VU, 2021; CRESWELL & CRESWELL, 2017). Therefore, this study ensures content validity by asking an expert to evaluate whether the questions cover all aspects of the construct, the questions were based on comprehensive literature to ensure all relevant domains are included and finally a pilot test was administered to identify missing or unclear items. Furthermore, the criterion-related validity assesses whether the measure correlates with external criteria that it should theoretically predict (KARNIA, 2024; BRYMAN & BELL, 2015). Though this study did not directly test this, the entire Structural Equation Model, is essentially a powerful test of how well the constructs predict each other through the hypothesized relationships between them, which is related to criterion validity logic.

Subsequently, ensuring validity is critical in quantitative research as statistical result and hypothesis testing depend on accuracy of measurement (VU, 2021). Employing rigorous data collection procedures, standardized instruments and appropriate statistical analyses enhances credibility, consistency and replicability (KARNIA, 2024; BRYMAN & BELL, 2015).

2.7. Ethical Consideration

The research gained approval from the University of Debrecen Faculty of Economics and Business Ethical Board based on completing the required documents and conditions. Following the university's procedures, ethical principles were carefully observed throughout the research process to ensure protection of participants and the integrity of the study. Prior to data collection, a brief explanation of the study's objective and the planned use of the data was provided to the participants. The participants received assurance that all answers would be kept anonymous and that no personal information would be shared, from here, all participants gave their informed consent and the participation was completely voluntary. Data were securely stored and managed in accordance with relevant data protection regulations to maintain participant privacy and prevent unauthorized access (SMITHSON, 2024). Additionally, participants were informed of their right to withdraw from the study at any time without any negative consequences. The study was conducted in accordance with institutional ethical guidelines ensuring adherence to best practices in research ethics.

3. RESEARCH FINDINGS AND THEIR EVALUATIONS

In this chapter, we analyze the data collected from the food supply chain sector in Jordan. This takes us from the analytical framework created in the previous chapter to the crucial step of empirical testing. The results reported here are based on the concepts of Structural Equation Modeling (SEM) and provide an extensive statistical analysis of the suggested conceptual framework that incorporates constructs from IS adoption to dynamic capabilities. The analysis sequence begins with the assessment of the measurement model's integrity thru Confirmatory Factor Analysis (CFA) followed by the test of the hypothesized structural paths driving supply chain competitiveness and finishing with the examination of the potential mediating role of IS challenges (HAIR et al., 2021). The empirical evidence in this chapter provides the basis for conclusions about the effect of information systems in practice on competitive dynamics, going from theoretical claims to empirical evidence.

3.1. Descriptive Statistics of the Sample

The preliminary phase of the research involved a demographic analysis, employing descriptive statistics to characterize the study's participants across variables such as age, gender, and educational level, see Table 2. This approach is methodologically standard for profiling a sample population and is grounded in the scientific study of human population structures (PALLANT, 2020). Accurately defining and measuring these participants' characteristics is a critical step for establishing the context and validity of research findings (SARDAK et al., 2018). Participants were also asked to indicate their company's geographic scale. The majority of 59% operated on an international level, while 41% operated nationally. The data of the educational levels projected that 73% of the participants have obtained a bachelor's degree which account for the largest proportion. This was followed by a 21.5% for Master's degree holders, 4% PhD holders, and a minimum of 1.5% of participants who only have obtained a high school certificate. Regarding gender, males were the dominant gender making up 53.5%, whereas the females comprised of 46.5%. The age of the respondents was also considered, with the 25–34-year age group being the most popular, presenting 47.5%, followed by a 26% for the 18-24-year age group. Next at 16.5% for the 35-44-year-olds, 7.5% for the 45-54-year-olds, and 2.5% for participants over the age of 55. In addition, the analysis of company size based on employee count concluded

that organizations with more than 500 employees have the largest share of 33.5%, meanwhile companies who have between 50-99 employees have the lowest share of 13.5%. It was also observed that slightly more than half, 53.5%, hold a position or function related to sustainability, corporate sustainability, or corporate social responsibility (environmental, social, governance (ESG)), whereas the smaller portion of 46.5% didn't hold any position in ESG. An analysis of information systems usage within supply chain operations revealed that 48% of participants had used IS for more than five years. Participants using IS between 2-5 years are 27.5%, while less than two years are 24.5%. The diversity of functional department representation was also observed with research and development at 23%, human resources at 21.5% and the lowest was distribution at 4.5%. The managerial hierarchy was also observed to indicate that most respondents did not hold leadership roles in their companies at 44% but a notable share were team leaders at 20.5% and 12.5% as top level managers.

Table 2: Demographics and Professional Attributes of Participants

Demographics	Categories	Frequency (n)	Percent (%)
Age	18 – 24 years	52	26
	25 – 34 years	95	47.5
	35 – 44 years	33	16.5
	45 – 54 years	15	7.5
	more than 55 years	5	2.5
	Total	200	100
Gender	Male	107	53.5
	Female	93	46.5
	Total	200	100
Education	High school	3	1.5
	Bachelors	146	73
	Masters	43	21.5
	Ph.D.	8	4
	Total	200	100
Company size	1 – 49 employees	43	21.5
	50 – 99 employees	27	13.5
	100 – 249 employees	31	15.5
	250 – 499 employees	32	16
	>500 employees	67	33.5
	Total	200	100
Nature of company	National	82	41
	International	118	59
	Total	200	100

Functional departments	Research and development	46	23
	Finance and accounting	18	9
	Distribution	9	4.5
	Sales	38	19
	Customer service	17	8.5
	Human resources	43	21.5
	Marketing	29	14.5
	Total	200	100
Hierarchy of position	Team leader	41	20.5
	First line manager	22	11
	Middle manager	24	12
	Top level manager	25	12.5
	Do not hold any leadership position	88	44
	Total	200	100
Using IS in SC operations	Less than 2 years	49	24.5
	Between 2-5 years	55	27.5
	More than 5 years	96	48
	Total	103	100
Hold a position or job related to sustainability	Yes	93	46.5
	No	107	53.5
	Total	200	100

(Source: Developed by Author)

A Harman single-factor test was conducted to assess common-method bias by entering all measurement items into an unrotated factor analysis. The first factor accounted for 41.25% of the total variance, below the 50% threshold, and the items resolved into eight factors with eigenvalues above one, indicating that no single factor dominated. Common-method bias is therefore not a serious concern, although this preliminary test is complemented by the well-defined multi-factor structure confirmed in the CFA. Prior to model estimation, the distributional properties of the constructs were examined (see Table 3). All item-level skewness values fell between -0.85 and -0.25 and kurtosis between -0.62 and $+0.80$, within the thresholds of $|\text{skewness}| < 2$ and $|\text{kurtosis}| < 7$ recommended for ML-based SEM (Curran, West & Finch, 1996), supporting the use of maximum-likelihood estimation. As a further safeguard against mild non-normality, the structural relationships were re-estimated with robust standard errors; the significance decisions were unchanged for all hypotheses except IS-enabled Sustainability, which became marginal ($p \approx 0.05$). The mediation analysis additionally used bootstrapping, which makes no normality assumption.

Table 3: Descriptive Statistics and Normality of Constructs

Construct	Mean	SD	Median	Skewness	Kurtosis
IS Adoption (ISA)	3.61	0.81	3.71	-0.64	0.35
Supply Chain Competitiveness (SCC)	3.70	0.83	3.88	-0.78	0.78
IS-enabled Sustainability (ISS)	3.54	0.83	3.67	-0.53	0.31
Resource Based View (RBV)	3.66	0.78	3.75	-0.32	-0.35
Dynamic Capabilities (DC)	3.60	0.80	3.71	-0.38	0.29
IS Challenges (ISC)	3.49	0.86	3.60	-0.69	0.40
KPI Effectiveness (KPIE)	3.49	0.78	3.54	-0.30	0.00

(Source: Developed by Author)

3.1.1. Industry and System Context

Contextual data on the core roles and IS infrastructure of the firms provides critical insight into the operating environment. The respondent pool is heavily skewed toward core supply chain actors with logistics providers (35%), product manufacturers (27.5%) and distributors/wholesalers (19.5%) making up the vast majority (82% in total). A clear technological hierarchy can be observed in the systems employed, with basic ERP systems dominating the platform, employed by 33.5% of firms, but a sharp decline in the use of more advanced tools. Specifically, AI/ML for demand forecasting (4%) and blockchain for traceability (3.5%) see markedly low adoption. When asked to evaluate the level of information systems integration across their supply chain, 65% of respondents answered “often” or “repeatedly”. Furthermore, the use of real-time data for decision-making is an established practice, with 64% of respondents using it “often” or “repeatedly”. This operational reliance is reflected in the year-end performance outcomes. The assessment of Key Performance Indicators (KPIs) reveals a positive trend with a strong bias, where the modal response for critical metrics like On-time delivery (58%), customer retention (55%) and product/service quality (54%) is a “slight increase”. This quantitative backdrop confirms that the industry is not only equipped with the technology but is also effectively translating that capability

into tangible performance improvements. Thus, the Jordanian food supply chain sector currently favors operational integration over predictive or transformative digital capabilities.

3.2. Assessment of the Measurement Model

3.2.1. Confirmatory Factor Analysis and Model Fit

Confirmatory factor analysis is a hypothesis-testing approach, its primary objective is to statistically evaluate the model's "goodness of fit" by determining how well this hypothesized structure replicates the observed data (KLINE, 2023). As a cornerstone of covariance based structural equation modeling, CFA is used for confirmatory theory testing and measurement validation. It is a powerful technique as it provides an explicit statistical test for a pre-specified factor structure, allowing researchers to vigorously evaluate their measurement models (WIDAMAN & HELM, 2023). The primary objectives of structural equation modeling are evaluating a hypothesized model's goodness of fit and estimating its parameters. This assessment is most commonly conducted using two complementary approaches: χ^2 goodness-of-fit test or a suite of practical fit indices. One of the main differences between them is that the χ^2 goodness-of-fit is a test of exact fit, where the null hypothesis (H_0) is that "the model fits the data perfectly". In practice, however, this test is often supplemented by descriptive fit indices, which provide a more flexible assessment of "close fit" and are generally less sensitive to sample size (MCNEISH & WOLF, 2023).

For this study, the fitness of the CFA model was assessed by a set of absolute, incremental, and parsimony-adjusted fit indices, in accordance with modern guidelines for measurement model validation (MARSH et al., 2020). Absolute fit measures provide a rough idea of the degree of fit between the hypothesized model and the observed data. The chi-squared/degree of freedom (χ^2/df) was 1.771 (see below in Table 4), which is well below the conservative cut-off of 2.0 indicating a good fit metric (KANG & AHN, 2021). The Root Mean Square Residual (RMR) was 0.05, below the cut-off of 0.08 for a close fit (XIA & YANG, 2019). The Goodness-of-Fit (GFI) was 0.706. Although this is below the ideal level of 0.9, note that current guidelines suggest GFI values greater than 0.7 can be viewed as acceptable for complex models, especially in social sciences where a perfect fit is rare (KANG & AHN, 2021).

Table 4: Model Fitness Analysis

Fit Index	Recommended Threshold	Model Values	Interpretation	Reference
Absolute Fit Measures				
CMIN/DF (χ^2/df)	<2(Good); <5(Acceptable)	1.771	Good Fit	Kang & Ahn, (2021)
RMR	<0.08(Acceptable)	0.05	Good Fit	Xia & Yang, (2019)
GFI	≥ 0.9 (Good); .7 (Acceptable)	0.706	Acceptable	Kang & Ahn, (2021)
Incremental Fit Measures				
CFI	≥ 0.9 (Good); >0.85(Acceptable)	0.873	Acceptable	Shi & Maydeu-Olivares, 2020)
IFI	≥ 0.9 (Good); >0.85(Acceptable)	0.874	Acceptable	Shi & Maydeu-Olivares, 2020)
TLI	≥ 0.9 (Good); >0.85(Acceptable)	0.866	Acceptable	Shi & Maydeu-Olivares, 2020)
Parsimony-Adjusted Measures				
PNFI	>0.5 (Acceptable)	0.71	Acceptable	Pek & Hoyle, (2022)
PCFI	>0.5 (Acceptable)	0.825	Acceptable	Pek & Hoyle, (2022)
Error of Approximation				
RMSEA	<0.06(Good); <0.08(Acceptable)	0.062	Acceptable	Sokolov, (2019)

(Source: Developed by Author)

The incremental fit indices, which assess the improvement in fit over a baseline null model, are all in the acceptable range. The Comparative Fit Index (CFI=0.873), Incremental Fit Index (IFI=0.874) and Tucker-Lewis Index (TLI=0.866) all meet or exceed the 0.85 value, a benchmark established in contemporary methodological reviews as indicative of adequate fit of the model in applied research settings (SHI & MAYDEU-OLIVARES, 2020). While not indicative of a “great” fit, these values are generally considered to represent an “acceptable” or “adequate” fit (HAIR et al., 2019). This suggests the model is a substantial improvement over a null model. Critically, the parsimony-adjusted indices, which reward simpler models, are strong. The Parsimony Normed Fit Index (PNFI=0.71) and Parsimony Comparative Fit Index (PCFI=0.825) are well above the 0.5 benchmark often used in contemporary research to indicate a well specified model that achieves good fit without unnecessary complexity (PEK & HOYLE, 2022). Finally, the Root Mean Square

of χ^2/df , RMR, RMSEA, and the parsimony-adjusted measures (PNFI, PCFI) all meet their respective criteria for a satisfactory model. The main purpose of CFA is to establish whether the model is plausible and adequate for proceeding with structural analysis, the cumulative evidence from these indices supports the conclusion that the measurement model provides a reasonably good fit to the data (KHOJASTEH, 2023). Therefore, the model is deemed sufficient to proceed with an evaluation of the reliability, validity, and subsequent testing of the structural relationships.

3.2.2. Reliability and Validity Analysis

After the confirmatory factor analysis, the reliability and validity of the measurement model were tested (HAIR et al., 2021). These tests are very important to measure the internal consistency of the constructs and to verify that different theoretical concepts are measured as expected, providing a solid basis for the subsequent structural analysis (RÖNKKÖ & CHO, 2022).

Reliability is the internal consistency of the measurement scales and was tested through Cronbach's alpha and Composite Reliability (CR). As presented in Table 5, the values of Cronbach's alpha for all constructs were between 0.88 and 0.949, exceeding the conservative threshold of 0.7, which indicates excellent reliability (CHO & KANG, 2024). Composite Reliability, which is generally considered more appropriate for SEM due to its lower sensitivity to the number of items, was also employed (RÖNKKÖ & CHO, 2022). The CR values ranged from 0.871 to 0.944, significantly above the threshold value of 0.7, strongly supporting the internal consistency of the scales (SARSTEDT et al., 2020).

Validity was tested by convergent and discriminant tests (CHEUNG et al., 2024). Convergent validity reflects the amount to which a group of items converge to measure the same underlying construct, it was examined using the Average Variance Extracted (AVE) and the statistical significance of the factor loadings (AB HAMID et al., 2017). The AVE of each construct was higher than the critical value of 0.5, and the AVE was 0.552 to 0.652. This demonstrates that each latent variable explains a reasonable amount of variance in its indicators relative to measurement error (VOORHEES et al., 2016).

Table 5: Reliability and Validity Analysis of Constructs

Construct	Indicator Loadings (range)	Composite Reliability (CR)	Average Variance Extracted (AVE)	Cronbach's Alpha (α)
Dynamic Capabilities (DC)	DC1 - DC7 (0.703 - 0.803)	0.912	0.598	0.914
IS Adoption (ISA)	ISA1 – ISA7 (0.712 – 0.794)	0.896	0.552	0.898
IS Challenges (ISC)	ISC1 – ISC5 (0.678 – 0.846)	0.871	0.575	0.880
IS Sustainability (ISS)	ISS1 – ISS6 (0.639 – 0.844)	0.888	0.571	0.897
KPI Effectiveness (KPIE)	KPIE1 – KPIE13 (0.565 – 0.837)	0.944	0.566	0.949
Resource-Based View (RBV)	RBV1 – RBV6 (0.638 – 0.824)	0.887	0.568	0.895
Supply Chain Competitiveness (SCC)	SCC1 – SCC8 (0.759 – 0.869)	0.937	0.652	0.940

(Source: Developed by Author)

Discriminant validity, which at testing the constructs are conceptually different, was examined by the Fornell-Larcker criterion. This criterion states that the root of the AVE of any given construct should be higher than its correlation with any other construct (AB HAMID et al., 2017) as shown diagonally in Table 6. Inspection of the full matrix shows the criterion is satisfied for most, but not all, construct pairs. The AVE square root for ISS (0.755) is exceeded by its correlation with Dynamic Capabilities (0.846), and a similar pattern arises for the ISA–SCC and RBV–DC pairs, indicating borderline discriminant validity for these conceptually adjacent constructs. Assessed with the more sensitive HETEROTRAIT–MONOTRAIT ratio (HTMT; HENSELER, RINGLE & SARSTEDT, 2015), all values fall below 0.90 and all but one (ISS–DC = 0.851) below the stricter 0.85 threshold (see Table 7), supporting discriminant validity across the model while transparently noting the marginal ISS–DC pair (VOORHEES et al., 2016). To summarize, the measurement model provides strong evidence of reliability, convergent validity and discriminant validity. These adequate behavioral measures show that the constructs are adequate and different, providing a firm basis for model evaluation and hypothesized relationships.

Table 6: Fornell-Larcker Criterion Validity Analysis

Construct	1	2	3	4	5	6	7
1. RBV	0.753						
2. SCC	0.653	0.808					
3. ISC	0.530	0.574	0.758				
4. KPIE	0.610	0.542	0.555	0.753			
5. ISS	0.752	0.713	0.698	0.612	0.755		
6. DC	0.756	0.726	0.649	0.638	0.846	0.774	
7. ISA	0.663	0.778	0.493	0.508	0.581	0.615	0.743

(Source: Developed by Author)

Note: Diagonal elements (in bold) are the square root of the AVE. Off-diagonal elements are the correlations between constructs. For discriminant validity, the diagonal value should be greater than the correlations in its row and column (SHRESTHA, 2021).

Table 7: HETEROTRAIT–MONOTRAIT (HTMT) Ratios

Construct	1	2	3	4	5	6	7
ISA	1.000						
SCC	0.778	1.000					
ISS	0.584	0.716	1.000				
RBV	0.668	0.654	0.759	1.000			
DC	0.609	0.727	0.851	0.747	1.000		
ISC	0.496	0.575	0.710	0.548	0.651	1.000	
KPIE	0.501	0.534	0.615	0.600	0.636	0.575	1.000

(Source: Developed by Author)

Threshold < 0.85 strict, < 0.90 liberal. *ISS–DC = 0.851 is marginally above 0.85 but below 0.90; reported transparently.

3.3. Structural Model and Hypothesis Testing

3.3.1. Structural Model Fit and Correlation Analysis

A correlation matrix was produced to assess the bivariate relationships between latent constructs, offering a first diagnosis of the proposed model linkages. The coefficients reported are Pearson correlations, supported by the distributional diagnostics in Section 3.1. As a robustness check, Spearman rank-order correlations were computed and were near-identical (maximum

absolute difference 0.05; see Table 8), confirming the results are not sensitive to the ordinal nature of the Likert data.

Table 8: Spearman vs Pearson with Supply Chain Competitiveness (SCC)

Construct Pairs with SCC	Spearman	Pearson	Difference
SCC-ISA	0.709	0.713	0.004
SCC-ISS	0.658	0.652	0.006
SCC-RBV	0.621	0.597	0.024
SCC-DC	0.630	0.672	0.042
SCC-ISC	0.513	0.519	0.007
SCC-KPIE	0.491	0.501	0.010

(Source: Developed by Author)

Maximum absolute difference 0.05, confirming robustness to the ordinal data.

The analysis shows that supply chain competitiveness (SCC) has significant positive relationships with all independent constructs. The strongest bivariate relationship is observed between SCC and ISA ($r^* = 0.713$) as seen in Table 8. This strong correlation highlights that technological integration is a key driver of competitive advantage, enabling superior operational visibility, process automation and responsiveness in complex supply chains. The results are in line with the established notion that digital transformation is critical for building resilient and efficient supply chain operations (IVANOV & DOLGUI, 2021). Furthermore, SCC demonstrates strong correlation with DC ($r^* = 0.672$) and ISS ($r^* = 0.652$). This pattern indicates that a firm's ability to sense, seize, and reconfigure its resources is essentially linked to its market performance (TEECE, 2018b). It is also in line with the notion that competitiveness is less about the static possession of resources and more about the ability for continuous reconfiguration and adaptation (FAINSHMIDT et al., 2019). The closeness to ISS means that employing IS for environmental and social governance is not an option but part of the core competitive strategy. This trend is even accelerated by global sustainability pressures (DUBEY et al., 2021; BEN-DAYA et al., 2023). The

findings suggest that in the Jordanian context, competitiveness is increasingly tied to agile and responsible business practices. The correlations in Table 8 are latent-variable correlations from the confirmatory factor model, whereas those in Table 9 are correlations among composite scores; this accounts for the small systematic differences between the tables (for example, the ISS–DC value of 0.846 versus 0.765).

Table 9: Correlation Analysis Results

Construct	SCC	ISA	ISS	RBV	DC	ISC	KPIE
SCC	1.0						
ISA	0.713**	1.0					
ISS	0.652**	0.521**	1.0				
RBV	0.597**	0.596**	0.671**	1.0			
DC	0.672**	0.552**	0.765**	0.672**	1.0		
ISC	0.519**	0.437**	0.621**	0.481**	0.579**	1.0	
KPIE	0.501**	0.457**	0.563**	0.547**	0.59**	0.52**	1.0

(Source: Developed by Author)

*Note: ** $p < 0.01$ (two-tailed)*

SCC has a modest association with RBV ($r^* = 0.597$) and KPIE ($r^* = 0.501$), which implies that tangible resources and performance measurement are relevant, but their direct relationship with competitiveness is not as strong as dynamic and adaptive capabilities. Therefore, having valuable resources is not enough to achieve competitive outcomes, but more crucially, the capacity to measure and dynamically reconfigure them (WILDEN & GUDERGAN, 2017; FAINSHMIDT et al., 2019). An interesting observation is a positive connection between SCC and ISC ($r^* = 0.519$). This may be explained by a “performance paradox” in which the more sophisticated and competitive firms are more aware and prepared to report systemic difficulties due to the more complex operations they have (WAMBA & QUEIROZ, 2022). Conversely, an a less evolved organization may not have the competence to perceive such difficulties (AL-KHATIB, 2023).

On the other hand, the high correlation between ISS and DC ($r^* = 0.765$) is theoretically supported. Designing sustainable supply chains is a dynamic process that requires firms to learn, innovate and transform their processes continuously in response to the demand of stakeholders and legislative change (GÖLGECI & KUIVALAINEN, 2020). However, this high inter-construct

correlation indicates a potential multicollinearity in the structural model that needs a careful examination to ensure the stability of the path coefficient estimates even in the face of reported discriminant validity (HAIR, 2014).

3.3.2. Direct Hypothesis Testing Results

This section explores the direct causal routes between the latent constructs hypothesized after identifying the foundational associations thru bivariate correlation (SARSTEDT et al., 2023; HAIR et al., 2021). SEM does not only involve simple correlations, it evaluates the potential of each independent variable to uniquely predict the dependent variable, while controlling for the effect of all other constructs in the model. This multi-variate approach is key to identify specific function of each feature on boosting Supply Chain Competitiveness (SCC). The study, by taking these factors into account, presents a more sophisticated and accurate image than correlation analysis alone, and can contribute to the exclusion of spurious connections and provide a clearer picture of direct relationships (SARSTEDT et al., 2021). Table 10 shows the results of direct hypothesis testing.

Table 10: Relationship between Studied Variables

Hypothesis	Path Relationship	Std. Estimate (β)	p-value	Supported?
H1	ISA $\rightarrow$ SCC	0.604	< 0.001	YES
H2	DC $\rightarrow$ SCC	0.261	< 0.001	YES
H3	ISS $\rightarrow$ SCC	0.282	< 0.001	YES
H4	RBV $\rightarrow$ SCC	0.009	0.868	NO
H5	KPIE $\rightarrow$ SCC	0.044	0.476	NO

(Source: Developed by Author)

Hypothesis 1 proposed that the adoption of information systems (ISA) would have a direct effect on SCC. The research provides a strong support to this hypothesis ($\beta = 0.604$, $p < 0.001$) and this path coefficient is the strongest in the model, which means that ISA is the most dominant

direct driver of competitiveness. The implication of this study is that for the enterprises in the food supply chain in Jordan, investments in core information technology are immediately transformed into improved supply chain competitiveness. These technologies provide the visibility, coordination and efficiency required to succeed in a fast-paced market (BELHADI et al., 2024). Hypothesis 2. The favorable effect of a firm's dynamic capacities (DC) on competitiveness is hypothesized. This hypothesis was also confirmed ($\beta = 0.261$, $p < 0.001$). But the effect is lower than with ISA and highly significant, indicating that technology alone is not enough. This result suggests that success is the result of a mix between technology tools and management agility, and that DC are crucial for transforming digital investments into real competitive results (VIAL, 2021). The results ($\beta = 0.282$, $p < 0.001$) in figure 12 confirm this. Hypothesis 3 anticipated that the use of information systems for sustainability (ISS) would enhance competitiveness. In practical terms this means that adopting IS to track and reduce carbon emissions for logistics, reduce food waste thru improved forecasting, or ensure ethical sourcing thru traceability systems immediately leads to a stronger market position. Improved performance is essentially linked to supply chain transparency and sustainability activities, as customers and business partners increasingly adopt environmentally friendly procedures and obtain competitive advantage (DUBEY et al., 2019).

Hypothesis 4 argued that having valuable and rare resources (RBV), would have a direct positive effect on competitiveness. However, the analysis did not find significant support for this path ($\beta = 0.009$, $p = 0.868$). This is a crucial finding which indicates that in the constantly changing context of Jordan's food supply chain, simply owning resources does not guaranty a competitive advantage. The lack of a significant effect indicates that static resources may become commoditized or obsolete if not actively managed and reconfigured. This observation provides empirical support for the theoretical critique that the traditional RBV may not be sufficient in highly volatile environments, in which the ability to change and adapt is more important than the resource portfolio itself (ELLSTRÖM et al., 2022). Hypothesis 5 proposed a direct positive effect of key performance indicators (KPI) on competitiveness. This was not supported ($\beta = 0.044$, $p = 0.476$) indicating that measuring performance indicators is a basic management task but not a direct driver of competitiveness. KPIs are often used as diagnostic tools for measuring outcomes but not a strategic capability that gives an advantage. The non-significant result suggests that KPIE may be a supporting mechanism that enables other capabilities not a direct driver. This is consistent

with the view that performance measurement systems provide the data for decision making, but the competitive advantage is from the actions taken based on that data (GUNASEKARAN et al., 2015). To assess whether multicollinearity suppressed the non-significant paths, variance inflation factors (VIF) were computed for the five predictors of competitiveness; all values ranged from 1.69 to 2.92, well below the conventional threshold of 5, indicating that multicollinearity is not a concern. The near-zero direct effects of RBV and KPIE therefore reflect a genuine absence of unique direct contribution rather than a statistical artefact. The possibility that these non-significant paths reflect statistical suppression among correlated predictors was tested and not supported: the variance inflation factors are well below the conventional threshold. The near-zero direct effects therefore reinforce, rather than undermine, the interpretation above — that resource holdings and performance-measurement effectiveness operate through the dynamic capabilities that deploy them rather than affecting competitiveness directly.

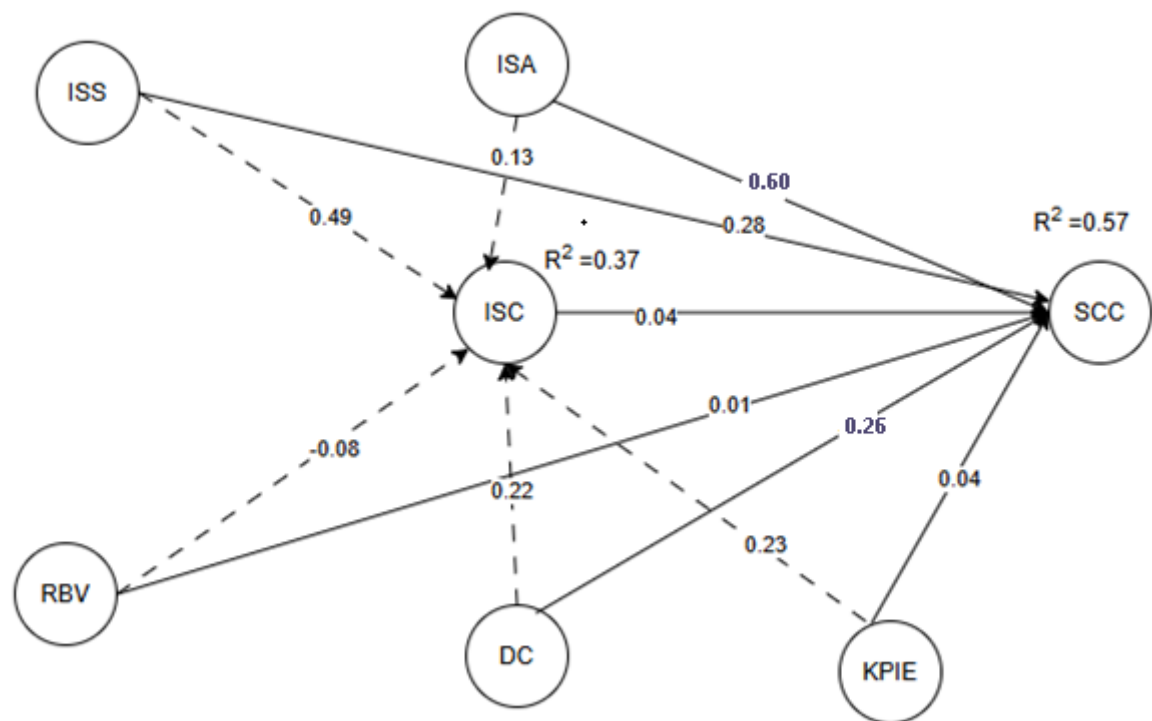


Figure 12: Structural Model with Path Coefficients and R-squared Values

(Source: Developed by Author)

To summarize, the model explains 57% of the variance in Supply Chain Competitiveness ($R^2 = 0.57$), which is considered as a substantial level of explanatory power in this field of research

(GÖLGECI & KUIVALAINEN, 2020). The results clearly show that competitiveness is driven by a combination of digital infrastructure (ISA), organizational agility (DC) and sustainable business practices (ISS), while the static possession of resources (RBV) and measurement systems (KPIE) do not exert a significant direct influence.

3.3.3. Mediation Analysis Results

This section examines the proposed mediating role of Information System Challenges (ISC) as outlined in Hypothesis H6. A mediation analysis tests whether the effect of an independent variable on a dependent variable (SCC) is transmitted through a third, mediating variable (ISC). In this study, it's investigated whether the various IS constructs influence supply chain competitiveness indirectly by first increasing or decreasing the perceived level of IS challenges. For assessing indirect effects, the bootstrapping procedure has been conducted as recommended by HAYES (2017), where this method is preferred as it does not rely on the assumption of normal sampling distributions, providing more robust confidence intervals for the indirect effect. The results of this analysis are presented in Table 11.

Table 11: Results of Mediation Analysis Bootstrapping

Indirect Path	Total Effect	Direct Effect	Indirect Effect	95% CI (Lower)	95% CI (Upper)	Result
ISA → ISC → SCC	0.609**	0.604**	0.005	-0.021	0.032	No Mediation
DC → ISC → SCC	0.269**	0.261**	0.008	-0.015	0.034	No Mediation
ISS → ISC → SCC	0.301**	0.282**	0.019	-0.008	0.051	No Mediation
RBV → ISC → SCC	0.006	0.009	-0.003	-0.033	0.019	No Mediation

KPIE → ISC → SCC	0.053	0.044	0.009	-0.021	0.041	No Mediation
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(Source: Developed by Author)

The results consistently demonstrate that the indirect effects are non-significant for all hypothesized paths. This is because the bootstrap confidence intervals (CI) for each indirect effect include zero (PREACHER & HAYES, 2004). As these intervals cross zero, it cannot be concluded that the indirect effect is different from zero and therefore mediation is not established. Therefore, hypothesis 6 (H6) is not supported. The findings indicate that ISC do not act as a significant mediating mechanism through which the other constructs influence SCC. This means that the powerful direct effects of ISA, DC, and ISS on SCC, reported in the previous section, are not meaningfully explained or channeled through the level of IS challenges faced by an organization.

This finding implies that the IS-driven capabilities-competitiveness relationship is strong in the food supply chain of Jordan. The positive effect of adopting new technologies, building dynamic capabilities and pursuing sustainability initiatives is not significantly weakened or enhanced by the challenges encountered during their implementation. Organizations seem to achieve competitiveness despite the challenges they face, suggesting a certain level of resilience or effective challenge management that disentangles the experience of challenges from the ultimate performance outcome. Thus, the digital transformation is perceived as manageable barriers to overcome rather than deterministic factors that determine success or failure (WONG et al., 2020).

In this chapter, the empirical findings of the study that investigated the factors affecting supply chain competitiveness in the food industry in Jordan were presented. The analysis began with descriptive statistics that depicted a sample of mainly young and highly educated professionals working for a diverse range of local and international companies, with a large proportion from logistics, manufacturing and distribution sectors. The assessment of the measurement model confirmed the reliability, convergent validity and discriminant validity of all constructs and the overall model showed acceptable fit indices. The analysis of the structural model provided strong evidence in support of the significant direct effects of Information Systems Adoption, Dynamic Capabilities and IS-enabled Sustainability on Supply Chain Competitiveness.

However, the hypotheses on the direct effects of the Resource-Based View and Key Performance Indicator Effectiveness were not supported. Finally, the mediating analysis showed that Information System Challenges do not constitute a significant mediating mechanism between the other constructs and competitiveness. Overall, these results provide a solid empirical foundation to discuss their theoretical and practical implications in the next chapter.

4. CONCLUSIONS AND RECOMMENDATIONS

This chapter examines the meaning behind the statistical relationships from the previous chapter. It explores how information systems reshape the foundations of competitiveness within Jordan's food supply chain. The analysis moves beyond confirming what the relationships are, and explains why these relationships matter for both theoretical significance and practical implications. The unique characteristics of the food supply chain create a particular relevant context for this study, as its perishability, traceability and logistics efficiency provide a meaningful field for examining how digital tools interact with organizational capabilities. This discussion aims to provide a meaningful understanding of how firms can navigate their digital transformation to achieve a durable competitive advantage.

The results of the structural equation modeling provided a clear answer to the main research question. Jordan's food supply chain's competitiveness is not driven by one factor alone but by a combination of digital infrastructure, organizational agility and strategic sustainability, each distinct and essential.

4.1. Discussion of Direct Hypotheses (H1 – H5)

H1: Information Systems Adoption has a significant positive influence on supply chain competitiveness.

The study found a very significant positive outcome for the first hypothesis that suggested Information Systems Adoption (ISA) had the greatest direct influence on Supply Chain Competitiveness (SCC) in the Jordanian food company ($\beta = 0.604$, $p < 0.001$). This conclusion highlights the role of digital infrastructure as a basis for modernizing supply chain competitive advantages within the framework of emerging markets. The strength of this relationship implies that the implementation of fundamental information systems is not only an operational enhancement but a strategic need for Jordanian firms directly increasing market domination. This can be conceptualized in several interrelated mechanisms that have been thoroughly described in a large body of literature. The adoption of integrated systems, especially Enterprise Resource

Planning (ERP), is the main enabler of the seamless data flow required to achieve end-to-end supply chain visibility, a factor that has been consistently identified as a critical performance driver, especially in complex and fragmented industries such as food and beverage (BÜYÜKÖZKAN & GÖÇER, 2018). Such visibility allows managers to follow items in real-time, which is crucial in handling perishable products and decreasing the likelihood of spoiling and stockouts, increasing reliability and cost effectiveness (TIWARI, 2021).

Also, the importance of ISA indicates a transition from classical intuition-based logistics towards data-driven decision making. This kind of process optimization can't be performed manually, but is made possible via the use of Warehouse Management Systems (WMS) and Transportation Management Systems (TMS). For example, WMS enhances the efficiency of the inventory positioning and the picking routes in the warehouses, which directly reduces the labor costs and the order cycle times (DE VASS et al., 2018), whereas TMS enables optimal route planning and load consolidation, which results in significant reductions in transportation costs (CHAN & ZHANG, 2011). These operational gains are not isolated, but together they build a strong competitive position based on lower operating costs and greater service levels. This is congruent with the resource-based perspective of the company, which has been extended to see IT assets as valuable, scarce and difficult to mimic resources that can lead to persistent competitive advantage (ALKHATIB & VALERI, 2024). In the case of Jordan, a fully functional ERP or advanced WMS can indeed act as such a strategic resource, leading to a measurable performance gap between the levels of the hierarchy.

The result corresponds to the general discussion of digital transformation claiming that digital technologies essentially redesign the paths of value creation and competition (HANELT et al., 2021). The use of IS is an essential enabler for market access and compliance in the Jordanian food supply chain, which is characterized by its need to communicate with global trade partners and to comply with the increasingly demanding international traceability standards. Systems that provide proof of origin, handling conditions and safety standards are no longer optional but are essential for participating in higher-value export markets (MONDAL et al., 2019). Moreover, the strength of the ISA-SCC relationship in this specific context may be even stronger than in developed economies, since in developing markets the baseline level of digitalization is often lower, resulting in disproportionately high returns on initial investments in core technologies

(ASHRAFI & MUELLER, 2015). This finding therefore not only confirms established theories of technology-driven advantage but also refines them by highlighting the contextual amplification of this effect in an emerging market scope. Consequently, the empirical support for H1 provides a clear and compelling narrative: for supply chain managers in Jordan's food industry, strategic investment in and commitment to information systems adoption is the most decisive step toward achieving and sustaining a competitive edge in an increasingly digital and demanding global marketplace.

H2: IS enabled dynamic capabilities positively influence supply chain competitiveness.

The analysis suggested a significant support for the effect of Dynamic Capabilities (DC) on SCC ($\beta = 0.261$, $p < 0.001$). Although this effect is not as strong as the effect of technological adoption itself, it is theoretically meaningful, and shows that the mere possession of advanced information systems does not automatically lead to superior market competitiveness. Instead, it is the organization's ability to leverage these systems to sense the changing market conditions, capture new opportunities and reconfigure resources that unlocks their potential for competitive advantage. This finding is consistent with the current understanding of DC as a meta theory of strategic change in dynamic environments, especially when considering a digital transformation (WARNER & WÄGER, 2019). For example, a company might have a sophisticated TMS, but it is the DCs that are able to quickly recalibrate delivery routes and inventory allocation in reaction to a sudden border delay or a spike in demand from a key retailer that turns this technological tool into a tangible competitive advantage (WAMBA & QUEIROZ, 2020).

The importance of this relationship can be further unpacked by looking at the micro-foundations of dynamic capabilities as they interact with information systems. IS enhances the sensing dimension by providing firms a steady flow of information on supplier performance, consumer preference and market trends, allowing them to identify shifts much earlier than they would through traditional means (MIKALEF et al., 2019). In the Jordanian context, this might involve using data analysis to sense a growing consumer preference for organic or locally sourced produce. The seizing dimension involves using resources to address the identified opportunities or threats. Integrated ERP systems simplify the allocation of financial and material resources to create

new product lines or negotiate agreements with local farmers (KARIMI & WALTER, 2015). Finally, the reconfiguring dimension is where the agility is actualized. For example, a firm's ability to reconfigure its supply network by changing transportation modes or by changing sourcing strategies depends heavily on the modularity and integration of its underlying IS architecture (BROZOVIC, 2018). This continuous cycle of sensing, seizing and reconfiguring powered by IS creates a supply chain that is not only efficient but also resilient and responsive, which are characteristics of competitiveness in the 21st century (EDWIN CHENG et al., 2022).

Moreover, this finding explains the non-significant result of the RBV (H4). It empirically shows that in a dynamic market, the ability to continuously deploy and redeploy valuable resources is more important than the static ownership of those resources. This is in line with the emerging critique that traditional RBV can be too static, and that a dynamic perspective is needed to explain competitive advantage in fast moving environments (BRINK, 2019). Hence, the beneficial effect of DC highlights a crucial managerial insight for Jordanian firms: competitive sustainability is achieved by simultaneously developing an organizational culture and structure that values adaptability, learning, and the flexible orchestration of all types of resources rather than just buying technology or accumulating assets. This requires investing in training, empowering employees, and fostering cross functional collaboration, making sure that the organization can fully leverage its technological investments to deal with the complexities and capitalize on the opportunities within the food supply chain (MIKALEF et al., 2020).

H3: IS sustainability has a significant positive impact on supply chain competitiveness.

The H3 was empirically supported ($\beta = 0.282, p < 0.001$) validating the strategic inclusion of sustainability goals in the digital transformation agendas of supply chains in emerging economies. The finding shifts the discourse from the realm of theoretical considerations to the domain of practical implications establishing Information Systems enabled Sustainability (ISS) as a quantifiable driver of competitive advantage in the Jordanian food sector. The positive and significant path coefficient indicates that sustainability becomes a value creating strategic imperative (WONG & ZHOU, 2015) when digitally facilitated and amplified, rather than a cost-centric compliance activity. This is in line with the fundamental premise of the Natural Resource-

Based View (NRBV) that proactive environmental strategies can be a source of competitive differentiation (ANDERSÉN, 2021) which has been empirically validated in further studies that link green supply chain practices to improved performance (BUI et al., 2021). IS are the critical enablers in today's digital age to operationalize these strategies, providing the data visibility, analytical power, and process control to translate sustainability goals into tangible results (AKBARI & HOPKINS, 2022).

ISS drive competitiveness can be analyzed in several interrelated pathways. First, ISS directly enhance operational efficiency and cost leadership by facilitating a more accurate management of resources. IoT-enabled monitoring systems in logistics and warehousing provide real-time surveillance of fuel and energy use as well as the condition of perishable commodities resulting in measures that decrease waste and maximize the use of resources (SUNNY et al., 2020). This is especially pertinent in the food business, where spoiling is a significant economic and environmental burden. Moreover, analytics and AI-based demand forecasting models help in reducing overproduction and wasteful inventory management resulting in more ecologically sustainable and lean operation which also turns out to be cost effective (WOSCHANK et al., 2020). This dual ecological and economic gain is an example of the notion of Circular Economy Efficiency where less environmental impact is balanced with higher financial performance (CENTOBELLI et al., 2020).

Secondly, IS-enabled sustainability (ISS) contributes to competitiveness not only through sustainability itself, but also through a distinct but related benefit – resilience, the capacity to absorb and recover from disruption. Although resilience is conceptually separate from sustainability, it is supported by the same IS-enabled visibility and monitoring practices. In an environment of increasing regulation and volatile input prices, digital sustainability tools are an important form of protection. Blockchain offers immutable records to prove ethical sourcing and provenance, thereby mitigating reputational risks and guaranteeing compliance with rigorous international standards (KOUHIZADEH et al., 2021). This instantly builds confidence with a new generation of partners and customers who require transparency to enter the market and secure long-term loyalty (YADAV et al., 2020). The capability to reliably substantiate sustainability claims digitally generates a powerful, intangible type of green legitimacy that protects businesses from regulatory shocks and market volatility (TASHMAN et al., 2019).

Finally, the significant effect of ISS points to its role in driving strategic innovation and revenue growth, moving beyond cost and risk to active value creation. Companies that lead in ISS are often better positioned to develop new, sustainable products and services or to access premium market segments that are inaccessible to their less sustainable competitors (LÜDEKE-FREUND et al., 2019). The data gathered from sustainability focused IS can reveal insights into new circular economy business models, which separate revenue from resource consumption (HENRY et al., 2020). With the adoption of digital capabilities, this strategic positioning allows firms to escape the commoditization trap and compete on value propositions that meet modern market demands (BOCKEN et al., 2019). Thus, H3's support indicates that investing in IS for sustainability is a multifaceted strategic investment for Jordanian food supply chain firms. It simultaneously drives operational excellence, builds resilient market positions, and unlocks innovative growth opportunities, creating a solid and durable foundation for competitiveness in the modern market (SILVESTRE & ÎRCĂ, 2019).

H4: Resource-Based Views (RBV) have a significant and positive effect on supply chain competitiveness.

The empirical analysis result seems to contradict the traditional strategic management paradigm, as the hypothesis that RBV has a positive effect on SCC was not supported. The path coefficient was negligible and not statistically significant ($\beta = 0.009$, $p = 0.868$). This seemingly abnormal finding provides a deep and critically important insight into the evolving nature of competitive advantage in dynamic, emerging market settings such as the Jordanian food supply chain. It strongly suggests that the ownership of valuable, rare and inimitable resources is not, per se, a sufficient condition to guarantee superior supply chain performance in the current business environment. This directly challenges the static core of the traditional RBV, which has been criticized for its inability to explain competitive advantage in dynamic markets, where the capacity to re-configure resources often matters more than the value of the resource stock itself (SALVATO & VASSOLLO, 2018). The results strongly encourage scholarly re-evaluation of the RBV's applicability in environments characterized by volatility, rapid technological change, and intense competition, such as the Jordanian food supply chain, where static resources can be portrayed obsolete or their value neutralized by the agile actions of competitors (WILDEN & GUDERGAN, 2015).

This finding can be explained and contextualized through previous literature that have sought to refine the classical RBV. According to the Dynamic Capabilities View (DCV), a firm's ability to seize, sense, and reconfigure its resource base is a more powerful source of sustained advantage in high velocity markets than the resource portfolio itself. This finding primarily offers strong empirical support for the core argument of the Dynamic Capabilities View (DCV) (SCHILKE et al., 2018). The Jordanian food sector, subject to fluctuating import/export regulations, seasonal variations, shifting consumer preferences, and geopolitical instabilities, which is a perfect example of such high velocity environment. In this context, a firm might possess a superior resource, such as an exclusive import license for a key ingredient. But the value of that static resource diminishes rapidly if it cannot restructure its supplier relationships and activities swiftly when that license is threatened or a replacement ingredient becomes available. This hierarchy of capacities is clearly illustrated by the importance of DC (H2) and the non-significance of RBV in this model, with dynamic orchestration breathing life and meaning into static resources (FELIN & POWELL, 2016).

Additionally, the nonsignificant RBV result also is consistent with the rapidly developing critique of resource interchangeability and the embedded resources conundrum. Studies have shown that resources can be a source of constraint, locking organizations into old business models and limiting the very innovation needed for future competitiveness (STEINER et al., 2017). Additionally, the results align with the concept of combinative capabilities, which argues that the resources' worth is not natural but rather developed from their creative and efficient combination with other resources and capabilities (HORVAT et al., 2019). Information technology is frequently the critical combining component in the digital age. For example, only when a transportation management is integrated with a fleet of vehicles and has the dynamic ability to use its data for real-time improvement can it become strategically effective. The RBV, in its pure form, may fail to adequately account for these critical, value creating interactions between different asset types.

The context of an emerging economy like Jordan adds another layer of explanation. In this type of markets, numerous firms can have similar bundles of generic, tangible resources, resulting in a competitive convergence situation, where no single firm can benefit from them over the long-term (ZAHRA et al., 2023). The basis of competition then shifts from, who has the resources to, who does the most intelligent and agile things with them. This is further compounded by the fact

that in globalized supply chains, many physical resources are increasingly standardized and accessible through logistics service providers, thereby diminishing their potential as a source of rare and inimitable advantage (YANG & LIRN, 2017). Consequently, the position of competitiveness migrates from the ownership of assets to the design and execution of superior, digitally enabled processes and the organizational structures that support rapid learning and adaptation (NYAMEBOAME & HADDUD, 2017). Therefore, the rejection of H4 is not disproof of the importance of resources, but rather a powerful empirical indication that the classical, static RBV provides an incomplete and potentially misleading picture of the drivers of supply chain competitiveness in today's market. It underscores a critical strategic imperative for managers in Jordan, where the focus must shift from asset accumulation to capability building, from hoarding resources to smoothly managing them in pursuit of transient, but renewable, market opportunities.

H5: Effectiveness of Key Performance Indicators has a significant and positive effect on supply chain competitiveness.

The statistical analysis showed that there is no significant relationship between the Key Performance Indicator Effectiveness (KPIE) and SCC ($\beta = 0.044$; $p = 0.476$). Therefore, Hypothesis H5 is not supported. This finding opens an interesting issue for future research. Why does the purported efficacy of performance monitoring systems not translate into a more robust competitive position in the food supply chain? This finding challenges the assumptions about the role of performance measurement and points to a more complex theoretical explanation about the mediation between measurement and action, the potential for strategic misalignment, and the qualitative aspects of performance management systems beyond simple metric tracking (GAWANKAR et al., 2020). The insignificance of this path does not mean that performance measurement is of no importance, but that KPIE is a fundamental, enabling factor, the value of which is determined by its integration with strategic processes and dynamic capabilities, rather than being an independent driver of competitive outcomes (MIO et al., 2022).

There is one big reason for this conclusion, and that is the big difference between measuring performance and controlling performance. Even when a firm has very effective KPIs that properly track measurements, it may not increase its competitiveness if the organization does not have the managerial skills or dynamic capacity to act on the insights acquired (BOURNE et al., 2018). This

fits nicely with the concept of performance measurement use that establishes a distinction between diagnostic and interactive use. As regards the food supply chain of Jordan, KPI systems may be mostly used as diagnostic tools that give a view of the performance but do not effectively promote the organizational learning and process innovation needed for competitiveness. The data is showing what is happening, but the competitive advantage is based on how the organization reacts, a function of its dynamic capabilities as backed by H2 (PEZESHKAN et al., 2016).

Furthermore, the nature of the KPIs themselves may be a significant factor. Traditional supply chain measurements are predominantly grounded on internal operational efficiency and unlikely to capture wider strategic drivers of competitiveness such as supply chain resilience, sustainability and customer co-creation (NOVITASARI & AGUSTIA, 2021). The KPI framework employed by Jordanian enterprises to monitor internal operations will not correlate with external market success unless it is strategically aligned with the modern factors of competitiveness in a globalized food industry. This reflects the principle of performance measurement alignment, which asserts that metrics must be derived from and linked to the strategic priorities of the firm to have a meaningful impact on performance (SAUNILA, 2016). For instance, focus on cost centric KPI, may unintentionally jeopardize investments in quality, traceability, or responsiveness that are increasingly valued by international partners and consumers (MADITATI et al., 2018). Thus, the effectiveness of a misaligned measurement system is unlikely to yield a competitive stance.

The non-significant result also invites another side of performance measurement systems. An overly aggressive or poorly designed KPI scheme can produce unintended negative consequences, where employees optimize for the metric rather than the strategic objective (MARTYN, 2016). As a complex, interdependent system, optimizing one KPI in isolation can create a negative impact on other KPIs, thereby nullifying any net competitive advantage. This systemic thinking perspective is often lacking in traditional performance management, and the absence thereof can decouple measured efficiency from real world effectiveness (GOSHU & KITAW, 2017). Effective KPIs alone provide only a basic level of control, while the real competitive advantage is created when these metrics are embedded in an advanced performance management culture that provides for continuous improvement, cross functional collaboration, and strategic adaptation (OKWIR et al., 2018). The rejection of H5 is an important reminder that the quality of managerial processes and strategic alignment around performance data are more

important in determining supply chain competitiveness than the technical excellence of the measurement system itself.

4.2. Discussion of Mediation (H6)

H6: Information systems challenge significantly mediate the relationship between IS constructs and supply chain competitiveness.

The bootstrap examination of the mediation hypothesis (H6) resulted in a uniform nonsignificant result indicating that Information System Challenges (ISC) do not operate as a mediating mechanism between the independent constructs nor SCC. Confidence intervals comprised 0 for all direct paths investigated and indirect impacts were small in magnitude. This complete absence of mediation is a theoretically rich, paradoxical result that pushes us to go beyond naïve barrier models of technology implementation. It claims that within the Jordanian food supply chain, the difficulties of implementing and integrating new information systems are not a critical determinant in the translation of other strategic IS enabled capabilities into competitive advantage. Instead, this finding suggests a more complex organizational reality whereby firms have achieved a certain level of resilience of implementation and/or the direct drivers of competitiveness are so strong that the constraining power of these challenges is neutralized at a strategic level (KOHTAMÄKI et al., 2019).

This outcome can be powerfully interpreted in terms of organizational resilience and absorption of operational friction. Strategically mature organizations have strong coping mechanisms and bypass procedures so that IS frictions do not impact strategic objectives, even when the IS frictions are substantial and tangible at the operational level (DUCHEK, 2020). This mindset shifts the issues from insurmountable barriers to hurdles to be overcome. For instance, a company with strong dynamic capabilities can coordinate external partners, retrain employees or use a phased approach so as to minimize the effects of large technical integration problems to realize the competitive advantages of the systems (DUBEY et al., 2024). This idea of problems being absorbed by other, more powerful organizational capacities was highly supported, as ISA, DC and ISS had large direct effects on SCC even when ISC was present. This is in line with the

idea of resourcefulness in the resilience literature, where the ability to adapt and problem solve when confronted with adversity is an important capability in itself (AL-AYED, 2019).

Furthermore, the nonsignificant mediation forces re-evaluation of the nature of the challenges themselves. It is plausible that the challenges measured, is perceived as normal costs of doing business in a developing economy and are thus, factored into strategic expectations and financial calculations (KHIN & HO, 2019). The psychological and strategic impact of challenges as a mediating variable is reduced when they are planned and budgeted for, both financially and in terms of managerial attention. Instead, they are incorporated in the implementation context rather than a variable that determines its future success or failure (ALNUAIMI et al., 2022). Several research studies on the adoption of technology in emerging markets support this view. These studies show that companies have a high threshold for operational friction and instead stress the strategic need for digitalization to ensure survival and growth (PLEKCHANOV et al., 202). The perceived burden of these implementation challenges may simply be overshadowed by the ambition to compete in a globalized market.

Additionally, the results also contribute to the discussion on the IS challenge dilemma, showing that a higher number of reported challenges might in some cases be an indicator of an audacious digital transformation and not necessarily a failure. Highly competitive organizations pushing the limits of technology adoption are more likely to face more complex and new challenges than their less ambitious competitors (DWIVEDI et al., 2022). Therefore, a positive correlation between a driver such as ISS and ISC may suggest that firms pursuing advanced sustainability objectives are struggling with the challenges of placing traceability or analytics systems in place. In this scenario, the challenges are a symptom of progress, not a barrier to it, which would explain their lack of a negative mediating effect (BENITEZ et al., 2018). Ultimately the rejection of H6 offers a crucial strategic insight: managers and policymakers should prioritize developing organizational resilience, dynamic capabilities, and strategic commitment to allow a firm to pursue its digital transformation goals despite the inevitable challenges (LOKUGE et al., 2019). The competitive differentiation lies not in a challenge free environment, rather in the organization's capacity to preserve and adapt through them. Table 12 portrays the summary of hypothesis testing results.

Table 12: Summary of Hypothesis Testing Results

Hypothesis	Accepted or rejected
H1: Information Systems Adoption has a significant positive influence on supply chain competitiveness.	Supported
H2: IS enabled dynamic capabilities positively influence supply chain competitiveness.	Supported
H3: IS sustainability has a significant positive impact on supply chain competitiveness.	Supported
H4: Resource-Based Views (RBV) have a significant and positive effect on supply chain competitiveness.	Rejected
H5: Effectiveness of Key Performance Indicators has a significant and positive effect on supply chain competitiveness.	Rejected
H6: Information systems challenge significantly mediate the relationship between IS constructs and supply chain competitiveness.	Rejected

(Source: Developed by Author)

5. MAIN CONCLUSIONS AND NOVEL FINDINGS OF THE DISSERTATION

This study set out to investigate the determinants of supply chain competitiveness within Jordan's food industry, with a specific focus on the role of information systems in shaping this competitiveness. The research was centered on structural equation modeling (SEM), to construct and validate a model that tested the influence of key factors including Information Systems Adoption (ISA), Dynamic Capabilities (DC), IS-enabled Sustainability (ISS), Resource-based View (RBV), and KPI effectiveness (KPIE), while also evaluating the potential mediating role of IS challenges (ISC). The findings of this research offer insights that contribute to both academic research and managerial practice.

Information systems adoption has been shown to have the most effective on supply chain competitiveness (SCC) among the identified group of drivers. This finding highlights an important change in strategic thinking, as ERP and WMS are now viewed as the fundamental bases of competitive supply chain rather than just as operational improvements. This digital infrastructure offers the necessary visibility, coordination, and data driven control required to compete on efficiency, cost, and reliability in the Jordanian food sector, which is distinguished by its logistical complexities and perishable goods. In addition, the study established Dynamic Capabilities as another strategic driver. The significant positive effect of DC demonstrates that technology alone is not enough. Where its competitiveness is derived from a firm's organizational and managerial capacity to take advantage of its digital tools, by sensing market shifts through data analytics or seize opportunities through agile decision making. It also confirms the most important competitive differentiator in the dynamic Jordanian food supply chain is not the software's static resource but rather the organizational ability to strategically transform data into a competitive advantage.

Furthermore, the significant positive effect of IS sustainability demonstrates that employing digital tools for environmental and social governance is a direct driver of competitiveness. Firms that use systems to track carbon footprints ensure traceability and minimizes wastes, which simultaneously cuts costs, mitigates risks, and builds the trust required

to access global markets. In today's global economy, sustainability when powered by IS, is a source of tangible competitive value.

The lack of a significant direct effect from the resource-based view (RBV), suggests that in the dynamic reality of today's market solely owning valuable resources is not enough. These resources are powerless without the dynamic capabilities to constantly equip and reconfigure them effectively. The advantage lies not in what you own, but in how intelligently it is used. Similarly, the finding of KPI Effectiveness (KPIE) shows that it does not directly drive competitiveness. It shows that performance measurement systems are diagnostic and not generative. They are measurements that shed light to problems and opportunities, but they are not what creates improvement. Competitiveness is driven by the managerial actions and strategic decisions influenced by that specific data set, also emphasizing the important role of DC. Another interesting result was the complete lack of mediation by ISC. This indicates that challenges such as high costs, technical problems, and lack of skill do not have to determine a project's ultimate success. For firms with strong direct capabilities and strategic commitment, these challenges become manageable obstacles rather than barriers. This concept teaches managers a critical lesson, where implementation should not be about avoiding risks but about proving your organization's resilience.

The research employed a methodological approach centered on Structural Equation Modelling (SEM) to test the proposed theoretical framework. The analysis began with Confirmatory Factor Analysis (CFA) to first establish the validity and reliability of the measurement model, making sure that the constructs are accurately defined within the intended model. Following this validation, SEM was used to examine the structural relationships within the model, providing a powerful and comprehensive assessment of the interconnections between ISA, DC, ISS, and their collective impact on SCC. The focus on firms within Jordan's food supply chain, may not be fully generalizable to other nation economies or industrial sectors with different characteristics. Furthermore, the cross-sectional nature of the data, cannot definitely account for changes over time nor establish casual links. These limitations, provide a clear path for future research, while keeping the validity of the findings within this project's context.

Finally, this study demonstrates that achieving supply chain competitiveness in a market like Jordan's, requires a focus on digital infrastructure, organizational agility and strategic sustainability. It provides managers with a clear, evidence-based mandate to invest not only in technology but in the human and strategic capacities. For policymakers, the findings underscore the importance of fostering an ecosystem that supports both digital adoption and sustainable business practices. By supporting these relationships, this research contributes an actionable framework for building supply chains that are not only efficient and competitive, but also resilient and prepared to meet the complex demands of globalized economy.

5.1. Research Contribution

5.1.1. Theoretical Contribution

The study's central novel contribution is empirical evidence that, in an emerging-economy food supply chain, information systems adoption and the dynamic capabilities that deploy it — rather than resource holdings or formal KPI use — are the decisive drivers of supply chain competitiveness. This research makes several contributions to the intersecting theoretical domains of Information System, Supply Chain Management and Competitiveness, and Strategic Management. The empirical findings from the Jordanian food supply chain context challenge established paradigms and offer subtle refinements, as detailed below.

The Dominance of Information Systems in Emerging Markets

This research redefines the strategic role of information systems from a supportive infrastructure to a primary strategic driver of supply chain competitiveness within an emerging market. The direct effect of IS Adoption (ISA) in developing economies is the use of digital technology as a foundation block for modern competitive supply chains as well as a tool for efficiency. The use of integrated systems like ERP and WMS provides firms a revolutionary competitive advantage in a country like Jordan where out-dated technology may still be in use and the potential for technological bypassing is high. These technologies are not only tools for the optimization of current processes, rather they establish the base on which modern transparent and efficient supply chain operations are built.

Integrating Sustainability as a Core Strategic Driver

The study is a strong integration of Green IS literature into the mainstream supply chain strategy. The positive and significant impact of ISS shows that the application of digital instruments for environmental and social governance is not a secondary activity, but a direct source of market benefit. Practically, it means that the investments in traceability systems, carbon footprint monitoring, and waste reduction are no longer just about risk management or corporate obligations. They are strategic investments to improve operational efficiency, build strong brand image and access premium markets with strict sustainability requirements. This finding confirms that sustainability achieved by means of information technology is intrinsically linked with competitiveness and is a key component of a modern and resilient business model. It embeds the principles of Green IS into the core of strategic supply chain theory.

Redefining the Strategic Hierarchy of Capabilities

This study empirically addresses the relative importance of having resources and deploying them effectively. The results suggest that Dynamic Capabilities (DC) are a critical meta-capability in governing the effectiveness of the Resource-Based View in the volatile context of an emerging market supply chain. While RBV posits that valuable, rare, and inimitable resources are the primary source of sustained advantage, the results reveal a more complex hierarchy. The significant positive influence of DC on supply chain competitiveness, compared with the nonsignificant negligible effect of RBV, indicates that the static possession of resources is an insufficient condition for competitive success in a dynamic environment. Instead, the firm's fundamental ability to continuously detect changes in the market, seize opportunities through agile decision making, and most importantly to redesign its existing resource base to maintain alignment with a dynamic market is where competitive advantage is primarily located. This does not portray the RBV to be fruitless, rather it includes it within a more dynamic framework. It suggests that resources are the necessary raw materials, but DC are the essential engines that transform these materials into a sustained competitive output. This strategic hierarchy recalibration offers a more powerful lens which to see the performance drivers in the fast paced, digitally driven world of modern global supply chains.

The Core Triad of Digital Supply Chain Competitiveness

This research consolidates its empirical findings to propose an alternative integrative model that identifies a core triad of capabilities, necessary for competitiveness in emerging market supply chains. The triad includes Digital Infrastructure (Information System Adoption) as the underlying layer, Organizations Agility (Dynamic capabilities) as the critical mediation capability, and Strategic Sustainability (Information System Sustainability) as the crucial strategic orientation. The model shows that competitiveness is a result of the effective interaction of these elements, and not due to any single factor. Technology provides the data and connectivity; agility enables strategic reconfiguration in response to this data and sustainability focus ensures that this reconfiguration is in line with long term value creation and market access. This framework provides managers and scholars with a clear roadmap for prioritizing strategic investments in this digital era, offering a more practical alternative for complex, resource heavy models.

The Concept of Challenge Absorption in IS Implementation

In this research, we offer a theoretical refinement to the theory of technology adoption by showing that Information System Challenges (ISC) need not mediate competitive performance. The nonsignificant mediation results indicate a decoupling effect in the sense that the strategic success or failure of digital initiatives is not solely determined by the presence of implementational challenges. This indicates the possibility that organizations can create the ability to absorb, minimize or eliminate obstacles with strong direct capabilities determined strategic execution. This finding provides new theoretical avenues to understand how organizations effectively manage the inevitable friction of digital transformation while staying competitive in the market.

The Diagnostic Nature of Performance Measurement

The study highlights an important theoretical distinction in performance management, showing that the effectiveness of Key Performance Indicators (KPIs) is an advanced diagnostic tool rather than a competitive advantage. Competitiveness is not an automatic output of measurements, but is instead produced by the organizational dynamics that the measurements inform. As a result, whereas KPI efficacy is a required but insufficient prerequisite for

competitiveness, it is the quality of the managerial response to that data that ultimately determines competitive outcomes.

5.1.2 Practical Implications

The findings of this study provide practical insights to different stakeholders in the Jordanian food supply chain. The empirical findings are translated into strategic guidance where policymakers, industry leaders, and other stakeholders have a clear roadmap for enhancing competitiveness.

For Supply Chain Managers and Logistics Professional:

The results necessitate a change in operational priorities. The organization should invest in and successfully implement integrated information systems like ERP and WMS as core strategic investments rather than as IT projects. These systems are no longer optional for achieving competitiveness. Second, to move beyond a passive role of system operation and actively manage dynamic capabilities. This involves forming cross functional teams capable of utilizing IS data to sense market changes, seize opportunities through rapid logistical reconfiguration, and transform challenges into opportunities. Finally, using these systems to drive sustainability initiatives that impact the bottom-line, like food waste through data-analytics.

For Senior Executives and Strategic Decision Makers:

At the strategic level, this research provides guidance for resource allocation and strategic planning. The organization's investment strategy must be redesigned to focus on growing the digital and human capital which enhance organizational agility rather than just acquiring physical assets. Budgeting must prioritize not only the owning of new technologies but also the investment in training and change management programs that develop the effective use of dynamic capabilities. Furthermore, the organization should reframe corporate sustainability from public relations to a core competitive strategy. Recognizing the importance of traceability and carbon footprint monitoring systems in gaining access to premium markets and establishing long-term value and reputation. The lack of IS challenges to mediation should enable the organization to move forward with digital transformation with the assurance that good leadership and strategy can overcome any implementation challenges.

For Policymakers and Government Agencies:

Policy interferences need to adapt to improve the national competitiveness of the food supply chain. Investing in design programs helps encourage the development of dynamic capabilities and implementation resilience, more than just investing in hardware or software purchases. This includes funding for managerial training in digital supply chain management, creating platforms for knowledge sharing and developing industry specific standards for digital integration that reduce technical integration challenges. Acknowledging the strategic significance of ISS, policymakers should speed up the creation of a national digital traceability infrastructure and provide incentives to companies that can demonstrate their use of IS to reduce their environmental footprint. It provides a space for sustainable and digitally progressive companies to thrive, where regulatory goals can be balanced with competitive pressures. Policymakers can also help shield the national economy's performance from the inevitable disruptions of international commerce by focusing on developing a resilient and agile supply chain ecosystem.

5.2. Limitations and Future Research

5.2.1. Limitations of the Study

When interpreting the results, several limitations of the study design should be taken into account. Firstly, the sample size limits the generalizability of the results. The sample was selected non-probabilistically, and is biased towards larger and more digitally mature firms (Section 3.1), which limits the generalizability of the findings to smaller or less digitized firms, although a sample size of 200 respondents is statistically adequate. Secondly, cross-sectional data collection was used to capture a specific point in time. Hence, the cross-sectional approach only provides a snapshot of a given geographic area, and hence the results may not be representative of the dynamics of supply chains in other locations, industries or socioeconomic conditions. The study is limited to the economic and regulatory framework of the food industry in Jordan, which may limit the applicability of the findings to other contexts.

Also, the data collection approach used has the potential of introducing biases that may affect the validity of the findings. All constructs were assessed using self-reported scales provided by individual respondents. This reliance on single source, self-reported data may create a risk of

common method bias, where the measurement technique itself may affect the observed relationships. Simultaneously, it opens the door to social desirability bias, as participants may have unintentionally or deliberately misrepresented their firm's actual capabilities and performance levels. The questionnaire required every item to be answered before submission, so the final dataset contained no missing values; data completeness is therefore not a limitation of this study, although the reliance on self-reported, single-respondent data is addressed above. Therefore, despite the potential contributions of the study, the limitations have to be carefully taken into account in assessing the relevance and accuracy of the contributions to the field.

Despite these limitations, this study successfully establishes a validated model that captures the core methods through which information systems influence supply chain competitiveness in an emerging market context. The previously identified limitations do not invalidate the results, but rather map out a path for future research. By employing longitudinal designs, expanding the industrial and geographical scope, and including more comprehensive measurement tools for dynamic markets, these limitations should get bypassed. By addressing these restrictions, future studies will clarify the understanding of digital transformation in global supply chains.

5.2.2. Suggested Future Research

This study has successfully developed a validated model explaining the core mechanisms through which information systems affect supply chain competitiveness in an emerging market context, and at the same time, it offers directions for new avenues for future research. Future studies could extend the geographical location of their study. Cross-national studies between Jordan and other emerging economies would extend and clarify the roles of different institutional frameworks, cultural dimensions and regulatory environments on the relationships between information systems adoption, dynamic capabilities and competitive outcome. Extending the research to other industrial sectors would also test the generalizability of these outcomes and potentially reveal any industry-specific drivers. Longitudinal research designs using panel data or multiple data collection, examines supply chain competitiveness over an extended time period. They can capture any casual links, patterns, and the long-term effects of information system adoption and organizational learning, revealing how initial technology investments either enable or constrain competitiveness over time.

Improving the methodological approach is another area for enhancement for future research. Using refined statistical methods could significantly improve the accuracy of future findings. Adapting qualitative or mixed methods methodologies, could lead to an increase of the finding's accuracy and reliability, capturing the complex interrelationships between different constructs. In addition, using tangible metrics such as financial performance indicators, actual data from the company's ERP logs, or certified sustainability reports, would provide a more solid foundation for validating and extending the current model. On another note, the finding that KPI effectiveness does not directly drive competitiveness suggests the need to investigate the specific organizational processes that translate performance measurement into competitive action. Future research could identify and test the mediating variables that bridge the gap between measurement and outcomes. Similarly, the insignificant effects of RBV and KPIE point to the importance of identifying the moderating conditions under which valuable resources and performance-measurement practices translate into competitiveness, preferably with a design reducing the degree of overlap among the closely related predictors to better identify their unique effects. Longitudinal and mixed-methods extensions would further address the cross-sectional and single-respondent limitations.

Looking beyond the firm itself, a crucial area for future work involves examining how the broader political and regulatory environment shapes digital transformation. It's a must to understand how specific government actions either fuel or block a company's ability to build competitive digitally driven supply chains. Comparing these policy approaches across different countries could reveal which strategies most effectively encourage the growth of dynamic capabilities and system integration. At the same time, the tracking of how new technologies like AI and blockchain are affecting the competitiveness, creating new opportunities to boost both the efficiency and resilience of supply chain operators.

By addressing and pursuing these limitations, scholars can build upon the foundation established in this study to develop more dynamic and comprehensive theories of digital competitiveness in supply chains. Such activities will not only enrich academic understandings, but will also provide guidance to practitioners navigating the complex interplay of technology strategy and sustainability in an increasingly digital global economy.

SUMMARY

The aim of this dissertation was to explore the key determinants of supply chain competitiveness in the food industry in Jordan with an emphasis on the role of information systems in determining this competitiveness. The research was driven by a central research question: what are the key determinants of supply chain competitiveness in the Jordanian food industry and what is the role of information systems in determining this competitiveness? To answer this question, the research proposed and tested an integrated theoretical model based on established strategic management models including the RBV and DC and the contemporary literature on green IS and supply chain performance measurement. The model considered ISA, IS-enabled DC, IS-enabled sustainability, the RBV and KPI effectiveness as potential drivers of competitiveness, but also explored whether IS challenges act as a mediating barrier or absorbable obstacle.

A quantitative research methodology was adopted to reach these objectives. Data were collected using a structured questionnaire distributed to professionals with expertise in the food supply chain in Jordan. The analysis was based on 200 valid responses. The study used a strong two-stage Structural Equation Modelling approach. First, Confirmatory Factor Analysis was performed to validate the measurement model, confirming the reliability, convergent validity and discriminant validity of all constructs using accepted metrics like Composite Reliability, Average Variance Extracted and the Fornell-Larcker criterion. Second, the structural model was estimated to test the hypothesized relationships.

Empirical results showed a distinct and strong hierarchy of drivers. Information systems adoption was the strongest direct predictor of supply chain competitiveness, setting up digital infrastructure as the required foundation upon which modern competitive supply chains are built. IS-enabled DC also had a significant positive effect, validating the idea that technology alone is not sufficient and that organizational agility in leveraging these tools is critical to translating digital investment into market advantage. IS-enabled Sustainability had a significant direct influence, setting up sustainability as a core strategic driver rather than a minor concern for compliance or corporate social responsibility.

Equally important were the non-significant findings. RBV had no direct effect on competitiveness, raising questions about the adequacy of static resource ownership in a volatile, digitally transforming market. Also, KPI Effectiveness was non-significant, indicating that performance measurement is a diagnostic tool, not a generative driver of competitive outcomes. Most critically, the mediation analysis did not reveal significant indirect effects through IS-challenges, introducing the idea of challenge absorption where firms have the resilience to nullify implementation barriers. These boundaries do not diminish the validity of its findings but rather a clear course for future work.

Collectively, these findings were synthesized into a tripartite model for emerging market competitiveness, proposing that sustainable advantage in Jordan's food supply chain is driven by the synergistic combination of digital infrastructure, organizational agility, and strategic sustainability. This framework provides a more parsimonious and applicable alternative to complex and resource-consuming models and provides managers and policymakers with a lucid strategic roadmap. The findings provide supply chain managers with a validated framework for prioritizing investment in digital technologies that directs resources towards technology adoption, agility building and sustainability integration as the three fundamental pillars of competitiveness. For senior executives, the research highlights the need to build organizational capabilities alongside technological infrastructure. For policymakers, the insights inform the design of support programs that promote implementation resilience and sustainable digital transformation in a sector critical to Jordan's economic and food security.

To summarize, the dissertation proves that triad of IS-enabled drivers, digital infrastructure, organizational agility and strategic sustainability significantly affects the competitiveness of the supply chains in the food industry of Jordan. The study empirically tests and confirms these relationships, clarifies the non-significance of static resources and performance measurement, and develops a comprehensive and contextualized model that translates the theoretical call for digitalization into a tangible strategic agenda. The findings represent a significant contribution to academic knowledge and practical supply chain management in emerging economies leading to efficient, competitive, resilient, and sustainable supply chains.

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1. Hattar, I. Z., & Felföldi, J. (2024). IMPACT OF INFORMATION SYSTEMS IN THE SUPPLY CHAIN: A SYSTEMATIC LITERATURE REVIEW. *Applied Studies in Agribusiness and Commerce*, 18(1). <https://doi.org/10.19041/APSTRACT/2024/1/3>
2. Hattar, I. Z., & Felföldi, J. (2024). APPLICATIONS OF INFORMATION SYSTEM WITHIN SUPPLY CHAIN MANAGEMENT. *Journal of Agricultural Informatics/Agrárinformatika Folyóirat*, 15(1). <https://doi.org/10.17700/jai.2024.15.1.692>
3. Hattar, I. Z., & Gál, T. (2026). Charting the Evolution of Information Systems in Supply Chain Management: A Narrative Review of three competitive eras. *Journal of Agricultural Informatics*, 17(1). <https://doi.org/10.17700/jai.2026.17.1.791>
4. Hattar, I. Z., & Gál, T. (2026). Sustainable and Competitive? The Dual-Role of Information Systems in Green Supply Chain Operations. *International Journal of Engineering and Management Sciences*, 1-15. <https://doi.org/10.21791/IJEMS.2026.10>
5. Hattar, C., Hattar, I.Z., & Al-Louh, H. (20XX). HRM at the Helm: Steering UN SDGs Toward 2030. *Journal of Management Development*, XX(X). Paper under review.

LIST OF CONFERENCES

1. Annual Doctoral School of Management and Business Doctoral Student Conference; February 11-12th 2025, University of Debrecen
2. Annual Doctoral School of Management and Business Doctoral Student Conference; May 2023, University of Debrecen
3. 6th International European Congress on Interdisciplinary Scientific Research Conference; August 26-27th 2022, Bucharest Romania

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List of Abbreviations

Supply Chain Management	SCM
Sustainable supply chain management	SSCM
Sustainable Supply Chains	SSC
Food Supply Chain	FSC
Food Supply Chain Management	FSCM
Information Systems	IS
Dynamic Capabilities	DC
Dynamic Capabilities Theory	DCT
Supply Chain Competitiveness	SCC
World Trade Organization	WTO
Enterprise Resource Planning	ERP
Electronic Data Interchange	EDI
Internet of Things	IoT
Artificial Intelligence	AI
Supply Chain	SC
Sustainable development	SD
Triple Bottom Line	TBL
Sustainable Development Goals	SDGs
Radio Frequency Identification	RFID
Information Technology	IT
Transportation Management System	TMS
Warehouse Management System	WMS
Resource-Based View	RBV
Value, Rarity, Inimitability, and Non-substitutability	VRIN
Machine Learning	ML
Key Performance Indicators	KPIs

Key Performance Indicators Effectiveness	KPIE
Information System Challenges	ISC
Information Systems Adoption	ISA
Information Systems and sustainability	ISS

APPENDIX

Questionnaire

Section 1: Personal Questions

1. Gender?
 - ☐ Male
 - ☐ Female
2. Age?
 - ☐ 18 - 24 years
 - ☐ 25 - 34 years
 - ☐ 35 - 44 years
 - ☐ 45 - 54 years
 - ☐ More than 55 Years
3. What is your education level?
 - ☐ High School
 - ☐ Bachelor's degree
 - ☐ Master's degree
 - ☐ PhD Degree

Section 2: Demographic & Firm Characteristics

4. What is the nature of the company you work for?
 - ☐ National
 - ☐ Multinational
5. What is the size of the company you work for in terms of the number of employees?
 - ☐ From 1 to 49 employees
 - ☐ From 50 to 99 employees
 - ☐ From 100 to 249 employees
 - ☐ From 250 to 499 employees
 - ☐ More than 500 employees
6. Do you hold a position/function related to sustainability, corporate sustainability, corporate social responsibility or ESG (environment, social and governance)?
 - ☐ Yes
 - ☐ No

7. What is the hierarchy of your position?
- ☐ Top level manager Manager
 - ☐ Middle Manager
 - ☐ First line Manager
 - ☐ Team Leader
 - ☐ I don't hold any leadership position
8. What is your company's primary role in the food supply chain?
- ☐ Producer/Manufacturer
 - ☐ Distributor/Wholesaler
 - ☐ Logistics Provider
 - ☐ Other (specify)

Section 3: Information Systems (IS) Adoption & Usage

9. Which of the following IS does your company use? (Multiple choice)
- ☐ ERP (Enterprise Resource Planning)
 - ☐ WMS (Warehouse Management System)
 - ☐ TMS (Transportation Management System)
 - ☐ RFID (Radio-Frequency Identification)
 - ☐ Blockchain for traceability
 - ☐ AI/ML for demand forecasting
 - ☐ Other (specify)
10. How long has your company been using IS in supply chain operations?
- ☐ <2 years
 - ☐ 2-5 years
 - ☐ >5 years

Rate your level of agreement with each statement

11. Rate the level of integration of IS across your supply chain
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
12. How frequently is real-time data from IS used for decision-making
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
13. We invest sufficiently in upgrading IS infrastructure

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

14. Our IS are customized to our supply chain needs

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

15. Employees have adequate training to use IS effectively

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

16. IS data quality is reliable for decision-making

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

17. We have dedicated IT support for supply chain IS issues

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

Section 4: Supply Chain Competitiveness

18. Our company achieves on-time deliveries efficiently

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

19. Our inventory turnover rate has improved due to IS

- a) Strongly Agree
- b) Agree

- c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
20. IS helps reduce supply chain costs
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
21. We can quickly adapt to demand fluctuations using IS
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
22. Our order accuracy has improved due to IS
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
23. IS enable faster response to customer complaints
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
24. IS help customize services for key clients
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
25. IS provides real-time alerts for potential delays
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree

Section 5: IS & sustainability

26. IS help track and reduce food waste
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
27. IS optimize energy usage in warehouses/transport
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
28. IS optimize packaging to minimize material use
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
29. We use IS to document sustainability certifications (e.g., ISO 14001).
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
30. We prefer suppliers with sustainability certifications due to IS data
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
31. IS ensure compliance with environmental regulations (e.g., Jordan's waste laws).
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree

Section 6: Resource-Based View (RBV) Factors

32. Our IT infrastructure is a competitive advantage
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
33. Competitors cannot easily replicate our IS capabilities
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
34. We have skilled personnel to manage IS
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
35. Our company invests in continuous IS training
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
36. Our IS data quality is reliable and accurate
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
37. IS data archives provide unique market insights
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree

Section 7: Dynamic Capabilities Theory (DCT) Factors

38. IS helps us identify market trends faster
- a) Strongly Agree

- b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
39. IS help us detect supply chain disruptions
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
40. IS provide real-time visibility into inventory levels
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
41. IS improve coordination with suppliers during demand spikes
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
42. We experiment with new business models (e.g., e-commerce) using IS
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
43. We quickly adjust strategies based on IS insights
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
44. Our company innovates processes using IS
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree

Section 8: Challenges & Moderating Factors

45. Cybersecurity risks delay IS investments
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
46. High implementation costs hinder IS adoption
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
47. Lack of government support affects IS usage
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
48. Resistance to change among employees slows IS adoption
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree
49. Seasonal demand fluctuations make it hard to justify permanent IS upgrades
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree

Section 9: KPI Effectiveness

50. Cost reduction achieved through operational changes
- a) Strongly Agree
 - b) Agree
 - c) Neither agree nor disagree
 - d) Disagree
 - e) Strongly Disagree

51. Revenue growth rate compared to industry benchmarks

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

52. Customer retention/churn rate as a loyalty indicator

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

53. Market share changes in core business segments

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

54. Brand recognition/awareness in target markets

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

55. On-time delivery/completion rates for key outputs

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

56. Product/service defect rates impacting quality

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

57. Employee productivity metrics (output per worker)

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

58. Process efficiency improvements (time/cost savings)

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

59. Employee retention/turnover rates

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

60. Training effectiveness (skill improvement metrics)

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

61. New product/service adoption rates

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

62. Strategic partnership/collaboration outcomes

- a) Strongly Agree
- b) Agree
- c) Neither agree nor disagree
- d) Disagree
- e) Strongly Disagree

