Arab American University
Faculty of Graduate Studies
Department of Administrative and Financial Sciences
Ph.D. Program in Strategic Management

“An Empirical Study on the Impact of Supply Chain Dynamic Capabilities on Supply Chain Resilience: The Mediating Role of Technological Innovation”

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Declaration

I declare that, except where explicit reference is made to the contribution of others, this dissertation is substantially my own work and has not been submitted for any other degree at the Arab American University or any other institution.

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Dedication

With profound gratitude and heartfelt emotion, I dedicate this dissertation to those whose love, support, and unwavering efforts have guided me after God.

To the cherished soul of my mother, who left this world but never departed from my heart. I dreamed that you would be with me in these moments. Your memory lives on in every achievement and step.

To my dear father, may God bless him, you are the steadfast lamp of my life, glowing with love, prayers, and unlimited support. Words fall short of expressing my gratitude for your presence in my life.

To my beloved children, Hams and Qais, the most precious gift in this life, your presence, love, and support fuel my determination and light my path even in the darkest hours.

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And to beloved Palestine, my homeland that embraces my dreams and hopes. To your martyrs, prisoners, and wounded, I dedicate this work with all love and loyalty, as you are the biggest dream inspiring me to strive for a brighter tomorrow.

I dedicate this humble work to all of you, as it is the fruit of your support, love, and sincere prayers!

Author: Huda Abed Al Rahman Mahmoud Takrouri

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An Empirical Study on the Impact of Supply Chain Dynamic Capabilities on Supply Chain Resilience: The Mediating Role of Technological Innovation

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Abstract

Background and Objectives: Business operations are increasingly complex and vulnerable. Climate change, political instability, and infectious diseases heighten supply chain disruptions. Intense competition, rapid IT growth, global economic acceleration, and evolving customer demands add further challenges to the organizations' performance and competitiveness. Over 70% of firms experience supply chain disruptions annually (Ali et al., 2024; Scholten et al., 2019). In light of the inherent volatility of the business environment, it is crucial to adopt a strategic approach that focuses on cultivating and enhancing dynamic capabilities within the supply chain. Furthermore, technological innovation is widely seen as a strategic approach to attaining and sustaining supply chain resilience (SCR) while also bolstering firms' profitability and competitiveness. Grounded on a Resource-Based View, Dynamic Capability, and Contingency theories, the objective of this study is to empirically examine the impact of supply chain dynamic capabilities (SCDCs) on supply chain resilience (SCR) with a particular emphasis on the potential mediating function of technological innovation (TI) on this nexus.

Method and Findings: To achieve this objective, a structured questionnaire was distributed to supply chain executives from industrial businesses in the West Bank of Palestine. The model was validated using SEM-PLS 4. Findings from 448 executives indicate a moderate level of SCR. SCDCs have a significant positive effect on TI ($\beta = 0.690$, $p \leq 0.05$) and a strong direct effect on SCR ($\beta = 0.703$, $p < .001$). SCDC also influences SCR indirectly through TI, with a total effect of (0.682), underscoring the significant role of TI in mediating the SCDC-SCR relationship. Technological innovation substantially positively affects supply chain resilience ($\beta = 0.542$, $p < .001$). Additionally, neither firm age nor size significantly influences SCR.

Recommendations, Originality, and Implications: Palestinian industrial firms should balance their investments between SCDCs and TI. Policymakers should devise and advocate strategies to bolster the integration of technological innovation for enhancing SC resilience, incentivize technological investments, promote regulatory reforms, and establish policy support that enhances trade and logistical efficiency while also alleviating resource accessibility challenges. The proposed holistic model contributes to the existing literature on SCDCs, TI, and SCR, aiding decision-makers in formulating supply chain resilience strategies through the integration of technological innovation. Future research could explore regional comparisons, sector-specific variations, and longitudinal designs, and invite additional mediators or moderators.

Keywords: Supply Chain Dynamic Capabilities (SCDC), Supply Chain Resilience (SCR), Technological Innovation (TI), Supply Chain Disruption Orientation (SCDO), Industrial Sector.

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List of Definitions of Abbreviations

Abbreviations	Title
SC	Supply Chain
SCR	Supply Chain Resilience
SCDCs	Supply Chain Dynamic Capabilities
SCC	Supply Chain Collaboration
SCDs	Supply Chain Disruptions
SCTI	Supply Chain Technological Innovation
SCP	Supply Chain Performance
DCT	Dynamic Capability Theory
RBV	Resource -Based View
VUCA	Volatile, Unpredictable, Complex, and Ambiguous
PMA	Palestine Monetary Authority
PCBS	Palestinian Central Bureau of Statistics
PFI	Palestinian Federation of Industries
SEM	Structural Equation Modeling
R&D	Research and Development
TI	Technological Innovation
SCA	Supply Chain Agility
SCIS	Supply Chain Information Sharing
SCF	Supply Chain Flexibility
SCC	Supply Chain Collaboration
SCLS	Supply Chain Leadership Support
SCI	Supply Chain Integration
SCDO	Supply Chain Disruption Orientation
PDI	Product Innovation
POI	Process Innovation

Chapter One: Introduction

This chapter presents a comprehensive overview of the study, including a concise overview of the problem's background and its significance. Moreover, it outlines the study objectives, questions, and hypotheses that serve as the guiding principles for the whole investigation. Furthermore, the study's setting and limitations were specified. The key study constructs were synthesized by integrating their conceptual and operational definitions. Conclude the first chapter by providing a concise summary.

1.1 Introduction

The ability of a company to withstand and recover from supply chain disruptions is considered a crucial organizational capability that allows the company to minimize the impact of disruptions and maintain its competitiveness (Hamidu et al., 2023; Scholten et al., 2019). Activities occurring at different stages within a supply chain are prone to experiencing unforeseen disruptions (Sawyerr & Harrison, 2020). The heightened awareness of climate change and the expanding global population have contributed to the escalation of both gradual-onset disasters (such as famines, droughts, and political crises) and sudden-onset disasters (such as floods, earthquakes, hurricanes, and coup d'états) in recent decades (Chen et al., 2020; Xu et al., 2020; Ivanov & Das 2020; Soni et al., 2014; Guha-Sapir et al., 2012). In today's uncertain and chaotic environment, every firm in the supply chain is in danger of disruption. According to Scholten et al. (2019), a significant proportion of organizations, over 70%, encounter Supply Chain Disruptions (SCDs) on an annual basis. These disruptions refer to situations that hinder the smooth movement of commodities, cash, or resources (Bode et al., 2011). Thus, impacting an organization's ability to deliver goods/services to its consumers. Hence, this has prompted a multitude of businesses throughout the world to decelerate or cease operations (Ndonye & Odiyo, 2022). Business enterprises have recognized the significance of supply chain disruption (SCD) and its potential adverse effects on operational and financial aspects; some examples include (The Chennai floods in India resulted in an approximate loss of $1 billion. Due to Panama Canal congestion, carrier services were delayed for more than ten days, as well as the industrial action undertaken by Brazilian transporters had a detrimental impact on the poultry and pork industry, causing an estimated loss of $184 million in one month (Kumar & Anbanandam, 2020).

In light of the numerous disruptions, globalization, and the heightened level of competition, firms seek out every possible avenue to sustain their operations and attain enhanced performance (Um & Han, 2021). The worldwide nature of supply chains heightened consumer expectations, and the decreasing lifespan of products drove this recognition (Hamidu et al., 2023). Thus, it is imperative to develop supply chain designs to effectively mitigate such disruptions (Sawyerr & Harrison, 2020). The optimal approach is proactively anticipating disruptions, effectively responding, and returning to its original or improved functional state. This competency necessitates a company to thoroughly examine the capabilities of its entire supply chain to endure, adjust, and progress in the face of change and unpredictability (Chatterjee et al., 2022).

Due to this rationale, there has been significant scholarly and professional interest in the advancement and enhancement of supply chain management to mitigate disruptions within the supply chain; the concept being discussed is commonly known as Supply Chain Resilience (SCR) (Hamidu et al., 2022, 2023). Furthermore, managers and policymakers are increasingly concerned about supply chain resilience (SCR) owing to the increasing scale and complexity of modern supply chains, coupled with the heightened likelihood of interruptions under Volatile, Unpredictable, Complex, and Ambiguous (VUCA) circumstances (Ndonye & Odiyo, 2022). In the face of a growing global economy, evolving information technology, and varying customer expectations, the business landscape is undergoing significant transformations, leading to heightened rivalry among firms. Therefore, it may be argued that businesses that rely primarily on the resilience of their supply chain may not consistently attain a satisfactory level of performance in the current dynamic environment (Stachova et al., 2019). Innovation is central to firm success and competitiveness (Acciaro & Sys, 2020). Moreover, it is one of the capabilities that aid companies in developing resilience to disturbances (Kamalahmadi & Parast, 2016). Likewise, Reinmoeller & Baardwijk (2005) examined the influence of innovation on resilience. They asserted that organizations could only overcome disturbances and adapt to fast environmental changes if sufficient resources were allocated to innovation. Moreover, Golgeci & Ponomarov (2013) averred that resilience is essential to a firm's continuity, and innovation is a significant facilitator of resilience. Historically, there existed a limited or delayed technology exchange between different industries. However, the rapid expansion of technological innovation and globalization facilitates the smooth adaptation of technology from one sector to another. Thus, the dynamic nature of the business environment poses challenges for businesses in sustaining their competitive edge (Chatterjee et al., 2022).

Technological innovation is considered a strategic alternative for achieving a firm's success and long-term viability (Hossain et al., 2022; Hamidu et al., 2023). Additionally, it serves as a means to maintain a competitive edge by enhancing adaptability (Stevenson & Spring, 2007). According to Ju et al. (2016), improving supply chain dynamic capabilities is crucial to strengthening technological innovation and firm performance. Additionally, enhancing supply chain capabilities is vital to augment sustained competitive advantage (Wang et al., 2006). Although implementing technological innovation incurs significant costs, it enables firms to address uncertainties and gain a competitive advantage (Chen, 2019). Likewise, managing disruption necessitates a higher investment in resilience building, a factor that has been shown to result in an escalation of operating expenses (Ivanov & Dolgui, 2020).

The current state of knowledge about the correlation between supply chain capabilities and supply chain resilience is lacking in terms of theoretical foundations, empirical evidence, and practical strategies for implementation (Gružauskas & Vilkas, 2017; Ju et al., 2016). Moreover, the current state of study on the mechanisms via which supply chains foster resilience is still nascent and requires further development to account for the evolving landscape of technological innovation and dynamics within supply chains (Datta, 2017; Dubey et al., 2020). Likewise, Kumar & Anbanandam (2020) asserted that the existing body of research indicates a scarcity of studies examining resilience building from a practical and comprehensive perspective.

In the Palestinian context, it is worth mentioning that some authors explored supply chain resilience. For example, Dwaikat et al. (2022) provided a conceptual framework for operational resilience to comprehend the mechanisms involved in achieving production changeover. Furthermore, Sultan et al. (2023) explored in their content analysis study the possible synergies that may be harnessed between industry and universities to enhance the resilience of the Palestinian agriculture sector. In their case study of a pharmaceutical company in the Palestinian Territory, Haloub et al. (2022) explored how entrepreneurial storytelling is pivotal in attracting new investors, fostering innovation, and cultivating resilience among entrepreneurs. Furthermore, the empirical study conducted by Zaid et al. (2021) provides valuable insights into enhancing organizational performance through supply chain quality management skills and knowledge transfer. Moreover, Bon et al. (2018) demonstrated that integrating green human resources management and green supply chain management practices may foster a sustainable corporate culture inside industrial enterprises. This integration has the potential to enhance an organization's overall performance by successfully addressing the environmental, economic, and social dimensions of its performance. Thus, reviewing related literature revealed a dearth of research exploring the interrelationships between supply chain dynamic capabilities, technological innovation, and supply chain resilience.

In light of this context, inquiry crops up concerning the impact of Supply Chain Dynamic Capabilities (SCDC) on Supply Chain Resilience (SCR) with a specific focus on examining the potential mediating role of technological innovation on the nexus between supply chain dynamic capabilities (SCDC) and Supply Chain Resilience (SCR), in the context of industrial firms in Palestine. To summarize, SCR is viewed as the proactive ability that firms build to limit the natural effects of multiple hazards connected with dynamic and disruptive settings (Um &Han, 2021). Several resilience strategies are available and could be adopted in accordance with the context of the supply chain and disruptions (Sá et al., 2020; Stone & Rahimifard, 2018). Irrespective of a company's chosen strategy, it is critical to support its overall strategy. Furthermore, an organization's strategies must be updated to ensure long-term viability (Ndonyeand & Odiyo, 2022).

1.2 Problem Statement and Definition of the Literature Gap

Dynamic, swift changes and heightened levels of rivalry among organizations characterize the contemporary business landscape. Moreover, the emergence of unforeseen disruptions and risks has presented significant challenges to the performance and competitiveness of organizations since the focus of competition has shifted from individual entities to supply chains (Cahyono et al., 2023). Every organization in the supply chain is subject to disruption. According to Sharma et al. (2020), if a risk event occurs at one point in the supply chain, it might substantially influence the remaining players. Companies that rely primarily on traditional supply chain management may encounter challenges in terms of competitiveness and profitability (Mandal, 2020). To achieve long-term viability, it is imperative for a supply chain to possess the capability to promptly recognize and adapt to unforeseen or abrupt changes by bolstering the resilience of the supply chain (Sabahi & Parast, 2020). Furthermore, the significance of innovation in ensuring a company's long-term viability and growth has been widely acknowledged (Kamalahmadi & Parast, 2016). Moreover, innovation is frequently perceived as essential in augmenting a firm's competitive advantage. This is primarily due to the strong association between a firm's innovation and its ability to generate market value (Cho & Pucik, 2005), adapt to uncertain circumstances (Stevens & Dimitriadis, 2004), and sustain its operations during periods of fluctuating or diminishing demand (Fisher, 1997). Nevertheless, the existing body of research on enhancing resilience in supply chains is deemed inadequate and necessitates additional focus. Furthermore, innovation's potential to bolster an enterprise's resilience has received comparatively less attention in scholarly discourse (Kamalahmadi & Parast, 2016). Despite the recognized importance of supply chain resilience and technological innovation as competitive attributes in dynamic and turbulent environments, which ultimately contribute to enhanced firm performance (Cahyono et al., 2023; Ju et al., 2016; Kamalahmadi & Parast, 2016), there is a noticeable dearth of empirical studies that specifically investigate the influence of supply chain dynamic capabilities on supply chain resilience (Gružauskas & Vilkas, 2017; Datta, 2017; Dubey et al., 2020; Kumar & Anbanandam, 2020). Specifically, the existing literature has not sufficiently addressed the nexus among supply chain dynamic capabilities, technological innovation, and supply chain resilience.

Thus, there is a need to contribute to the related corpus of knowledge by developing a holistic framework that empirically analyzes the interconnection among these factors. Furthermore, it is essential to address this topic to assist supply chain decision-makers in formulating supply chain resilience strategies that effectively enhance operational efficiency and mitigate the consequences of disruptive incidents within the framework of industrial firms in Palestine. Thus, strengthening the organization's competitive ability to withstand the fiercely competitive landscape. Consequently, this study addresses this gap by empirically examining the mediating role of technological innovation on the nexus between supply chain dynamic capabilities and supply chain resilience, and employing firm size and firm age as control variables. Based on a comprehensive analysis of the pertinent contemporary literature, a research gap has been detected, as depicted in **Figure. 1.1**

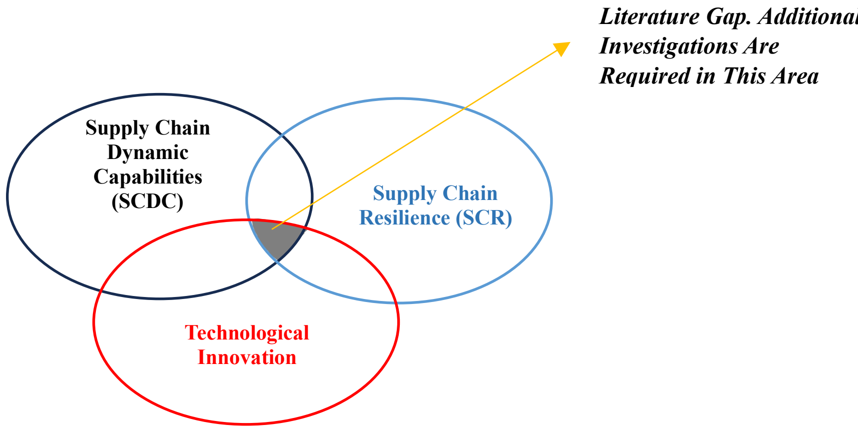

Figure (1.1): Definition of the Literature Gap

1.3 Study Significance and Justification

In their study, Raj et al. (2022) examined the supply chain challenges encountered by manufacturing organizations in emerging economies due to the COVID-19 pandemic. The authors indicated that a substantial majority of organizations, exceeding 80%, place considerable importance on supply chain resilience. Furthermore, Kamalahmadi & Parast (2016) conducted a study to examine the many elements contributing to organizational resilience. Their analysis revealed that company innovation is a critical organizational capability that bolsters supply chain resilience. Furthermore, Asree et al. (2018) asserted that firms that demonstrate a superior capability to adapt and innovate relative to their competitors have a notable competitive edge since innovation is a critical catalyst for gaining a competitive advantage. Although innovation's significance in ensuring a company's long-term viability has been acknowledged, its relationship with supply chain resilience has been underestimated (Kamalahmadi & Parast, 2016). Furthermore, it is essential to comprehend the interconnection among supply chain dynamic capabilities, technological innovation, and supply chain resilience from a dynamic capability standpoint. This understanding is crucial as it empowers businesses to allocate resources toward developing organizational capabilities that can enhance technological innovation and supply chain resilience (Kamalahmadi & Parast, 2016). Moreover, this study aims to support supply chain decision-makers in effectively formulating supply chain resilience strategies to address disruptions in highly dynamic conditions. Therefore, this study is anticipated to contribute to both theoretical and managerial dimensions.

Theoretically, this study will contribute to the existing body of knowledge in the following ways. (1) The proposed framework, from a dynamic capacities viewpoint, has the potential to enrich the existing academic understanding significantly. This conceptual framework integrates the notion of supply chain resilience (SCR) and supply chain dynamic capabilities (SCDC), namely, agility, information sharing, collaboration, flexibility, supply chain disruption orientation (SCDO), leadership support, and SC integration. Additionally, this holistic framework seeks to incorporate technological innovation, encompassing both product and process innovation. Furthermore, control variables such as firm size and age will be considered. (2) To the best of the authors' knowledge and through an intensive examination of existing academic literature, it appears that this specific model that combines those above three primary study constructs of SCDC, technological innovation, and SCR has not been previously explored. Furthermore, (3) reviewing the relevant prior works revealed that the majority of the research conducted on supply chain resilience in this body of literature is conceptual (Ali et al., 2017; Scholten & Schilder, 2015; Ponomarov & Holcomb, 2009; Mandal, 2012; Ponis & Koronis, 2012; Roberta Pereira et al., 2014; Kumar & Anbanandam, 2020). To this end, this inquiry will employ a rigorous survey-based quantitative approach to empirically assess the interconnection among the constructs of the proposed conceptual model. (4) Additionally, the motivation for examining the interplay of SCDC, technological innovation, and SCR in the context of Palestine, i.e., the developing economy, stems from the aim to contribute to the existing scholarly discourse that predominantly concentrates on developed nations while neglecting the developing countries. Notably, firms in developing countries often have distinct hurdles, including constrained infrastructure, political volatility, and economic uncertainty (Hamidu et al., 2023).

Practically, this empirical inquiry can yield novel perspectives and strategies for overcoming these hurdles, resulting in an overall enhancement of industrial firms' performance and competitiveness through the analysis of the associations, as mentioned earlier. Additionally, (5) this study will be the first endeavor of its nature conducted within the Palestinian setting to examine the impact of technological innovation on the nexus between supply chain dynamic capabilities and supply chain resilience in the industrial context. However, the Palestine Monetary Authority (PMA) published the 2016 Economic Forecast Report. According to the Report, the Palestinian economy is still vulnerable to several obstacles and dangers that threaten and limit its ability to expand and achieve sustainable development. The most visible is the continued Israeli occupation, which requires the Palestinian economy to rely on its Israeli counterpart, reliance on aid and international funding, rising political and economic insecurity, a lack of adequate legislation which is required to create an environment conducive to firm growth, dealing with four currencies, and difficulties accessing financial resources (PMA, 2016). Therefore, this research will assist supply chain decision-makers in implementing supply chain resilience strategies that have the potential to alleviate these challenges.

1.4 The Study Objectives and Questions

The primary objective of this study is to address the current gap in the existing body of knowledge by examining the extent to which supply chain dynamic capabilities influence technological innovation and supply chain resilience. However, this study seeks to provide a holistic framework exploring the relationship among supply chain dynamic capabilities, technological innovation, and resilience. This proposed integrated framework aims to connect theoretical concepts and practical applications. Including dynamic capabilities to enhance the development of supply chain resilience through the mediating role of technological innovation is of utmost importance since cultivating and maintaining a resilient supply chain is an ongoing endeavor rather than a one-time occurrence (Pettit et al., 2013).

Specifically, this study aims to empirically explore (1) the mediating function of technological innovation on the nexus between supply chain dynamic capabilities and supply chain resilience. Additionally, (2) to examine the impact of supply chain dynamic (SCDC) on Supply chain resilience. (3) This study will also investigate the influence of supply chain dynamic capabilities (SCDC) on technological innovation. (4) Furthermore, this study will investigate the impact of technological innovation on supply chain resilience. (5)

Additionally, this study will investigate the potential control effect of firm size and age on supply chain resilience.

This thereby improves supply chain resilience to disturbances and ultimately enhances firm performance and competitiveness within the industrial sector in Palestine. Furthermore, this investigation aims to furnish industrial (particularly manufacturing) businesses, policymakers, and supply chain decision-makers with strategies for enhancing supply chain resilience in response to challenges by highlighting the critical importance of developing and implementing technological innovation. Hence, this study specifically focuses on five research inquiries. However, the primary focus of the study is to investigate the mediation function of technological innovation on the nexus between supply chain dynamic capabilities and supply chain resilience. To meet the primary objective, this investigation addressed the following inquiries:

A. How do supply chain dynamic capabilities impact technological innovation?
B. How do supply chain dynamic capabilities impact supply chain resilience?
C. Does technological innovation mediate the nexus between supply chain dynamic capabilities and supply chain resilience?
D. How does technological innovation impact supply chain resilience?
E. Is there any controlling effect of firm size and age on supply chain resilience?

1.5 The Study Hypotheses

Following the extensive review of the prior work and the development of the study's proposed model, the following hypotheses evolved:

H1: There is a Positive Relationship between Supply Chain Dynamic Capabilities and Technological Innovation.

- H1a: There is a positive relationship between agility and technological innovation.
- H1b: There is a positive relationship between information sharing and technological innovation.
- H1c: There is a positive relationship between flexibility and technological innovation.
- H1d: There is a positive relationship between SCDO and technological innovation.

- H1e: There is a positive relationship between collaboration and technological Innovation.
- H1f: There is a positive relationship between leadership support and technological innovation.
- H1g: There is a positive relationship between SC integration and technological innovation.

H2: There is a Positive Relationship between Supply Chain Dynamic Capabilities and Supply Chain Resilience.

- H2a: Agility positively influences supply chain resilience.
- H2b: Information sharing positively impacts supply chain resilience.
- H2c: Flexibility positively impacts supply chain resilience.
- H2d: SCDO positively affects supply chain resilience.
- H2e: Collaboration positively impacts supply chain resilience.
- H1f: Leadership support positively influences supply chain resilience.
- H2g: SC integration positively influences supply chain resilience.

H3: Technological Innovation Has a Positive Impact on Supply Chain Resilience.

H4: The Relationship between Supply Chain Dynamic Capabilities and Supply Chain Resilience is Mediated by Technological Innovation.

- H4a: The relationship between agility and supply chain resilience is mediated by technological innovation.
- H4b: The relationship between information sharing and supply chain resilience is mediated by technological innovation.
- H4c: The relationship between flexibility and supply chain resilience is mediated by technological innovation.
- H4d: The relationship between SCDO and supply chain resilience is mediated by technological innovation.
- H4e: The relationship between collaboration and supply chain resilience is mediated by technological innovation.

- H4f: The relationship between leadership support and supply chain resilience is mediated by technological innovation.
- H4g: The relationship between SC integration and supply chain resilience is mediated by technological innovation.

H5: The Firm Size and Firm Age Dimensions Exhibit a Controlling Impact on Supply Chain Resilience.

1.6 The Study Setting

Firms operating in Palestine encounter several obstacles within a dynamic and competitive landscape, including economic and political instability, Israeli occupation and total reliance on Israeli counterparts, inadequate legislative framework, dependence on international aid, management of multiple currencies, and limited access to financial resources (PMA, 2016). Therefore, it is imperative to assist organizations in enhancing their supply chain management, mitigating supply chain risks, and enhancing their competitive advantage. Thus, this study will be conducted in Palestine. It will be anchored to a representative sample of high-ranking supply chain executives overseeing the industrial enterprises of 2,994 (PCBS, 2019) of varying sizes operating in various economic activities and regions across the West Bank, focusing on manufacturing firms (which typically have supply chain departments).

The manufacturing industry faces significant strain due to globalization's rapid process. This pressure necessitates that enterprises stay updated with technological innovation and effectively adapt to changing regulations and customer needs (Kusiak, 2022). In this investigation, the selection of the industrial sector was based on its significant impact on the gross domestic product (GDP), with a contribution of 13% to the GDP (PCBS, 2020). It also played a crucial role in the overall exports, accounting for almost 73% of the nation's exports (PCBS, 2020). Additionally, the industrial sector in Palestine demonstrated a high level of employability, employing 57,776 individuals dispersed throughout various industrial activities. Furthermore, the proportion of employed people in the industrial sector in the West Bank reached 80.8% of the total working population, while it was 19.2% in the Gaza Strip (PCBS, 2019). This initiative aims to support decision-makers in formulating strategies to enhance supply chain resilience and minimize or mitigate these challenges.

Furthermore, the primary data for this study will be acquired via structured, self-administered questionnaires. The acquired data will be thoroughly analyzed utilizing Structural Equation Modeling (SEM), a comprehensive multivariate approach. To guarantee robustness, the data will go through a variety of advanced statistical methods, including construct validity and reliability tests that are tailored to the study setting. This analytical approach will help to quantify the influence of supply chain dynamic capabilities on supply chain resilience. Furthermore, it will allow for a thorough investigation of the potential mediating function of technological innovation within this relationship.

1.7 The Study Limitations

This research endeavor will inevitably confront several restrictions that encompass the available data pertaining to supply chain dynamic capabilities, technological innovation, and supply chain resilience, which is constrained to the data that will be exclusively gathered through the survey. This investigation will focus on a selection of firms functioning within the industrial sector. This will restrict the extent to which the findings of this study may be generalized. Despite the extensive body of studies on dynamic capabilities within the realm of strategic management, there exists a dearth of studies investigating the use of dynamic capabilities in the context of supply chain management. Additionally, a dearth of scholarly research is conducted on the subject matter within the region of Palestine. Furthermore, due to exceptional circumstances, enterprises in the Gaza Strip will be excluded from the research study. Finally, the participation of supply chain executives and business owners in this survey is voluntary.

1.8 The Study Assumptions

In this research endeavor, the underlying assumptions are as follows: The data to be gathered from the participants in the sample is representative of their respective populations. Furthermore, the data collection and reporting method is devoid of any bias. The study's participants clearly understand supply chain resilience and survey terms. The survey participants' responses are candid, unambiguous, and devoid of influence or biases. They complete the survey honestly and without bias, resulting in accurate data. Ultimately, it is presumed that the survey will be efficient and precise, generate novel ideas, and contribute to the existing literature.

1.9 Definitions of the Study Variables

Study variables are the precise features, qualities, or aspects being measured, observed, or manipulated. The variables can encompass independent variables, which are factors that the researcher manipulates, measures, or controls; dependent variables, which are outcomes or reactions that are measured or observed (Ghauri et al., 2020); and any other variables that may be relevant to the research question or hypothesis. The study variables are essential components of a research investigation that are analyzed to understand the relationships, effects, or patterns within specific phenomena or communities. Furthermore, having a clear grasp of the definitions of study variables is crucial when designing and carrying out research studies and analyzing and interpreting the findings.

1.9.1 Conceptual Definitions

Conceptual definitions are analogous to definitions found in dictionaries. They elucidate the meaning of an idea by providing a definition based on other concepts. This study has created conceptual definitions through conceptualization, which entails identifying and defining the main concepts of the study's primary constructs, which include:

Supply Chain Dynamic Capabilities (SDCC) is the study's exogenous variable, which, according to Teece, could be defined as the firm's internal and external capacity for integrating, developing, and restructuring resources, technology, and operations. This capability enables the business to respond and react to constantly changing circumstances (Teece et al., 1997).

Technological Innovation is the study's endogenous and exogenous variable- the mediator variable of the study. It could be characterized as organizational endeavors aimed at restructuring and consolidating internal and external systems, infrastructure, human resources, and processes (Kissi et al., 2021; Hamidu et al., 2023; Ju et al., 2016; Lee et al., 2018). In this investigation, technological innovation will be divided into product innovation, which relates to introducing new products, services, or programs to the market, and process innovation, which addresses improvements in techniques or procedures to improve service, cost, throughput, or processing (Kahn, 2018).

Supply Chain Resilience (SCR) is the study's endogenous variable. It could be defined as the dynamic capability enabling the supply chain to proactively plan for, mitigate, react, restore, and learn from disruptions (Hohenstein et al., 2015; Datta, 2017).

Control Variables drawing on prior scholarly works by Hopkins (2021), Ali et al. (2017), Kamalahmadi & Parast (2016), Soltani et al. (2013), and Ju et al. (2016), this investigation will examine the potential influence of control variables such as firm size (in terms of employee count) and firm age (in terms of years) on supply chain resilience (Lee et al., 2018; Can Saglam et al., 2021).

1.9.2 Operational Definitions

Operationalization is a further step to conceptualization. When researchers articulate the specific methods by which a concept will be assessed in a study, it involves the identification of indicators that may determine the presence or absence of a variable, as well as its magnitude, among other factors. Thus, operational definitions refer to precise, quantifiable, observable conceptualizations delineating the investigated variables. The operational definitions for the variables in this research study were as follows:

Supply Chain Dynamic Capabilities (SDCC) after conducting an extensive examination of relevant scholarly works and conducting in-depth interviews with experts and academics well-versed in supply chain resilience and technological innovation, this study has identified the supply chain dynamic capabilities that have been frequently employed in previous research and are also recommended by experts for investigating their interrelationships with technological innovation and supply chain resilience. Thus, the proposed conceptual framework of this study will encompass supply chain dynamic capabilities, namely agility, information sharing, collaboration, flexibility, Supply Chain Distribution Orientation (SCDO), leadership support, and supply chain integration. The variables items are assessed using a five-point Likert scale, with 1 representing strong agreement and 5 representing severe disagreement.

Technological Innovation (TI), the assessment of Technological Innovation will be conducted by examining product innovation, which comprises four statements, and process innovation, which comprises three statements (Lee et al., 2018; Hamidu et al., 2023). These statements will be evaluated using a five-point Likert scale, ranging from 1 (representing strong agreement) to 5 (representing strong disagreement).

Supply Chain Resilience (SCR), the evaluation of Supply Chain Resilience (SCR) will be conducted using a set of five questions, as outlined by previous studies (Yu et al., 2019; Altay et al., 2018; Golgeci & Ponomarov, 2013; Can Saglam et al., 2021). The items will be assessed using a five-point Likert scale, with responses ranging from 1 (representing strong agreement) to 5 (representing strong disagreement).

1.10 Summary

Fast-paced changes and heightened levels of rivalry among firms mark the contemporary business environment. Furthermore, the advent of unexpected disruptions and hazards has posed substantial challenges to businesses' performance and competitiveness, as the emphasis on rivalry has migrated from individual entities to supply chains. Every business in the supply chain is susceptible to interruption. Therefore, a risk event at one point in the supply chain can significantly impact the remaining stakeholders.

Industrial, particularly manufacturing, firms operating in Palestine encounter several obstacles within a dynamic and competitive landscape, including economic and political instability, Israeli occupation and total reliance on Israeli counterparts, inadequate legislative framework, dependence on international aid, management of multiple currencies, and limited access to financial resources (PMA, 2016). Therefore, it is imperative to assist organizations in enhancing their supply chain management, mitigating supply chain risks, and enhancing their performance and competitiveness.

To ensure long-term viability, a supply chain must possess the capacity to rapidly identify and adjust to unanticipated or sudden alterations by enhancing its resilience. Moreover, the importance of innovation in maintaining sustained profitability and growth has been widely acknowledged. Furthermore, innovation is often regarded as crucial in augmenting a firm's competitive edge.

To address supply chain resilience (SCR) for this cohort group, ensuring supply chain dynamic capabilities (SCDC) and technological innovation (TI) are necessary. The SCR of industrial enterprises is a well-explored phenomenon worldwide. According to the existing body of knowledge, the association between SCDC, TI, and SCR is underestimated nationally and internationally. Therefore, further studies are required to establish the interconnection among the aforementioned variables. Consequently, this study addresses this gap by empirically examining the mediating role of technological innovation on the nexus between supply chain dynamic capabilities and supply chain resilience and employing firm size and firm age as control variables in the context of the industrial firms in the West Bank of Palestine.

Chapter Two: Literature Review

This chapter examines explicitly the fundamental concepts of this study. It outlines some of the theocratical perspective(s) applied in SCR literature. It provides the theoretical underpinning of the adopted theories employed in this study to investigate the concept of supply chain resilience and its connection with the study constructs. It presents a theoretical background on supply chain dynamic capabilities, technological innovation, and supply chain resilience. It elucidates their interconnections and summarizes prior works relevant to the context of this study. It presents the study's framework and the development of the study hypotheses. It elucidates the connection between the strategic management field and supply chain resilience. This chapter concludes with a succinct summary demonstrating the author's contemplation of the reviewed previous works, highlighting the research gap and the theoretical and practical implications of the study.

2.1 Theocratical Perspective(s) Applied in SCR Literature

Previous research has employed many theoretical frameworks to investigate the concept of supply chain resilience. For example, Ponomarov and Holcomb (2009), Blackhurst et al. (2011), Brusset and Teller (2017) adopted the Resource-Based View theory, Spiegler et al. (2012), and Wang et al. (2016) used the Systems Theory. While Day (2014) and Tukamuhabwa et al. (2015) employed Complex Adaptive Systems. Sawyer & Harrison (2020) used the High-Reliability Theory in SCR research. Belhadi et al. (2021) and Hamidu et al. (2023) used Organizational Information Processing Theory (OIPT), Garrido-Moreno et al. (2024) employed Dynamic Capability Theory (DCT), and Ndonye & Odiyo (2022) adopted Dynamic Capability Theory (DCT) and Contingency Theory. However, this investigation will adopt the following theoretical perspectives:

2.2 Theoretical Underpinning

2.2.1 Resource-Based View (RBV)

The theory of the resource-based view (RBV), first proposed by Wernerfelt (1984) and later developed by Barney (1991), highlights the crucial role of a firm's valuable resources and opportunities in driving its competitive advantage (Barney, 1991). It provides valuable insights for guiding strategic management decisions by underlining the vital role of a company's internal resources and capabilities in attaining a competitive edge. The Resource-Based View (RBV) framework is a theoretical framework that analyzes and evaluates the internal resources possessed by a firm. Its purpose is to develop a strategy that optimizes the allocation and exploitation of available resources, facilitating the organization's ability to effectively and efficiently attain its desired goals and gain a competitive edge (Ahmed & Huma, 2021). Due to the potential for significant and enduring economic ramifications, establishing strategic resilience and robustness is crucial in effectively managing supply chain disruptions (Ahmed & Huma, 2021).

According to Grant's theoretical framework, the assets owned by a company extend beyond tangible physical, monetary, and human resources. This concept was initially introduced by Ansoff in 1965. Moreover, it is essential to acknowledge that a company's resources encompass more than just the tangible assets already described. The inclusion of intangible organizational knowledge and capabilities, along with technological expertise, as proposed by Hofer & Schendel in 1978, are also encompassed within a firm's resource base. According to Grant (1991), a distinction can be made between resources and capabilities. Grant posits that those resources are responsible for creating a firm's capabilities, while capabilities serve as immediate drivers of competitive advantage.

(RBV) asserts that an organization can attain exceptional performance by procuring and effectively utilizing resources that exhibit the characteristics of value, rarity, inimitability, and non-substitutability (VRIN). According to Barney (1991), it is widely believed that the aforementioned capabilities have the potential to significantly improve a firm's ability to integrate and adopt novel technologies successfully. The notion of capabilities has transformed, giving rise to the concept of dynamic capabilities. Dynamic capabilities are characterized by their ability to effectively respond to swiftly changing circumstances by combining and adapting internal and external capabilities (Teece et al., 1997).

2.2.2 Dynamic Capabilities Theory

Dynamic capabilities' prominence is heightened when significant volatility exists within the business environment (Ju et al., 2016). According to Teece et al. (1997), the concept of dynamic capability in a corporation pertains to "its ability to adapt and adjust its internal and external resources, capabilities, technologies, and functions to effectively address challenges, identify potential opportunities, and mitigate the adverse consequences of disruptions." Notably, the capability is demonstrated through acquired and enduring behavioral patterns employed by an organization to enhance its effectiveness through the production and adaptation of its operational methods (Brusset & Teller, 2017).

The Dynamic Capabilities Theory (DCT) represents a progression of the Resource-Based View (RBV); while the RBV primarily emphasizes the appropriation and capture of value, the DCT places a distinct emphasis on innovation and value creation (Katkalo et al., 2010). According to Teece (2007), in turbulent and uncertain environments, it is typically observed that value creation and innovation occur before value capture, and this sequence is of utmost importance. It is essential to acknowledge the variability in the value of dynamic capabilities, as it is contingent upon the specific context. It is crucial to recognize that no universally applicable technique guarantees overall effectiveness. Nevertheless, this capability is vital for firms to maintain competitiveness and relevance in a rapidly changing and unpredictable business environment (Barreto, 2010; Di Stefano et al., 2010). This concept aligns with supply chain resilience since it establishes specific organizational procedures and resources that might provide a lasting competitive advantage, primarily at the firm level (Pereira et al., 2020).

The Dynamic Capabilities Theory (DCT) posits that an organization may attain a competitive advantage by cultivating specific characteristics that enhance its ability to navigate uncertain and volatile business environments effectively, hence achieving desirable performance levels even in disruptions (Piening & Salge, 2015). The examination of the interplay of supply chain dynamic capabilities, technological innovation, and supply chain resilience in volatile contexts may be grasped by employing the theoretical framework of dynamic capabilities theory, as it posits that value creation is significantly impacted by the utilization of technological innovation inside the organization, as highlighted by Jimenez-Jimenez et al. (2019). Moreover, Muithya & Muathe (2020) argue that firms employ specific behavioral capabilities to facilitate the development of innovative products and processes for new markets; the aforementioned capabilities encompass absorptive, adaptable, innovative, and networking capabilities. A firm's innovation ability allows it to devise remedies for emerging obstacles, effectively respond to environmental changes, and implement required strategies (Sabahi & Parast, 2020).

To effectively adapt to a dynamic environment and enhance the pace of innovation, a company must modify and reallocate its resources and capabilities in accordance with its management process and market positioning. Thus, innovative businesses perform much better in customer satisfaction, adapt more effectively to environmental unpredictability, and are better equipped to deal with demand fluctuation. This implies that innovative companies exhibit a greater level of resilience (Sabahi & Parast, 2020).

2.2.3 The Contingency Theory

Today's supply chains are time-sensitive, and interruptions severely hinder operational performance (Laguir et al., 2023). Dynamic settings impose significant uncertainty about the running of supply chains. To attain the necessary operational performance, firms must focus on developing the dynamic capabilities of Supply Chain Distribution Orientation (SCDO) and enhancing SC resilience (Laguir et al., 2023). Hence, it is essential for organizations to cultivate their aptitude for awareness, consciousness, and recognition, capabilities that often emerge from experiences with disruptive occurrences (Ambulkar et al., 2015). These occurrences contribute to establishing the firm's orientation on forthcoming supply chain disruptions (Patel et al., 2013).

However, the contingency theory approach, as proposed by Fiedler in 1993, is widely recognized as a fundamental idea that explores the relationship between the unpredictable external environment and the necessary adaptive strategies that enterprises must implement to maintain a sustainable supply chain system (Chatterjee & Chaudhuri, 2021). According to Fiedler (1993), contingency theory posits that there is no universally optimal strategy for maintaining a supply chain in a volatile environment. How turbulence manifests itself, together with a business's internal and external circumstances, has a significant role in shaping the firm's strategy for managing turbulence (Pratono, 2016).

In the strategic management context, the notion of strategy may be separated into two main components: process (how strategy is generated) and substance (what strategy is). Several academics studied the link between various strategic features and performance, focusing on the process or the content (Wagner & Bode, 2008). However, Ketchen et al. (1996) discovered that the organization's internal and external environment is crucial in decision-making in addition to content and procedure. Hence, this framework should include this information. Contingency scholars claim that the success of a business is contingent upon the level of coherence between the firm and its external environment, as well as the strategies employed by the firm. To enhance efficiency and effectiveness, organizations must adapt their structure to the context and environment (Venkataraman, 1989). If this "match" is not achieved, opportunities are missed, expenses rise, and the organization's existence is jeopardized. Given the necessity for prompt and synchronized reactions to supply chain interruptions, along with the need for ongoing involvement of stakeholders, it is of utmost importance that supply chain partners are sufficiently incentivized to cooperate in specified ways to minimize disruptions or irritation (Ndonye & Odiyo, 2022).

Contingency theory posits that, as previously stated, no universally optimal method exists for a firm to navigate unforeseen external occurrences effectively. Consequently, organizations must establish a contingency plan to address unanticipated circumstances effectively. In this scenario, business leadership must be agile in selecting brief strategies that suit an unanticipated, tumultuous environment. Therefore, effective leadership must determine the most suitable strategy for unforeseen and turbulent circumstances (Pratono, 2016).

2.3 Theoretical Background

2.3.1 Resilience

As mentioned earlier, the contingency theory (Fiedler, 1993) is widely recognized as a fundamental framework that explores the relationship between the unpredictable external environment and the strategic decisions enterprises must make to maintain a sustainable supply chain system. A central tenet of contingency theory (Fiedler, 1993) is that there is no one universally applicable strategy for dealing with uncertainty in the supply chain. That is why firms must have a well-thought-out contingency plan for handling unexpected events in the supply chain (Fredericks, 2005). Accordingly, companies employ strategies to ensure their supply chain resilience. However, the adopted strategy depends on the level and nature of the ever-changing and turbulent setting (Chatterjee & Chaudhuri, 2021).

Holling (1973, p. 17) provided an early description of resilience in scholarly literature, describing it as "the capacity of these systems to assimilate alterations in state variables, driving variables, and parameters while maintaining persistence." In a comprehensive examination of the concept of resilience across various disciplines, Folke (2006) identified two distinct definitions.

One aspect pertained to the trait of robustness in systems, which refers to their ability to withstand significant disruptions while maintaining their operation. The second perspective, as described by Brand and Jax (2007), emphasizes the effects of disruption on a system, including its reorganization and ability for transformation, learning, and innovation.

Nevertheless, from an organizational standpoint, resilience encompasses achieving business goals regardless of substantial interruptions and the speed at which performance levels attain equilibrium post-disruption (Sheffi, 2005). Moreover, it is widely recognized as a significant contributor to sustained competitive advantage, including both strategic and operational dimensions, and is considered crucial for achieving organizational success (Coutu, 2002).

However, it is impossible for a single business to establish significant levels of resilience in isolation (Seville et al., 2006); hence, extending resilience to encompass supply chain stakeholders has become undeniable. Incorporating Supply Chain Risk Management (SCRM) into the design of supply chains has become increasingly significant due to the inherent risks involved (Wilding, 2013). Hence, it is imperative to reconfigure conventional supply chains to incorporate resilience within their framework (Sabahi & Parast, 2020). The scholarly investigation of resilience within the supply chain has been a subject of inquiry for two decades. Nevertheless, the concept of the supply chain has generated ongoing debate and disagreement among scholars concerning its specific definition, practical implementation, and thorough understanding (Tukamuhabwa et al., 2015; Hohenstein et al., 2015).

2.3.2 Supply Chain Resilience (SCR)

The concept of supply chain resilience has evolved, beginning with the first recorded definition proposed by Rice & Caniato (2003), who defined it as "the ability to respond to unforeseen disturbances and restore regular operations within the supply network. In their seminal work published in 2009, Ponomarov & Holcomb (2009, p.131) presented an all-encompassing elucidation of supply chain resilience, delineating it as the “adaptive capability of a supply chain to adapt to unforeseen events, effectively respond to disruptions, and restore operations to the desired level of interconnectedness and control over structure and function.”

Whereas, Hohenstein et al. (2015) asserted that resilience may be defined as “the ability to anticipate and effectively address unforeseen risks, promptly recover from potential disruptions, and restore the original state or progress toward a more favorable condition (p.

90).” Subsequently, supply chain resilience literature was enriched by the contributions of Tukamuhabwa et al. (2015), Kamalahmadi & Parast (2016), and Datta (2017). The contemporary comprehension of SCR has progressed beyond the simple ability to respond and recover from disturbances (Rice et al., 2003; Christopher & Peck, 2004). The current scope of the concept includes the supply chain's capacity to strategically anticipate, minimize, adapt to, rebound from, and acquire insights from various interruptions (Hohenstein et al., 2015; Datta, 2017).

Furthermore, Yao & Fabbe-Costes (2018, p. 260) asserted that the concept of SCR could be characterized as “the intricate and collective ability of organizations within a supply chain to sustain a dynamic equilibrium, respond to, and recoup from a disruptive event, and to restore performance by assimilating adverse effects, adapting to unforeseen alterations, and leveraging the knowledge of achievement or lack thereof.”

According to Kissi et al. (2021), Supply Chain Resilience enhances supply chains' adaptive capabilities to reduce the probability of disruptions affecting operations, mitigate the spread of adverse effects, and enable swift response and recovery to restore operations to a stable condition. Supply Chains (SC) play a pivotal role in effectively managing corporate enterprises due to the inherent complexity of their operations. Hugos (2018) states that SC activities are often classified into four primary types. This framework's components include planning activities such as pricing, inventory management, and demand forecasting. Additionally, sourcing activities such as credit, procurement, and collections are included. The making phase involves production, product design, and facility management. Lastly, the delivery phase encompasses delivery scheduling, order management, and return processing.

Therefore, Supply chains are complex networks consisting of multiple entities and processes with varying vulnerabilities and perspectives on risk (Ndonye & Odiyo, 2022).

Furthermore, Ju et al. (2016) stated that supply chain management is a comprehensive methodology that enables the effective oversight of every individual phase of the process, starting from acquiring raw materials and concluding with delivering goods or services. Its primary objective is to provide remarkable customer value and attain a competitive edge. Thus, supply chains are prone to many risks that may arise from the actions or involvement of one or more entities (Hearnshaw & Wilson, 2013). Due to extensive geographical coverage, numerous supply chains encounter significant global issues (Ben-Daya et al., 2019). The increasing complexity of products may be attributed to the rapid pace of technological innovation and the constant influx of novel products into the market across many industries (Hamidu et al., 2023).

Therefore, the latest understanding of Supply Chain Resilience has evolved beyond the mere capacity to react and bounce back from disruptions (Rice et al., 2003; Christopher & Peck, 2004). It has been widely acknowledged as a dynamic capability enabling the supply chain to proactively plan for, mitigate, react, restore, and learn from disruptions (Hohenstein et al., 2015; Datta, 2017). The present study will employ the conceptualization of supply chain resilience proposed by Hohenstein et al. (2015) and Datta (2017). In general, the literature analysis indicates that the majority of definitions of Supply Chain Resilience encompass several elements pertaining to an organization's preparedness, reaction, recovery, and growth in the face of disruptions (Ndonye & Odiyo, 2022).

In their study, Hossain et al. (2022) discovered four distinct metrics pertaining to resilience: robustness, rapidity, resourcefulness, and redundancy. The robustness of a system relates to its strength. Whereas rapidity refers to the speed with which a system can regain its original condition or attain an acceptable level of operation following a disruption. Resourcefulness denotes the ability of a system to allocate resources in response to a disruption effectively. Finally, redundancy is defined as the degree to which a system reduces the probability and consequences of interruptions.

Thus, this study will employ the dimensions suggested by Yu et al. (2019), Altay et al. (2018), Golgeci & Ponomarov (2013), and Can Saglam et al. (2021) to measure supply chain resilience that entails the firm's supply chain ability to respond to unexpected disruptions. The firms' capability to return to a more desirable state after being disturbed. Maintaining financial preparedness to withstand disruption. The ability to maintain desired control over structure and operations. The ability to extract meaningful insights and knowledge from the external business environment and past experiences of disruptions. These dimensions contribute to developing dynamic capabilities that enhance responsiveness and foster a greater motivation to respond and navigate disruptions effectively.

In the aftermath of the COVID-19 pandemic, supply chain resilience is now at the top of the C-suite agenda. SCR is broadly focused on the supply chain's ability to cope with immediate disruptive events (He et al., 2021), therefore resuming or improving performance

(Hendry et al., 2019). SCR is assessed in all three phases of disruption: readiness (proactive, pre-disruption), reaction (reactive, post-disruption), and recovery. The concept is derived from previous scholarly endeavors emphasizing restoring stability following a perturbing incident (Scholten et al., 2019; Kamalahmadi & Parast, 2016), as depicted in **Figure 2.1**.

However, the COVID-19 pandemic has given rise to the concept of adaptive resilience, which posits that a complex and interconnected supply chain cannot maintain a state of equilibrium. Resilience may be seen as a contextualized capability acquired via ongoing adaptation and learning (Belhadi et al., 2021).

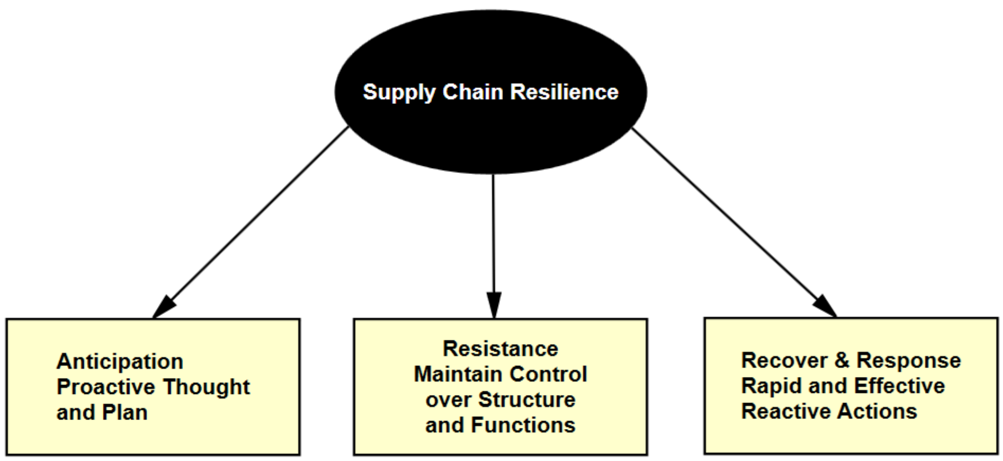

Figure (2.1): Supply Chain Resilience Phases- (Scholten et al., 2019; Kamalahmadi & Parast, 2016).

2.3.3 Supply Chain Capabilities

The principles of supply chain resilience, as first posited by Christopher & Peck (2004), have garnered significant attention and are regarded as a foundational paradigm for understanding the notion of supply chain resilience. In the literature, various authors employ various terminologies to describe the concept under discussion. For instance, Pettit et al. (2010), Pettit et al. (2013), Jüttner & Maklan (2011), and Parast et al. (2019) utilize the word 'capabilities,' while Christopher & Peck (2004) use the term 'elements,' and Ponomarov & Holcomb (2009) refer to 'antecedents. The term "competencies" has been discussed by Wieland & Wallenburg (2013). This study employs the concept of 'capabilities' proposed by Jüttner & Maklan (2011).

Following this, capabilities, elements, antecedents, or competencies, which are often used interchangeably by various authors, have since received additional refinement and expansion by several scholars (Briano et al., 2010; Christopher et al., 2011; Mandal, 2012). In the systematic literature review conducted by Parast et al. (2019), the authors aimed to examine the interconnection between supply chain resilience and innovation. The authors have highlighted information sharing, leadership, and collaboration as strategies that have enhanced business innovation and supply chain resilience. The authors identified various capabilities contributing to developing supply chain resilience throughout their study. **Table 2.1** provides a brief overview of these capabilities.

Table (2.1): Supply Chain Capabilities- Parast et al. (2019)

Capability	Authors	Definition
Redundancy	"Azadeh et al. (2014), Sheffi (2005) and Tang (2006)."	The availability of emergency supplies, as evidenced by buffer stocks, spare capacity, alternative locations, and multiple sources.
Flexibility	"Tang & Tomlin (2008), Yang & Yang (2010)."	The ability to adjust and react to alterations in sourcing, production, and order fulfillment procedures.
Collaboration	"Christopher & Peck (2004), Soni et al. (2014), Scholten & Schilder (2015)."	Examples of strategies that can be employed in business include product life-cycle management, collaboration between customers and suppliers, and sharing risks and rewards with partners.
Trust	"Nishat Faisal et al. (2007), Ponomarov & Holcomb (2009), Soni et al. (2014)."	In a reliable network characterized by a predetermined level of trust among its constituents, issues, and obstacles are openly deliberated and addressed.
Information Sharing	"Scholten & Schilder (2015), Mandal (2012), Melnyk (2014)."	The dissemination of information, such as collaborative forecasting among the many stakeholders within a supply chain.
Agility	"Wieland & Wallenburg (2013), Soni et al. (2014)."	The capability of a supply chain to promptly adapt to fluctuations.
Visibility	"Soni et al. (2014), Wieland & Wallenburg (2013), Azadeh et al. (2014)."	The accurate recording of data about items as they traverse throughout the supply chain, including where they are and what they are.

Velocity	“Wieland & Wallenburg (2013), Scholten et al. (2014), Carvalho et al. (2012).”	The rate at which a supply chain reacts to market events regarding speed.
Supply Chain Risk Management (SCRM) Culture	“Christopher & Peck (2004), Christopher et al. (2011), Mandal (2012), Soni et al. (2014).”	It exhibits the behaviors and beliefs of enterprises’ employees and management toward risk management. It demonstrates how employees and upper-level management engage with and handle transactions within and outside the firm from a risk management standpoint.
Leadership	“Wilding (2013), Demmer et al. (2011), Rice & Caniato (2003), Blackhurst et al. (2011).”	The provision of support and commitment from upper-level managers.

2.3.4 Technological Innovation

According to the recommendations put forth by Sabahi & Parast (2020); to attain supply chain resilience, organizations must adopt innovative solutions that surpass conventional supply chain management strategies. The authors asserted that the capability of supply chain technological innovation has been characterized as a crucial factor in enabling businesses to attain supply chain resilience. This competency has been observed to provide novel (innovative) prospects for developing competitive advantages (Mandal, 2020). It is undeniable that one of the primary objectives of the "fourth industrial revolution (Industry 4.0)" is to expedite the advancement of businesses' innovation capabilities (Wang et al., 2020, p.84). To effectively navigate a volatile business landscape and ensure the continuity of supply chain operations, it is imperative for organizations to embrace Industry 4.0 technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Cyber-Physical Systems (CPS), Blockchain, and Cognitive Computing (Chatterjee et al., 2022).

According to Hopkins (2021), technological innovation can be employed independently or in conjunction with other technologies to facilitate enhanced exchange of information, collaboration, and visibility, all of which are integral capabilities of supply chain resilience. Yu et al. (2022) asserted that cultivating a receptive attitude towards technological innovation fosters the development of information processing abilities, which are critical for improving performance and fortifying supply chain resilience. Furthermore, a study conducted by Ju et al. (2016) aimed to empirically investigate the influence of supply chain dynamic capabilities on operational performance. The study also attempted to explore the mediating effect of technological innovation in the association between operational performance and dynamic capabilities. The results demonstrate that the dynamic capabilities of a supply chain, such as collaboration, information sharing, integration, and agility, positively impact an organization's technological innovation and operational performance. Moreover, the findings indicate that the influence of supply chain dynamic capability on operational performance is partially mediated by technological innovation.

In their study, Gružauskas & Vilkas (2017) conducted a comprehensive survey of scientific literature to identify specific capabilities that impact the supply chain's resilience. The critical capabilities of supply chain resilience include integration, collaboration, redundancy, and flexibility. However, the authors asserted a dearth of research concerning incorporating these capabilities into the resilience of supply chains. The authors suggested that integrating these capabilities with the emerging technologies of Industry 4.0 can lead to attaining supply chain resilience.

Furthermore, a study conducted by Hamidu et al. (2023) aimed to examine the mediated-moderated influence of supply chain technological innovation (SCTI) on the association between supply chain resilience and supply chain performance (SCP) within the context of manufacturing firms. It was revealed that supply chain technological innovation positively mediates the relationship between supply chain resilience and supply chain performance. Nevertheless, it has been documented that SCTI negatively moderates this nexus. The authors declared that it is instructive to argue that the sheer presence of a more improved SCTI is insufficient to increase manufacturing businesses' SCP but rather should be a means via which SCR may improve SCP.

However, **Table 2.2** synthesizes the prior work of some scholars who investigated supply chain dynamic capabilities, technological innovation, and supply chain resilience, which is relevant to the context of this investigation.

Table (2.2): Previous works examining supply chain dynamic capabilities, technological innovation, and supply chain resilience interconnections

Author(s) and Year	Methodology	Objective(s) of the Study	Main Finding (s)
Ali et al. (2024)	**Quantitative (Survey)**	To investigate the synergistic impact of AI technology, supply chain collaboration, and information sharing on supply chain resilience.	Experimental results demonstrate that AI technology enables timely information and insights generation, fostering collaboration, trust, transparency, and data sharing across the supply chain network.
Badwan (2024)	**Quantitative (Survey)**	To examine the roles of supply chain partnerships, cross-functional integration, responsiveness, and resilience in attaining competitive advantages in Palestine.	The findings indicate that cross-functional inventory data integration and immediate operation improve supply chain responsiveness, resilience, and cooperation. Supply chain partnerships improve responsiveness, resilience, and competitive advantage by forming work teams and sharing best practices.
Alshawabkeh et al. (2024)	**Quantitative (Survey)**	To investigate the influence of Digital Collaboration (DC) and Analytics Capability (AC) on Supply Chain Resilience (SCRES).	The analytical capability among companies is a fundamental antecedent of digital collaboration, and both analytical capability and digital collaboration are essential prerequisites for organizations to enhance their performance by bolstering the resilience of their supply chains.
Feng and Jalali (2024)	**Quantitative**	To investigate how technological innovation capabilities influence the execution of sustainable supply chain management and how they can assist organizations in navigating internal obstacles to sustainable supply chain management implementation	All technological innovation capabilities significantly impact the implementation of sustainable supply chain management, particularly the learning capability, resource allocation capability, and manufacturing capability. Notably, organizing capability exerted a minimal impact on sustainable supply chain implementation.
Issa et al. (2024)	**Quantitative (Survey)**	To investigate the influence of green innovation strategies on supply chain resilience, mediated by green logistics management practices and moderated by dynamic and structural supply chain complexity.	The analysis strongly supports the interrelated functions of green innovation strategy and logistics management practices in enhancing supply chain resilience.
Manchidi (2024)	**Quantitative (Survey)**	To identify the strategic actions related to sustainable innovation and competitiveness undertaken by companies in a developing economy.	The findings provide empirical insights for companies to leverage in supply chain leadership strategic actions to promote sustainable innovation and competitiveness in emerging

			economies. The findings show that developing economy firms must adopt and recognize sustainable innovation and competitiveness to enhance market goods and services.
Li et al. (2024)	**Quantitative (Survey)**	To investigate the mediating role of supply chain innovation in the relationship between digital supply chain and supply chain dynamic capabilities.	The study demonstrates that the digital supply chain substantially enhances SC innovation and SC dynamic capabilities. SC innovation significantly enhances SC's dynamic capabilities. Furthermore, SC innovation partially mediates the relationship between the digital supply chain and supply chain dynamic capabilities.
Garrido-Moreno et al. (2024)	**Quantitative (SEM) & Qualitative (Interviews)**	This study uses the framework of dynamic capabilities theory to examine the impact of service innovation and organizational resilience on service company performance in Spain.	The results confirm that innovation and resilience are essential dynamic capabilities for adjusting to a changing business environment and sustaining competitiveness. They also demonstrate that digital technologies like social media platforms and external networks facilitate service innovation.
Hamidu et al. (2023)	**Quantitative Analysis**	This study aims to investigate the mediating and moderating effects of supply chain technological innovation (SCTI) on the connection between SCR and SCP.	The authors recommend collaboration, flexibility, redundancy, and agility as resilience strategies.
Junaid et al. (2023)	**Quantitative Analysis**	To investigate the relationship among supply chain dynamic capabilities (SCDCs), supply chain integration (SCI), supply chain resilience (SCR), sustainable competitive advantage (SCA), and sustainable supply chain performance (SSCP) within the healthcare industry in Pakistan.	The results illustrate supply chain dynamic capabilities' favorable influence on supply chain integration and resilience, resulting in a competitive edge and enhanced performance.
Forliano et al. (2023)	**Quantitative Analysis**	This study explores how organizations' technology orientation affects their resilience to the coronavirus disease (COVID-19) pandemic and considers the mediating function of digital strategy maturity.	The findings validate that the firm's technological orientation favorably impacts the maturity of its digital strategy, resulting in increased organizational resilience.
Yu et al. (2022)	**Quantitative Analysis**	This study examines how openness to technological innovation affects the development of information processing abilities, such as inter-functional coordination and inter-partner informational justice, which are crucial for establishing supply chain resilience (SCR) and improving performance.	The study found that inter-functional coordination and informational fairness have a major role in mediating the association between openness to technological innovation and SCR. Additionally, information processing capacities and SCR have a positive connection with operational performance.

Irfan et al. (2022)	**Longitudinal Case Study**	To assess the potential of dynamic capabilities and knowledge management (KM) in supporting organizations to build a resilient supply chain during significant disruption and uncertainty.	Findings revealed that firms, particularly in developing countries, are utilizing technology to enhance the capabilities of knowledge management (KM) to strengthen resilience and gain a competitive edge. Enterprises strategically utilize digital technology and unique resources to acquire, communicate, and integrate market information. This allows them to develop a resilient supply chain model that can overcome challenges related to logistics and delivery.
Do et al. (2022)	**Quantitative Analysis**	To examine the theoretical mechanism that connects resource-based management initiatives (RBMI) with the resilience and innovation of small- and medium-sized companies (SMEs) in Vietnam.	The findings demonstrate that innovation management strategies improve organizational resilience, which in turn boosts innovation. The findings suggest that organizational learning plays a mediating role in these connections.
Yuan et al. (2022)	**Qualitative (Case Analysis)**	To examine the resilience mechanism of platform-based sharing economy enterprises by specifically analyzing the importance of absorptive capacity.	The results suggest that a consistent absorptive capacity permits three consecutive phases of resilience: anticipation of alterations, reduction of vulnerability, and use of shared resources.
Pratono (2022)	**Quantitative Analysis**	To provide a structural model based on the theoretical literature, expanding the research areas related to competitive strategy.	Innovation positively influenced the performance of the company, but organizational resilience had the greatest impact on the competitive advantage of firms. Product development has less impact on a firm's competitive advantage during high information technology turbulence than during low turbulence. Organizational resilience and marketing communication provide organizations with a competitive edge. The authors propose four strategic innovation scenarios.
Dovbischuk (2022)	**Quantitative Analysis**	To utilize a theoretical framework to analyze the relationships between different innovation-focused dynamic capabilities, dynamic resilience, and firm performance in logistics service providers (LSPs) and in-house logistics departments of industrial companies during the COVID-19 pandemic.	The presence of innovation-oriented competencies and organizational learning was found to have a positive correlation with increased levels of resilience during the epidemic. A positive correlation exists between resilience business performance and logistic services quality.
Blichfeldt & Faullant (2021)	**Quantitative analysis (correlation).**	To examine if adopting digital technology leads to increased innovation in terms of both incremental and radical product and service innovation.	Digital technologies are employed in low-tech industries to create innovations in products and services, resulting in improved performance. Conversely, in high-tech industries,

			digital technologies directly affect performance and are, therefore, more commonly employed to achieve efficiency improvements rather than for innovative purposes.
Li et al. (2021)	**Qualitative (Content analysis)**	To investigate the innovative initiatives Chinese restaurant businesses undertake during and after the COVID-19 pandemic, both in terms of their emergency response strategies and recovery endeavors.	Based on the push-and-pull theory of business motivation, the findings proposed a crisis management model and also explained how some innovative initiatives improved business resilience during the pandemic.
Eslami et al. (2021)	**Quantitative analysis**	To examine the connection between supply chain integration, supply chain agility, and financial performance in terms of dynamic capability. Additionally, the study aims to evaluate whether the implementation of Industry 4.0 digital technologies influences the relationship between (a) supply chain integration and supply chain agility, and (b) supply chain agility and financial performance.	Findings revealed that supply chain agility completely mediates the relationship between supply chain integration and financial performance. Although Industry 4.0 digital technologies enhance the impact of supply chain agility on financial performance, they do not moderate the relationship between supply chain integration and supply chain agility.
Hopkins (2021)	**Quantitative Analysis**	To assess the present level of adoption of many critical Industry 4.0 technologies by leveraging the experience of supply chain practitioners.	The author asserted that collaboration, exchange of information, and visibility are integral capabilities of supply chain resilience.
Sabahi and Parast (2020)	**Systematic Literature Review (SLR)**	To investigate whether more resilient firms to disruptions are likewise more innovative.	Utilizing innovation can enhance an organization's agility, flexibility, and information-sharing capabilities. These capabilities, in turn, play a substantial role in bolstering supply chain resilience.
Parast et al. (2019)	**Systematic Literature Review (SLR)**	To examine the connection between a firm's ability to withstand supply chain disruptions, i.e., SCR, and its innovation.	Leadership, information sharing, and collaboration capabilities have been found to enhance both business innovation and firm resilience when confronted with supply chain disruption.
Gružauskas and Vilkas (2017)	**Scientific Literature Review**	To ascertain specific capabilities that influence the resilience of supply chains.	The authors identified collaboration, flexibility, redundancy, and integration as key capabilities of supply chain resilience. The authors contend that combining these capabilities with emerging Industry 4.0 technologies can lead to supply chain resilience.
Ju et al. (2016)	**Quantitative Analysis**	To analyze the impact of supply chain dynamic capabilities on operational performance and determine technological innovation's role in mediating this connection.	The beneficial influence of technological innovation on operational performance in a firm may be attributed to the dynamic capabilities of the supply chain, namely collaboration, information sharing, integration, and agility.

Scholten et al. (2014)	**Case Study of VOAD El Paso**	To integrate theory and practice to provide a holistic framework for supply chain resilience through analysis of the correlation between the theoretical concepts of supply chain resilience and practical emergency management strategies employed by operational practitioners.	Within the framework of the four main phases of disaster management, the authors have emphasized the relationship between disaster management protocols and essential capabilities required to establish supply chain resilience, including knowledge management, collaboration, agility, risk awareness, and supply chain re-engineering.
Mandal (2012)	**Quantitative Analysis**	To ascertain the essential components of supply chain resilience deemed significant by IT professionals for the daily, efficient, and effective operation of a resilient supply chain.	This study indicates that to develop a resilient supply chain, supply chain managers and decision-makers should consider design/re-engineering, agility, collaboration, and supply chain risk management as essential aspects of their design features.

2.4 Study Framework and Hypotheses Development

2.4.1. The Linkages Among Supply Chain Dynamic Capabilities (SCDC), Technological Innovation, and Supply Chain Resilience

In the context of a constantly changing and dynamic business landscape, marked by notable transformations in market structures such as shorter product lifecycles, global volatility, alterations in national legislation, and imbalances in supply and demand, as well as inventory costs owing to inadequate market demand forecasts, attaining supply chain efficiency is a challenging endeavor (Lee, 2004). Hence, the company's resilience to supply chain disruptions is a critical organizational capability that enables it to effectively navigate the implications of such disruptions while maintaining its competitive edge (Fiksel, 2015). Hence, it is imperative for a company to develop and identify the necessary capabilities to effectively execute the suitable strategies essential for dynamic and unpredictable contexts and to enhance their responsiveness to supply chain disruptions (Liao et al., 2010; Blackhurst et al., 2011).

In addition, Sabahi & Parast (2020) asserted that to attain supply chain resilience, it is imperative for all firms to use novel approaches that surpass conventional supply chain management strategies. Moreover, organizations are compelled to prioritize innovation to proficiently adjust to swift fluctuations in products, services, challenges, and customer preferences (Sabahi & Parast, 2020; Golgeci & Ponomarov, 2013). According to the study by Parasat et al. (2019), businesses may improve their innovation and supply chain resilience by allocating resources toward developing essential organizational capabilities that are prerequisites for fostering innovation and resilience. The authors revealed that businesses that cultivate a more innovative environment are likely to exhibit more resilience in the face of disruptions. This is because innovation enables firms to enhance capabilities that directly and indirectly increase risk management capability.

According to (Teece et al., 1997), supply chain dynamic capabilities could be characterized as the ability of an organization to effectively incorporate, construct, and restructure technology, resources, and functions both within and outside the organization. This ability enables the business to adapt and respond to constantly evolving circumstances. These Supply Chain Dynamic Capabilities have the potential to exert an impact on technological innovation and supply chain resilience.

After conducting an extensive examination of relevant scholarly works and conducting in-depth interviews with experts and academics well-versed in supply chain resilience and technological innovation, this study has identified the supply chain dynamic capabilities that have been frequently employed in previous research and are also recommended by experts for investigating their interrelationships with technological innovation and supply chain resilience. Thus, the proposed conceptual framework of this study will encompass supply chain dynamic capabilities, namely agility, information sharing, collaboration, flexibility, Supply Chain Distribution Orientation (SCDO), collaboration, leadership support, and supply chain integration. Therefore, this research study hypothesizes the following main hypotheses:

H1: There is a Positive Relationship between Supply Chain Dynamic Capabilities and Technological Innovation.

H2: There is a Positive Relationship between Supply Chain Dynamic Capabilities and Supply Chain Resilience.

Hence, based on the intensive investigation of the pertinent literature review, the subsequent sections will thoroughly elucidate the supply chain dynamic capabilities and their interconnections with technological innovation and supply chain resilience.

2.4.1.1 Agility

According to Wieland & Wallenburg (2013), the concept of supply chain resilience encompasses two distinct dimensions. The first dimension is proactive and focuses on the idea of robustness. The second dimension is reactive and pertains to the concept of agility. Agility in supply chain management (SCM) relates to the capability to efficiently and quickly manage suppliers, internal entities, and customers (Dubey et al., 2018b). In the current era characterized by disruptive forces, it is crucial for firms to exhibit agility across several domains, including supply chain management. This attribute enables organizations to endure and thrive against fierce competition (Claudio et al., 2021).

Therefore, the concept of agility is closely linked to the capability of supply chains to promptly and effectively respond to disruptions and emergencies (Christopher & Peck, 2004; Ponomarov & Holcomb, 2009). Among the 14 factors identified by Soni et al. (2014), agility was the most prominent enabler of supply chain resilience. However, visibility and velocity are two aspects of agility proposed by (Christopher & Peck, 2004; Faisal et al., 2006; Wieland & Wallenburg, 2013 Scholten et al., 2014; Azadeh et al., 2014).

Wieland & Wallenburg (2013) argue that **visibility** allows managers to acquire knowledge regarding changes, making it an essential requirement for initiating a response. The authors contend that enhancing communication and collaboration can increase agility and resilience by employing enhanced visibility of activities and operations. However, the ability to view one end of the pipeline from the other end is characterized as visibility (Christopher & Peck, 2004). Furthermore, attaining supply chain visibility relies on establishing solid partnerships with both customers and suppliers and is a direct result of investing in information sharing (Christopher & Peck, 2004; Soni et al., 2014; Brandon-Jones et al., 2014).

Furthermore, the notion of **velocity** is critical to agility (Scholten et al., 2014). The loss per unit of time in a risk occurrence is determined by its velocity (Jüttner & Maklan, 2011). Barroso et al. (2011) investigated the significance of recovery speed, asserting that supply chain resilience could be realized by reconfiguring the supply chain to effectively manage unfavorable accidents and interruptions. According to Christopher and Peck (2004), three fundamental principles can enhance supply chain velocity. Firstly, streamlined processes involving parallel activities and electronic-based systems should be utilized instead of paper-based methods. Secondly, the elimination of non-value-added time that does not contribute value from the customers' standpoint. Lastly, reducing bound lead times refers to swiftly responding and adapting to short-term fluctuations. In their study, Wieland & Wallenburg (2013) examined the impact of communication, collaboration, and integration on agility. They declared that communication and collaboration contribute positively to agility by improving visibility and velocity.

Moreover, Lee (2004) proclaimed that prosperous companies should develop Triple-A Supply Chains characterized by their Agility, Adaptability, and Alignment. Implementing the Triple-A Supply Chain framework empowers enterprises to respond to dynamic market conditions effectively, facilitate seamless coordination of company operations, foster information sharing, manage risks, and enhance overall supply chain partners' competitiveness and performance. Ashrafi et al. (2019) asserted that during periods of disruption and emergency, the capability to respond effectively is strongly linked to the notion of agility, which may be enhanced via the use of innovative practices. Hence, it may be argued that innovative firms are expected to adapt to disruptions more quickly due to their propensity for pursuing original ideas and solutions (Christopher & Peck, 2004; Ponomarov & Holcomb, 2009).

Ju et al. (2016) studied a sample of 206 enterprises in Korea. Their research findings indicate that supply chain dynamic capabilities, including agility, have a favorable impact on operational performance and technological innovation. Additionally, results revealed that the relationship between supply chain dynamic capability and operational performance is partially mediated by technological innovation. Likewise, according to Akgün & Keskin (2014), there is a favorable association between competence orientation, agility, and product innovation. Therefore, the enhancement of supply chain agility may be achieved by improving visibility in terms of demand levels and inventory levels throughout the supply chain and maintaining partners' engagement in regular and frequent communication. Furthermore, it is imperative to uphold supply chain agility by enhancing ***velocity***, which entails the ability to respond promptly in making supply chain decisions, expeditiously introducing new goods to fulfill consumers' expectations, and swiftly delivering items to clients ahead of schedule (Rojo et al., 2018; Dubey et al., 2018b; Barrat & Oke, 2007; Kaufmann & Gaeckler, 2015; Vickery et al., 2015; Kaipia, 2008; Chiang et al., 2015). It is worth noting that multiple empirical studies have provided evidence supporting the assertion that supply chain agility has a favorable impact on business performance (Al Humdan et al., 2020; Benzidia & Makaoui, 2020).

However, it might be summed up by quoting Mandal (2012, p. 56), who said, “While supply chain resilience is challenging to achieve, it is not impossible. One such strategy to achieve is the creation of an agile supply chain. Therefore, as elucidated earlier, agility will be measured by velocity and visibility utilizing six items. It will be measured by velocity using three items: Fast response to SC decisions, swift introduction of new items, and provision of items to clients before the due date (Kaufmann & Gaeckler, 2015; Vickery et al., 2015; Kaipia,2008; Chiang et al., 2015). Additionally, SC agility will be measured by visibility utilizing three items: visible stock levels, visible demand levels, and maintaining constant contact with partners (Dubey et al.,2018b; Barrat & Oke, 2007). Therefore, this study hypothesizes the following:

H1a: There is a positive relationship between agility and technological innovation.

H2a: Agility positively influences supply chain resilience.

2.4.1.2 Information-Sharing

Many experts in supply chain management have stressed the significant impact of information sharing on enhancing a company's resilience in the event of a disruption (Datta et al., 2007; Soni et al., 2014). According to Christopher & Peck (2004), establishing a healthy supply chain defined by information sharing among its participants is critical in encouraging collaboration and limiting risks. Mandal (2012) asserts that effective collaboration necessitates the efficient and effective delivery of relevant information to each individual engaged. In their study, Soni et al. (2014) examined ten factors that contribute to the resilience of supply chains. The authors identified information sharing, visibility, and collaboration as distinct drivers among these factors. The authors also examined internal and external information sharing as two elements supporting resilience in large firms.

Furthermore, in a comprehensive examination of multiple cases, it was found that six out of seven firms placed significant importance on establishing pre-defined communication protocols. This emphasis was driven by the objective of minimizing the impact of disruptions by facilitating effective information sharing (Blackhurst et al., 2011). However, information sharing between suppliers and manufacturers can be defined as acquiring and disseminating information about risks that threaten the supply chain (Matook et al., 2009).

Furthermore, Premkumar & King (1994) defined information sharing as organizational capital, a valuable resource pertaining to transmitting and exchanging knowledge within an organization. The effectiveness of information delivery plays a crucial role in determining the quality, accessibility, accuracy, and relevance of the information (Cao & Zhang, 2011). Kwak et al. 2018 asserted that the role of innovation in the supply chain is crucial for enhancing information channels and facilitating the broader and faster dissemination of information, ultimately leading to improved risk management. Furthermore, sharing information with partners in the supply chain may lead to improved decision-making about ordering, capacity allocation, collaborative forecasting, and production/material replenishment. This, in turn, enhances customer response and optimizes the supply chain dynamics (Huang et al., 2003). According to Pereira's (2009) findings, exchanging critical information across supply chain partners can enhance inter-organizational coordination and increase the product quality of manufacturing enterprises.

In their study of 125 manufacturing businesses in North America, Zhou & Benton (2007) examined the integration of information sharing and supply chain practice in supply chain management. The authors discovered that effective information sharing considerably improves effective supply chain practice. Additionally, supply chain dynamism significantly improves effective supply chain practice and information sharing. The study's primary findings indicate that achieving successful supply chain performance necessitates the simultaneous implementation of efficient information sharing and effective supply chain practices. Harland et al. (2004) discovered that acquiring, sharing, and distributing knowledge across SC partners enables innovation, resulting in long-term SC competitiveness.

Furthermore, Lee et al. (2018) asserted in their empirical investigation involving 197 Malaysian manufacturing enterprises that it is essential for manufacturers in Malaysia to effectively communicate pertinent information on events, difficulties, or modifications that might potentially impact their partners throughout the supply chain. This includes sharing proprietary information and business knowledge that holds significant importance and exchanging information that facilitates effective business planning. Undoubtedly, adopting this approach will enhance the dissemination of information, optimize the efficiency of supply chains, and enhance an organization's rate of technology adoption, therefore fostering a competitive edge in the technological landscape and ultimately providing a prompt reaction to the evolving demands of customers. Likewise, Ritala et al. (2015) empirically analyzed 150 technology-intensive enterprises in Finland. The results indicated that the act of sharing external information has a beneficial impact on innovation performance. However, it was observed that high levels of firm employees engage in unintentional and intentional knowledge leakage, negatively moderating this association.

Therefore, SC information sharing will be measured by four items: Knowledge sharing of core business processes. Sharing of information essential for business planning. Sharing critical issues that could impact/harm supply chain partners, and sharing information about any changing needs (Lee et al., 2018; Ju et al., 2016). Hence, this inquiry proposes the following hypotheses:

H1b: There is a positive relationship between information sharing and technological innovation.

H2b: Information sharing positively impacts supply chain resilience.

2.4.1.3 Flexibility

Flexibility within the supply chain context could be characterized by the ability to successfully assume various postures to address unusual conditions and swiftly adjust to significant changes (Lee, 2004). Consequently, this phenomenon serves to bolster the resilience of the supply chain. In the study by Rojo et al. (2018), the authors utilized the framework introduced by Moon et al. (2012). Through their analysis, the authors observed that the notion of supply chain flexibility encompasses multiple dimensions or indicators.

These dimensions include sourcing flexibility, which encompasses the accessibility of materials and services and the ability to procure them per evolving requirements. Another dimension is operating system flexibility, which pertains to producing products with various combinations, volumes, and characteristics to accommodate a wide range of consumer requirements. Distribution flexibility is another dimension encompassing a firm's capability to effectively and efficiently manage its warehouses, distributors, capacities, and other distribution facilities. Lastly, information systems flexibility pertains to the ability of an organization's information systems to adjust and accommodate evolving market conditions, particularly in situations where unforeseen discrepancies emerge.

According to Rojo et al. (2016), a flexible supply chain can serve as both a reactive capability and a strategic function. In contexts characterized by uncertainty, organizations have the potential to gain a competitive edge by leveraging their flexibility to effectively navigate and adapt to uncertain and dynamic conditions, hence outperforming their rivals (Stevenson & Spring, 2007). The likelihood of a firm successfully creating and implementing innovative solutions to disruptions or threats is higher when the firm's network exhibits greater flexibility. This flexibility enables the firm to leverage its network to foster innovativeness effectively. It is anticipated that diverse facets of flexibility contribute to the enhanced resilience of an innovative organization, as an innovative culture not only promotes a more significant number of solutions to potential challenges but also enhances their implementation (efficacy) (Rojo et al., 2018).

According to Lau (1996), a firm with high organizational flexibility can promptly adapt to internal and external environmental changes. Therefore, in a context characterized by a firm's innovativeness, including flexibility enables the generation of a higher quantity of original ideas in situations that entail risk, owing to the inherent flexibility embedded in its system. Based on the above discussion, SC flexibility will be measured by four items: sourcing flexibility, operational flexibility, distribution flexibility, and SC information system flexibility (Rojo et al., 2018; Can Saglam et al., 2021; and Juan et al., 2022). Therefore, the following hypotheses could be proposed:

H1c: There is a positive relationship between flexibility and technological innovation.

H2c: Flexibility positively impacts supply chain resilience.

2.4.1.4 Supply Chain Disruption Orientation (SCDO)

Supply chain risks pose significant challenges to continuing business operations in the long run. Assessing supply chain risks must become integral to the decision-making process across all organizational levels (Christopher & Peck, 2004). In his scholarly investigation, Duncan (2012) articulated his perspective on “the presence of risk everywhere, irrespective of who owns it." Moreover, Mandal (2012) outlines four essential steps for implementing risk management in the supply chain: risk identification, risk mitigation, risk assessment, and risk performance.

There has been a recent uptick in research and practice aimed at improving Supply Chain Disruption Orientation SCDO and SCR implementation for managing supply chain disruptions (Ambulkar et al., 2015; Blackhurstet al., 2011; Scholten & Schilder, 2015; Stevenson & Busby, 2015). Disruption orientation is essential for reconfiguring and reorganizing dynamic capabilities to maintain firm operations in the modern information era characterized by massive disruptions (Kim et al., 2015; Teece & Leih, 2016). An SCDO refers to a firm's strategic orientation toward recognizing and anticipating future disturbances, as well as examining and deriving lessons from prior disruptions (Ambulkar et al., 2015; Bode et al., 2011). In supply chain interruptions, companies may address the situation by implementing measures to update or restructure their risk management infrastructure. Additionally, they may draw upon past instances of disruptions to exploit new opportunities and mitigate threats (Ambulkar et al., 2015).

The term "supply chain disruption orientation" was coined by Bode et al. (2011, p.837) to describe "a firm's general awareness and consciousness of, concerns about, seriousness toward, and recognition of the opportunity to learn from supply chain disruptions." According to Bode et al. (2011), enterprises focused on supply-chain disruption orientation can acquire knowledge from past disruptions and develop proactive capabilities to handle SC disruptions effectively in circumstances characterized by intense competition. As such, the approaches associated with an effective SCDO include the reinstitution or rectification of risk management infrastructure (Bode et al., 2011), the application of lessons learned from past disruptions to mitigate future threats (Reimann et al., 2017), and the pursuit of previously unrealized opportunities (Ambulkar et al., 2015). After conducting an in-depth study of 112 Brazilian firms, Queiroz et al. (2022) emphasized the importance of supply chain disruption orientation in assisting firms in building supply chain resilience. Furthermore, Stephens et al.'s (2022) empirical study of 227 American firms found that organizations would employ their SCDO to foresee, mediate, and construct supply chain activities to bolster their capacity to handle disruption ramifications. Moreover, the authors revealed that SCDO is a strategic approach toward supply chain interruption that strengthens an organization's ability to build supply chain resilience. In their study, Ambulkar et al. (2015) examined the connections among supply chain disruption orientation, firm resilience, and resource reconfiguration. They found that supply chain disruption-oriented firms necessitate the capacity to rearrange resources or possess a risk management resource infrastructure in order to cultivate resilience. However, greater SCDO is correlated with larger buffers and a risk appetite (Bode et al., 2011).

In light of the emergence of novel products and the accelerated pace of innovation, it is imperative for organizations to devise distinctive strategies that are tailored to this specific environmental framework (Fisher, 1997). Cultivating a disruption orientation involves the establishment of a prospective functional organizational capability that enables a firm to adapt to the dynamic nature of the supply chain effectively. However, SCDO necessitates organizational procedures that could be employed to (re)arrange the firm's available resources (Eisenhardt & Martin, 2000). The resources encompass many elements, such as production equipment, inventories, and procedures related to alliances and material procurement. While Product innovation is essential and helpful, it may also increase the complexity and unpredictability of running a firm. This is in line with the primary results of the empirical study of 164 firms conducted by Ambulkar et al. (2022); the study revealed a positive correlation between heightened levels of product innovation activity and increased reliance on suppliers, thus a subsequent rise in product diversity.

Consequently, these factors contribute to an escalation in the vulnerability of firms to supply chain disruptions and associated risks. According to Bode et al. (2011) and Yu et al. (2019), firms with a high level of SCDO and a history of frequent disruptions within their supply chain may manifest various feelings towards these disruptions. These feelings. are measured through multiple dimensions, including a perception that disturbances are unavoidable, the firm remains vigilant and considers SC disruption is looming, the company has addressed previous disruptions, and the company can thoroughly evaluate and derive insights from any disruption (Bode et al., 2011; Yu et al., 2019). Moreover, previous research has indicated a positive correlation between the degree of innovativeness within an organization and the presence of a learning-oriented approach and joint decision-making processes (Hurley & Hult, 1998).

Therefore, SCDO will be measured by four items, including the perception that disturbances are unavoidable. The firm remains vigilant and considers SC disruption looming. The company has addressed previous disruptions. Moreover, it can thoroughly evaluate and derive insights from any disruption (Bode et al., 2011; Yu et al., 2019). Thus, this study hypothesizes the following hypotheses:

H1d: There is a positive relationship between SCDO and technological innovation.

H2d: SCDO positively affects supply chain resilience.

2.4.1.5 Collaboration

Collaboration among fourteen enablers was the second most crucial aspect in improving supply chain resilience, according to research conducted by Soni et al. (2014). Collaboration is widely acknowledged as a crucial factor in shaping the resilience of supply chains. This can be attributed to its facilitation of various other elements, including but not limited to visibility, awareness, avoidance, decision-making, and integration. Furthermore, collaboration facilitates preparedness for interruption and empowers supply chain partners to promptly adapt to alterations (Kumar & Anbanandam, 2020). The enhancement of risk reduction and supply chain recovery capability is advocated through collaboration among supply chain players.

The term "supply chain collaboration" was used by Simatupang et al. (2002) to describe the coordinated activities of two or more participants in a supply chain to gain a competitive advantage. This is accomplished by sharing information, distributing benefits, and collaborative decision-making. The primary objective of such collaboration is to enhance profitability by effectively meeting the needs of end customers rather than pursuing individual endeavors. Fawcett et al. (2012) declared that supply chain collaboration is considered a crucial dynamic capability that has the potential to yield distinct performance advantages. The authors have identified several factors that drive the necessity for collaboration among firms within their supply chains, including safeguarding a company's strategic position, establishing a global presence, enhancing financial performance, and emphasizing the development of a high-performing team.

Salam (2017) posits that collaboration is based upon a combination of trade partners who collectively share responsibilities and objectives and engage in the mutual exchange of planning, management, execution, and performance assessment information. This collaborative endeavor aims to attain a synchronized supply chain.

However, the establishment of collaborative partnerships between parties requires two crucial factors: trust and information sharing (Kamalahmadi & Parast, 2016). Trust was one of 14 characteristics that participants in research by Soni et al. (2014) found to help strengthen supply chain resilience. According to the survey's respondents, trust was regarded as the seventh most essential factor. In their study, Ponomarov & Holcomb (2009) examined the mutual trust behaviors shown in buyer-supplier interactions. They observed that a higher level of mutual trust might enhance relational resilience. The design of a cooperative relationship necessitates the presence of a trustworthy network, hence improving the resilience of supply chains. According to Wicher and Lenort's (2012) research, a trustworthy network has a high degree of mutual trust between nodes, facilitating open discussions regarding difficulties.

According to Pettit et al. (2010), collaboration is characterized by the capacity to engage in productive interactions with other entities to achieve mutually advantageous outcomes. Cooperative conduct and collaborative risk distribution reduce uncertainty, according to Reinmoeller & Van Baardwijk (2005). Furthermore, Makkonen & Vuori (2014) asserted that the achievement of superior operational performance is contingent upon establishing a close and collaborative relationship between a customer and supplier. Consequently, the larger the degree of reliance, the greater the firm's incentive to sustain collaboration. Similarly, trust and technology are critical elements that create such dependency. However, organizations have widely recognized that the use of technological innovations significantly enhances the overall efficiency of the supply chain. This improvement is achieved by collaborating with many supply chain stakeholders (Wang & Hu, 2017).

According to the research conducted by Chatterjee et al. (2022), fostering collaboration among all stakeholders is crucial to enhancing supply chain resilience in disruptive circumstances. This collaboration is anticipated to strengthen teamwork and facilitate achieving the desired firm performance. In their study, Ju et al. (2016) argued that collaboration among supply chain partners is a dynamic capability that has a favorable influence on technological innovation and operational performance. Specifically, collaboration has a significant role in influencing product and process innovations, ultimately resulting in cost reduction, delivery, flexibility, and quality enhancements. In their study, Hamidu et al. (2023) identified collaboration as one of the supply chain resilience strategies, alongside flexibility, redundancy, and agility. These strategies assist managers in effectively addressing current challenges and improving overall performance by leveraging the role of technological innovation practices. Jimenez-Jimenez et al. (2019) conducted an empirical investigation to analyze the direct effects of information technology (IT) and supply chain collaboration on product innovation. The study was conducted on a sample of 200 manufacturing enterprises. The investigation further examined the indirect impact of information technology (IT) on product innovation using the mediating function of supply chain collaboration. The results indicated that supply chain collaboration positively influences product innovation, suggesting that engaging in collaborative relationships with external partners can facilitate technological innovations.

According to Salam (2017), the ability to identify and establish connections between complementary capabilities through collaboration results in enhanced performance. Furthermore, collaboration facilitates the speedy creation of innovative goods, reducing product and supply chain expenses, enhancing overall quality, shortening cycle times, and ultimately improving customer satisfaction.

Therefore, to foster successful collaborative relationships, it is imperative that partners engage in joint efforts to develop novel market and customer responses. Establish a comprehensive communication plan and maintain regular interaction during disturbances. Cooperating in the design of their processes or products, and collaborating in implementing their operational processes, these items were adopted from studies by (Ju et al., 2016; Simatupang & Sridharan, 2008; Cao & Zhang, 2011). Therefore, the following hypotheses could be posited:

H1e: There is a positive relationship between collaboration and technological Innovation.

H2e: Collaboration positively impacts supply chain resilience.

2.4.1.6 Leadership Support

The significant role of leaders and senior managers in effecting cultural change within a company cannot be overstated (Parast et al., 2019); the authors identified leadership as one of the critical characteristics that improved organizations' capability to withstand and recover from supply chain disruptions. Furthermore, the authors averred that investing in innovation enhances a company's ability to endure and recover from processes, demand, and supply disturbances, resulting in higher overall performance. However, the notion of leadership is commonly understood as a social phenomenon wherein "individuals exert influence over others to guide their actions toward the attainment of certain objectives." A broader conception states that leadership entails implementing management practices distinguished by top-level management's support, employees' active involvement, and the ability to make exceptional decisions (Han et al., 2020). Nevertheless, it is essential to note that researchers lack consensus about a universally accepted definition of leadership (Ndonye & Odiyo, 2022).

Organizations require measurement strategies to continue their innovation initiatives. However, Sloane (2007) offered crucial metrics, such as the need for businesses to keep track of new concepts initially. Second, they must demonstrate efficiency by calculating how many ideas make it through the first round of selection and become initiatives. Finally, the system should track how many prototypes become new products. Indeed, institutional methods to capture and monitor innovations are the clearest sign of leadership's unwavering commitment to innovative solutions (Hamel, 2002).

Furthermore, Bag et al. (2021) demonstrated that leadership plays a crucial role in augmenting the influence of company dynamic capabilities on innovation and supply chain resilience. Similarly, the study conducted by Shin & Park (2021) provided empirical evidence supporting a favorable association between a firm's leadership, supply chain capabilities, and the overall supply chain resilience outcome. Oeij et al. (2022) emphasized that fostering environments conducive to innovation is a crucial leadership responsibility. This encompasses the implementation of mechanisms that facilitate the advancement of innovation, such as the facilitation and assessment of novel concepts, the identification and cultivation of potential ideas, the establishment of platforms that enhance organizational capabilities, the engagement with external networks to harness resources, and the establishment of meticulously designed systems for measuring and rewarding (Davila et al., 2012).

Empirical research has indicated that several leadership styles, such as authoritative, transactional, and transformational, have been found to foster employee innovativeness. Among these types, authoritative leadership has been identified as the most successful (Ndonye & Odiyo, 2022). In their case study, Demmer et al. (2011) stated that top management plays a crucial role in fostering innovation in SMEs; Demmer is one of the few domestic automotive suppliers in Michigan that has succeeded in repeatedly reinventing itself by developing new products, expanding into new markets, and providing innovative technological innovation for its customers.

Furthermore, Pham et al. (2023) conducted a study to examine the influence of transformational leadership on both green innovation and green learning in Vietnamese construction enterprises. According to the findings, transformational leadership promotes green innovation, encompassing both green product and process innovation. Similarly, Zhang et al. (2018) argue that leadership support significantly impacts a firm's innovative capabilities in effectively navigating turbulent environments. In this case, the organization requires financial aid, which can be obtained with the leadership team's support (Le & Lei, 2018).

Additionally, Chatterjee et al. (2022) examined the influence of businesses' absorptive capability on adopting emerging technology while also exploring the moderating role of leadership support in the link between adopting contemporary technology and firm performance. The study demonstrates the moderating influence of leadership support on the nexus between adopting modern technology and firm performance. Moreover, as Scholten and Schilder (2015) and Wieland and Wallenburg (2013) noted, leadership contributes to company resilience and performance. Sharif & Irani (2012) argue that leadership within the supply chain setting positively impacts the overall performance of organizations.

In conclusion, companies that exhibit resilience necessitate cultivating innovation, which is facilitated by leadership with the requisite power and willingness to take risks. This assertion is supported by empirical research that has demonstrated the significance of attributes such as innovativeness, creativity, inspiration, spontaneity, improvisation, adaptability, and interpersonal connections in the realm of leadership (Mamula et al., 2019). However, the following dimensions will be employed to measure leadership support as a supply chain dynamic capability: The sufficient support senior management provides during the disruption. The crucial role is in effectively navigating and managing a chaotic environment. The essential role of senior management in decision-making during unpredictable circumstances. The pivotal role of upper-level management in formulating supply chain resilience strategies. The experience of the upper echelon leadership in navigating a volatile business climate (Chatterjee & Chaudhuri, 2021; Smart et al., 2017; Zhang et al., 2018; Le & Lei, 2018).

Following the above argument, SC leadership support will be measured by four items: sufficient support from senior management during the disruption, by effective navigation and management of a chaotic environment. The essential role of senior management in decision-making during unpredictable circumstances. The pivotal role of upper-level management in formulating supply chain resilience strategies. The experience of the upper echelon leadership in navigating a volatile business setting, as adopted by (Chatterjee & Chaudhuri, 2021; Smart et al., 2017; Zhang et al., 2018; Le & Lei, 2018; Donate & Guadamillas, 2011; Venkatraman, 1989; Fiedler, 1993). Therefore, this study posits the following hypotheses:

H1f: There is a positive relationship between leadership support and technological innovation.

H1f: Leadership support positively influences supply chain resilience.

2.4.1.7 SC Integration

Supply Chain Integration strategically coordinates and manages collaborative efforts between enterprises and inside firms (Hendijani & Saei, 2020). Supply chain integration is the extent of collaboration between an organization and its significant partners throughout the supply chain (Flynn et al., 2010). Wiengarten et al. (2019) claim that collaborative efforts enhance the efficiency and efficacy of utilizing resources across all participants within the supply chain. Supply chain integration pertains to the ability of a company's leaders to effectively incorporate and coordinate all internal processes and external partners, such as distributors, retailers, and suppliers, to ensure the smooth flow of the final product to the end customer (Zhao et al., 2013). Thus, it is possible to gauge the degree of supply chain integration by evaluating the extent to which the exchange of information, capital, and material flows between the central firm and its partners (Rai et al., 2006). Supply chain integration can take several manifestations, ranging from integrating with suppliers, commonly referred to as backward or upstream integration, to integrating with consumers, commonly referred to as forward or downstream integration (Siagian et al., 2021).

Furthermore, the notion of supply chain integration (SCI) has been classified into two primary components by Wei et al. (2021), Li (2015), and Frohlich & Westbrook (2001). These components include internal integration (inter-functional or inter-departmental) to external (with downstream or upstream actors) integration. Supply chain integration may be seen as a strategic choice aimed at establishing linkages across various stakeholders in the supply chain, including suppliers, manufacturers, distributors, and customers, to exchange necessary information pertaining to emerging markets, goods, consumers, and future markets. According to Tian et al. (2021), organizational structure and culture are crucial in providing a solid basis for forming supply chain integration.

In their study, Liu et al. (2020) asserted that integrating suppliers will provide enhanced collaboration between the involved parties, enabling them to jointly innovate regarding product innovation, process innovation, and material requirements. Furthermore, the integration of information systems inside firms has been found to have a favorable impact on both process innovation and product innovation. In their study, Ju et al. (2016) asserted that integration among supply chain partners has a favorable influence on technological innovation and firm operational performance.

Furthermore, Siagian et al. (2021) stressed the importance of supply chain integration as a strategy to boost business results by fostering innovation, flexibility, and resilience. Integrating all stakeholders throughout the supply chain facilitates coordinating activities such as planning, production, delivery, and information sharing. Moreover, Nguyen et al. (2021) studied 389 pharmaceutical firms, indicating a strong and negative connection between supply chain risk and supply chain integration. Furthermore, empirical evidence has demonstrated that integrating supply chain processes yields a statistically significant and favorable impact on the supply chain's resilience and the organizations' overall performance. It is noteworthy to recognize that a substantial body of academic studies has established a favorable correlation between supply chain integration and business success (Wei et al., 2021; Tian et al., 2021; Hendijani & Saei, 2020; Zhou et al., 2020; Weingarten et al., 2019). Following the above discussion, SC integration will be measured by four items: The departmental integration in the firm. The relationship between integration capability and collaboration within the firm. Involvement of key supply chain partners in goal-setting, planning, and problem-solving. Proactive response to changing demands (Demand forecast). These items were adopted from studies by (Muafi & Sulistio, 2022; Eslami et al., 2021; Ju et al., 2016). Therefore, this study posits the following hypotheses:

H1g: There is a positive relationship between SC integration and technological innovation.

H2g: SC integration positively influences supply chain resilience.

2.4.2 The Mediating Role of Technological Innovation and The Impact of Technological Innovation on Supply Chain Resilience

2.4.2.1 Innovation and Firm Innovativeness

According to Hurley & Hult (1998), there are two stages of innovation: innovativeness (organizational culture) and the capacity to innovate (organizational outcome). Innovativeness could be defined as “the inclination toward embracing novel ideas within the cultural framework of an organization.” The innovativeness of the culture reflects the organization's commitment to innovation. The term "innovative capacity," a concept coined by Burns & Stalker (1961), describes a firm's propensity to effectively embrace or apply new ideas, procedures, or products. Cohen et al. (1990) define innovative capacity as absorptive capability; this capability could be measured by the number of innovations a company can effectively embrace or execute.

According to Schumpeter (1939), the classical concept of innovation encompasses the creation of novel goods, the establishment of innovative organizational structures, the exploration of untapped markets, the development of novel manufacturing methods, and the discovery of alternative sources of raw materials. Moreover, Rogers & Rogers (1998) defined innovation as the range of actions and modifications undertaken by a company to develop novel or enhanced goods or processes to improve its overall performance. When paired with resources and other organizational capabilities, the innovativeness of the firm's culture produces a better potential to innovate. Firms with a more substantial capacity for innovation can gain a competitive edge and attain higher performance levels.

According to Fagerberg & Verspagen (2009), the concept of innovation encompasses the utilization of novel knowledge, ideas, methods, and skills, which have the potential to generate unique capabilities and impact the competitive position of an organization. Innovation commonly manifests in various domains, such as technologies, products, processes, strategies, services, and organizational structures (Rogers, 2003).

Ju et al. (2016) propose that innovation may be categorized into many categories: radical versus incremental, administrative versus technological, exploitative versus exploratory, and product versus process. Organizations must possess the capacity for innovation to effectively address evolving trends in products, services, customer demands, and challenges (Kim et al., 2015). According to Gunday et al. (2011), there is a connection between the type of innovation and the overall performance of organizations. Different forms of innovation have differing degrees of positive and substantial connections with particular aspects of organizational performance. Sabahi & Parast (2020) argue that adapting successfully to changes in the market requires businesses to increase their innovation capacity by reorganizing and refocusing their innovation processes and resources. An organization that can reorganize and rearrange its pool of resources in a dynamic context may be better positioned to capitalize on opportunities to develop capabilities that mitigate the impact of disruptions. Furthermore, innovative organizations abandon boring methods to effectively seek innovative ideas, thereby ensuring their resilience in the face of contemporary dynamic and disruptive environments (Teece, 2007).

In their study, Reinmoeller & Van Baardwijk (2005) emphasized the significance of innovation in enhancing resilience. They observed that the resilient Dutch companies examined in their research experienced a notable increase of 235% in their focus on innovation over a span of 20 years. The researchers asserted that companies possess the potential to effectively navigate disturbances and disruptions, as well as successfully adapt to swift environmental changes, but only if they allocate sufficient resources towards fostering innovation.

2.4.2.2 Product and Process Innovation

A set of principles that regulate the methods by which goods and services are manufactured is what Kemeny (2010) calls "technology. Innovation refers to the original utilization of ideas, skills, procedures, and knowledge that have the potential to enhance an organization's competitive advantage and foster unique capabilities (Sabahi & Parast, 2020; Mandal, 2020). According to Xu et al. (2019), innovation is a dynamic and creative procedure to generate enhanced value for a novel product to satisfy client needs and yield advantageous outcomes for the firm. Thus, technological innovations encompass the efforts made by organizations to incorporate and restructure their external and internal systems, infrastructure, human capital, and procedures. The primary goal is to exploit innovative opportunities that enhance data management, sourcing, production, and distribution. These technological innovations aim to attain responsiveness, cost-effectiveness, and timeliness within the supply chain (Kissi et al., 2021). In their study on the drivers of technological innovation in rural small food industries in Iran, Soltani et al. (2013) identified many factors that impact technological innovation. These factors include the age of the business, (R&D) activities, fixed capital, and production capacity.

As mentioned earlier by Ju et al. (2016), technological innovations may be categorized into two main types: product innovations and process innovations. Product innovations refer to creating and implementing novel and effective goods or services within the commercial sphere. Process innovations encompass the adoption and execution of novel manufacturing or service operations. Likewise, Kahn (2018, p.454) declared that product innovation refers to introducing new products, services, or programs to the market. "It encompasses product enhancements, line expansions, cost savings, new markets, new product categories, and new technology." Process innovation addresses improvements in techniques or procedures to improve service, cost, throughput, or processing.

According to Marsillac & Roh (2014), it is commonly observed that product innovation is frequently accompanied by process innovation. This is because any alterations or improvements made to a product necessitate corresponding changes to the process of providing that product. However, many scholarly works focused on the product dimension (new product development/launch, product attributes, and design). However, process innovation and its ramifications for the supply chain have received little attention thus far (Sabri et al., 2018).

Kaufman et al. (2000) argued that organizations may improve their capacity to participate in process and product innovations by carefully managing their relationships with customers and suppliers. In terms of new product ideas, Ulusoy (2003) declared that customers are the most important, followed by the R&D department, trade exhibits, and corporate management. If a company can tap into the capabilities of collaborative innovation with its SC partners, it will boost its absorptive capacity, allowing it to introduce innovative goods and services more frequently and at a faster rate (Cao & Zhang, 2011).

Based on the existing body of work on Supply Chain Resilience, Resource-Based View (RBV) and Dynamic Capabilities Theory (DCT) propose that for a firm to sustain its competitive advantage in a continuously changing business landscape, it is imperative to effectively manage and optimize its resource base through coordination, integration, combination, and reconfiguration. According to Jimenez-Jimenez et al. (2019), technological innovation holds significant importance in the value-creation process. Moreover, technological innovation can increase both the quality and flexibility of products or services while simultaneously reducing lead time and cost. As a result, it significantly impacts an organization's competitive advantage and performance.

A pre-COVID-19 worldwide survey of 1,116 experts in the context of supply chain management revealed that the rapid growth of digital technologies and innovations significantly influences and enhances supply chain operations (Kokina & Blanchette, 2019). Parast et al. (2019) investigated whether or not innovative firms are more resilient to supply chain disruptions. According to the authors, a firm with a more innovative environment is better equipped to exhibit more resilience in the face of disruptions since innovation boosts the firm's capabilities, which in turn improves its risk management in direct and indirect ways.

This idea is similar to the viewpoints expressed by Sabahi & Parast (2020) and Yu et al. (2022) that embracing technological innovation fosters the enhancement of information processing capabilities. These capabilities are vital for bolstering the supply chain resilience and enhancing performance. Supply chains are exhibiting a growing level of dynamism in response to evolving business contexts and technological innovation. This has presented difficulties in effectively overseeing the movement of resources and has amplified the likelihood of encountering disturbances (Yu et al., 2019). According to dynamic capabilities theory, supply chain capabilities are required to achieve a sustainable competitive position in a continually changing business environment (Teece, 2007). To maintain profitability and competitiveness, supply chain dynamic capabilities must be enhanced (Stevenson & Spring, 2007).

This is in line with the research outcomes of (Marsh & Stock, 2006; Helfat et al., 2009), who declared that a firm's survival and continuity depend on its capacity to adapt to market changes and innovate by assessing and optimizing resources and investments. Thus, firms that manage resources efficiently during dynamic environmental changes are more likely to have turbulence-mitigation capabilities (Eddleston et al., 2008).

In the same vein, Pettit et al. (2019) asserted that organizations must enhance their capabilities to effectively use their existing capabilities and increase their integration ability to optimize the utilization of available opportunities. Therefore, to effectively adapt to the dynamic environment and enhance the rate of innovation, a company must modify and reallocate its resources and capabilities in accordance with its management procedures and market positioning (Ju et al., 2016). Similarly, enforcing supply chain dynamic capabilities, which allows the firm to respond to changes effectively, is crucial for maintaining the firm's competitive advantage and profitability (Stevenson & Spring, 2007).

Irfan et al. (2022) studied a Pakistani textile producer and supplier over eight years to determine whether and how dynamic capabilities and knowledge management (KM) might assist enterprises in developing a resilient supply chain during high disruption and uncertainty. The authors stated that organizations, especially in emerging nations, are adopting technology to improve KM's capability. They may collect, store, exchange, and build new knowledge/models via KM to improve resilience and competitive advantage. By investing in digital technology and unique resources, focal enterprises strategically gather, transmit, and integrate market information and establish a resilient supply chain model to overcome logistics and delivery challenges.

As mentioned earlier, a study conducted by Hamidu et al. (2023) empirically investigated to determine how supply chain technological innovation (SCTI) mediates and moderates the link between SCR and SCP. The SCTI facilitated a favorable connection between the SCR and SCP. In addition, SCTI has a negative moderating effect on the nexus. Furthermore, implementing an SCTI alone is insufficient to improve SCP in manufacturing firms. Instead, SCR should be used as a channel to improve SCP. Furthermore, and in the context of service innovation, Garrido-Moreno et al. (2024) examined the impact of service innovation and organizational resilience on company performance in Spain using the framework of dynamic capabilities theory. The results confirm that innovation and resilience are essential dynamic capabilities for adjusting to a changing business environment and sustaining competitiveness. The findings also demonstrated that digital technologies like social media platforms and external networks facilitate service innovation.

Furthermore, Yang et al. (2022) conducted a study to conceptualize emerging IT capability and examine its significance in facilitating enterprises to withstand supply chain disruptions and achieve long-term success. The authors asserted that emerging IT capability empowers organizations to allocate resources dynamically. Thereby enhancing their resilience against adverse events that might result in supply chain disruptions.

In a nutshell, supply chain resilience and firm innovation are intertwined. Supply chain disruptions can be detrimental to a firm. Understanding the firm’s SCR capabilities is critical in unforeseen and severe events. As a result, innovation may be produced, deployed, and exploited in the face of supply chain interruptions and calamities. Innovative firms are more likely to devise novel strategies to hedge, fence off, or mitigate the negative consequences of unanticipated supply chain disruptions (Gölgeci & Ponomarov, 2015). Consequently, the literature review provided an examination of previous research studies that have demonstrated the existence of a positive relationship between technological innovation (product and process) and the resilience of the supply chain (Belhadi et al., 2021; Singh & Singh, 2019; Yu et al., 2019).

In light of the above arguments, technological innovation will be measured by product innovation, employing three items: The use of the latest technologies in new product development. The speed of new product development. The number of new products that are first-to-market (early market entrants) (Lee et al., 2018; Hamidu et al., 2023). Furthermore, technological innovation will be measured by process innovation using three items encompassing the technological competitiveness of processes. Adoption speed of process innovations. The rate of changes in processes (Lee et al., 2018; Hamidu et al., 2023). Hence, we propose the following hypotheses:

H3: Supply chain dynamic capabilities impact supply chain resilience through the mediating role of technological innovation.

- H3a: The relationship between agility and supply chain resilience is mediated by technological innovation.
- H3b: The relationship between information sharing and supply chain resilience is mediated by technological innovation.
- H3c: The relationship between flexibility and supply chain resilience is mediated by technological innovation.
- H3d: The relationship between SCDO and supply chain resilience is mediated by technological innovation.
- H3e: The relationship between collaboration and supply chain resilience is mediated by technological innovation.
- H3f: The relationship between leadership support and supply chain resilience is mediated by technological innovation.

- H3g: The relationship between SC integration and supply chain resilience is mediated by technological innovation.

H4: Technological innovation has a positive impact on supply chain resilience.

2.4.3 Control Variables

Drawing on prior scholarly works by Hopkins (2021), Ali et al. (2017), Kamalahmadi & Parast (2016), Soltani et al. (2013), and Ju et al. (2016), this investigation will examine the potential influence of control variables such as firm size (in terms of employees' number) and firm age (in terms of the number of years) on supply chain resilience. Therefore, this study hypothesizes the following:

H5: The firm size and firm age dimensions exhibit a controlling impact on supply chain resilience.

2.4.4 Conceptual Framework of the Study

After a comprehensive study of the existing literature on the research constructs and their interconnections, the proposed conceptual framework is depicted in **Figure 2.2.**

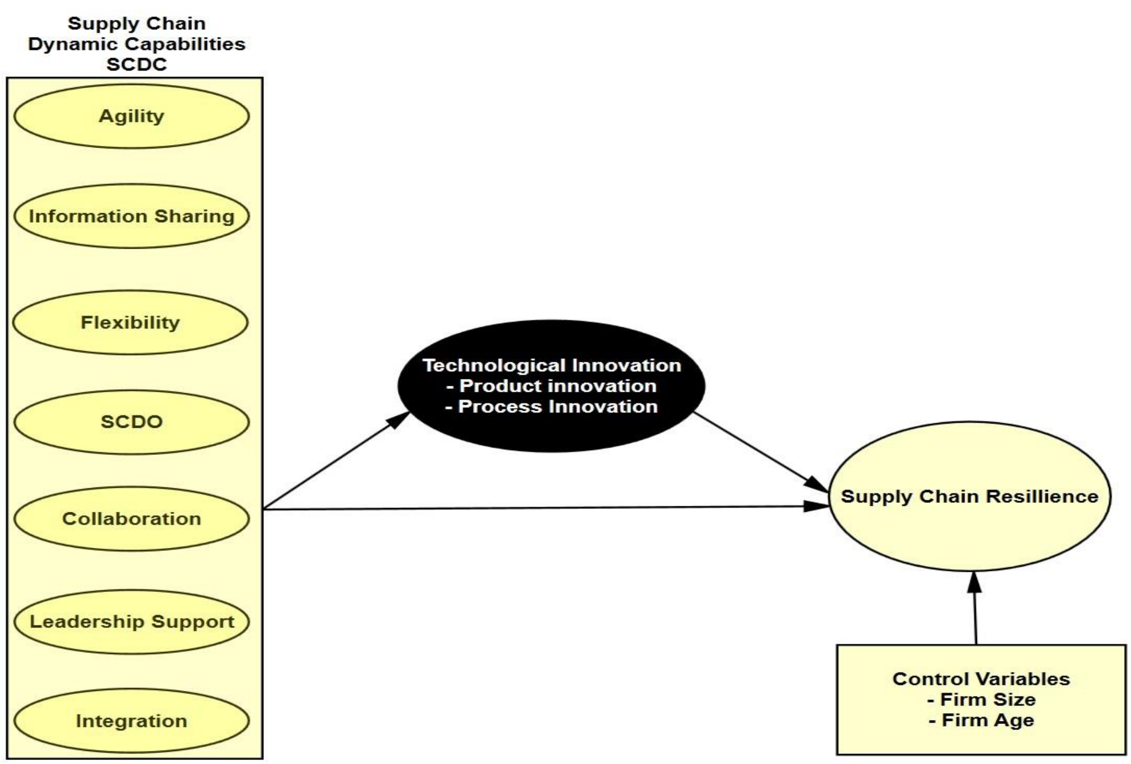

Figure (2.2): Conceptual Framework of the Study

.4.4.1 Hypotheses of the Study

Following the extensive review of the prior work and the development of the study's proposed model, the study's hypotheses have been posited, as shown in **Figure 2.3**

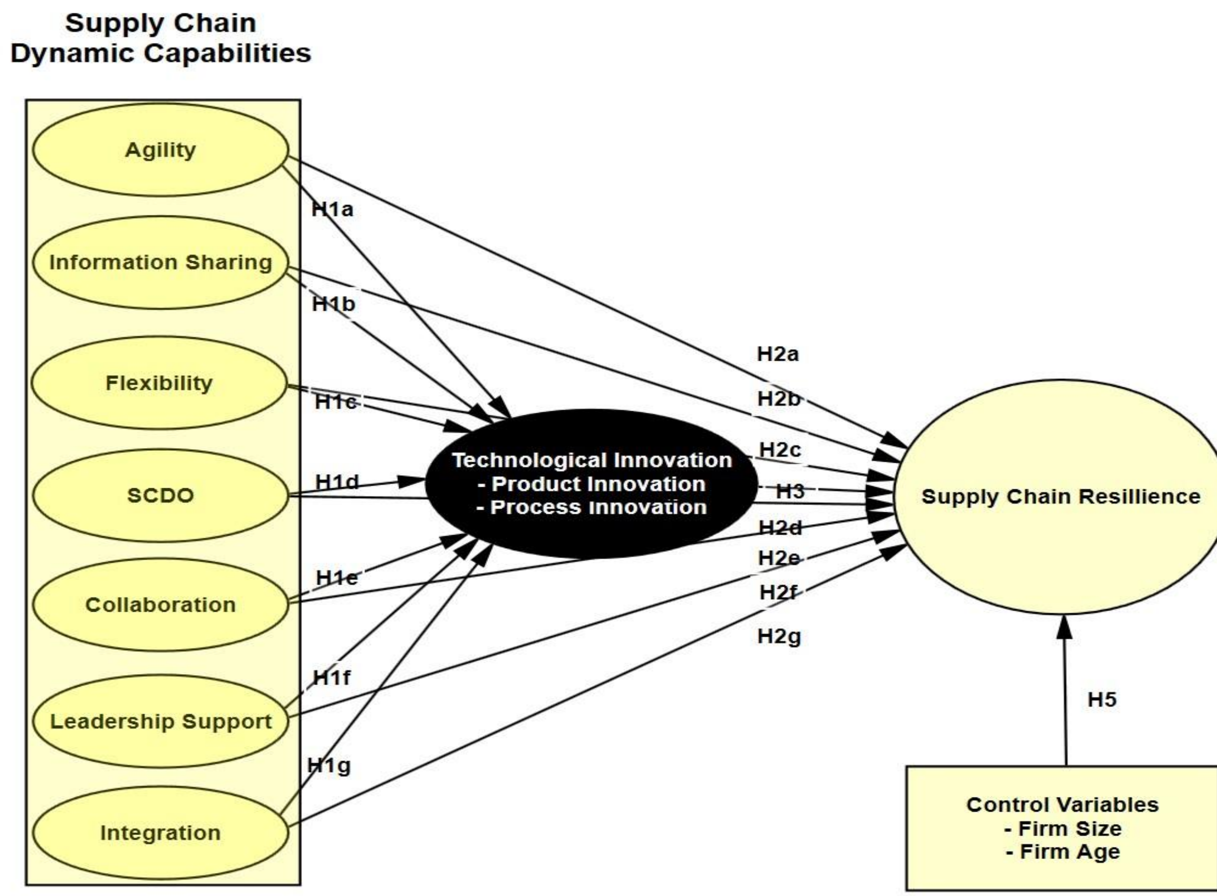

Figure (2.3): The Study's Hypotheses

2.4.4.2. Conceptual Framework Validation

Through conducting a thorough review of relevant scholarly literature and employing theoretical frameworks such as the Resource-Based View (RBV), Dynamic Capabilities (DC), and Contingency theories, as well as meeting with professionals and academics who possess substantial expertise in supply chain resilience and technological innovation, it has been identified that supply chain dynamic capabilities namely agility, information sharing, flexibility, collaboration, leadership support, supply chain disruption orientation, and integration have the potential to impact technological innovation and supply chain resilience

Furthermore, technological innovation (measured by product innovation and process innovation) might mediate the relationship between supply chain dynamic capabilities and supply chain resilience. Additionally, technological innovation might positively impact supply chain resilience. Moreover, firm size and firm age might exert a controlling effect on supply chain resilience.

2.5 The Linkage Between Strategic Management and Supply Chain Resilience

Current supply chain management topics like just-in-time, market globalization, technological disruptions, economies of scale, cost reduction through offshoring production, supplier consolidation, outsourcing, international market volatility, and global economic instability increase the probability of supply chain disruptions because of their international dissemination and fragmentation. Supply chains must embrace new strategies to quickly and efficiently respond to unpredictable market changes. Thereby boosting firm success and competitiveness (Calvo et al., 2020).

Although there have been considerable scholarly investigations on supply chain risk management and resilience strategies (Rahman et al., 2022), previous studies have primarily examined the various types and causes of risks, techniques for analyzing risks, strategies for mitigating risks, and models for understanding risk disruptions. However, none of these studies have specifically investigated SC resilience strategies for effectively managing and mitigating disruptions (Paul et al., 2016; Ho et al., 2015). It is indeed accurate that competition presently exists inside the intra-supply chain rather than within the confines of a single business; the success of SCR relies on the strategic initiatives undertaken by some pivotal stakeholders rather than an overhaul of the whole supply chain (Sá et al., 2020).

In particular, supply chain resilience depends on organizations' capacity to strategically respond to and control unexpected occurrences at each supply chain echelon. A predominant strategy for Supply Chain Resilience that has been extensively examined in prior scholarly works is comprised of four distinct stages: (1) readiness, (2) reaction, (3) recovery, and (4) adaptation (e.g., Adobor & McMullen, 2018; Stone & Rahimifard, 2018).

Furthermore, supply chain resilience was characterized by Hohenstein et al. (2015) based on ex-ante and post-ante interruptions. An ex-ante strategy is a proactive approach to establishing preparation, encompassing redundancy, collaboration, visibility, inventory management, predefined plans, and human resource management. On the contrary, a post-ante strategy is a responsive/reactive approach employed in response to a disturbance, including elements of adaptability, collaboration, human resource management, and redundancy, with the aim of recovery and growth. Most research on the reactive aspect of SCR has focused on the time and cost required. It has been shown that the effectiveness of resilience in a corporation is contingent upon its ability to promptly adapt to disruptions (Chowdhury & Quaddus, 2017). Moreover, cost is another critical factor influencing resilience in reacting to disturbances (Ivanov & Dolgui, 2020). Therefore, firms could implement several resilience strategies based on the specific characteristics of their supply chain, the nature of the disruption, and the prevailing environmental conditions (Sá et al., 2020; Stone & Rahimifard, 2018).

2.6 Summary

Our in-depth delve into relevant existing literature provided us with a comprehensive grasp of the supply chain dynamic capabilities in relation to technological innovation and supply chain resilience. However, organizations must promptly take action and revamp their business strategy in a volatile and intricate economic landscape. Companies have recognized innovation as a strategic necessity for maintaining competitiveness in response to market alteration and external environmental challenges. Additionally, supply chain resilience has garnered recognition as a crucial factor in enabling firms to respond successfully to these pressures. Although the significance of these strategic factors in an unstable environment is widely acknowledged, a dearth of empirical research is explicitly dedicated to analyzing them in developing nations.

Therefore, this study examines the impact of the seven dimensions of supply chain dynamic capabilities in addition to the impact of technological innovation (product and process) along with the controlling effect of firms' size and age on supply chain resilience, with a particular focus on the mediating function that technological innovation could exert on the nexus between supply chain dynamic capabilities and supply chain resilience. This can provide a more holistic framework that identifies interconnections among the study constructs and explains their mechanism. Therefore, it assists supply chain players in recognizing the most convenient and usable strategies and employing them in a volatile, unpredictable, complex, and ambiguous business environment.

Chapter Three: Methodology

This chapter details the research design and methodology employed in the study. It covers the population, sample, and selection methods employed. Additionally, it outlines the creation, validity, and reliability of the study instrument, along with the execution of the pilot study. Validated constructs, measurements, and measured items are provided. The chapter also presents the study techniques, including data collection methodology and statistical methods for data analysis. Furthermore, it emphasizes the ethical considerations taken into account throughout the research.

3.1 Research Paradigm: Cross-sectional, Quantitative, Ontological, and Deductive Study

Research is a systematic inquiry involving data collection, analysis, and interpretation to understand, characterize, forecast, or regulate a specific phenomenon. The research concept is deeply rooted in the complex understanding of existence (ontology) and knowledge (epistemology). This foundation gives rise to various research paradigms, including positivism, post-positivism, interpretivism/constructivism, and critical theory (Saliya, 2023; Uzun, 2016). These research paradigms, with their varying ontological and epistemological interpretations, form the rich theoretical framework of this study, shaping its approach and findings. Research paradigms, defined as the overarching understanding of the nature of research, guide investigations based on specific ontological and epistemological assumptions. However, differing interpretations of ontology and epistemology can influence and alter these paradigms (Uzun, 2016).

Research paradigms are distinguished by their objective or subjective perspectives on reality and their use of either inductive or deductive methods for generating information (Charmaz & Bryant, 2019). Positivism, sometimes known as 'the scientific method,' is a philosophical approach rooted in rationalism and empiricism (Erciyes, 2020). It originated with influential thinkers such as Aristotle, Bacon, Locke, Comte, and Kant. From an ontological perspective, positivism posits that reality is objective and exists independently of any observer or researcher (Saliya, 2023)

As stated by Irene (2014), the epistemological foundations of positivism are inherently objective, asserting that deductive reasoning can accurately capture reality. According to this perspective, reality exists independently of human perception. The researcher's role is to identify causal linkages and conduct experiments with rigorous control over variables, such as in pre-test/post-test designs. Thus, the choice of ontological and epistemological perspectives significantly impacts the study's design, ultimately shaping the researcher's adopted paradigm.

Quantitative studies typically adopt an ontological stance aligned with realism, asserting the existence of an objective reality independent of human experience. They also embrace objectivism, which holds that social phenomena and their meanings exist independently of social actors (Bibi et al., 2022; Saliya, 2023).

The research process comprises four interconnected elements: epistemology, theoretical perspective, methodology, and methods. Epistemology guides the theoretical perspectives, which in turn define the research methodology. Finally, the methodology determines and controls the research methods, including data collection and analysis (Scheiner, 2020; Bourne, 2024).

In a quantitative ontological investigation, the epistemological position is often either positivist or post-positivist. Consequently, knowledge is believed to originate from observable facts and empirical evidence. Positivist epistemology emphasizes using scientific methods to produce and verify hypotheses, preferring empirical, objective research methodologies that can be replicated (Al-Ababneh, 2020; Saliya, 2023). This is relevant to the setting of the current study, which seeks to evaluate the influence of supply chain dynamic capacities on supply chain resilience, emphasizing the mediating function of technological innovation in this nexus. A theoretical framework was developed, and hypotheses were tested employing scientific methods.

To reveal the relationships between the variables under research, a deductive approach can be used to construct causal linkages and quantitatively measure the variables' properties. As stated in Chapter Two, a thorough analysis of the relevant existing literature was conducted to develop the research's theoretical framework. Specific tests were then used to evaluate the study hypotheses and analyze the relationships between the study variables (Casula et al., 2021).

Therefore, this study employed a deductive methodology, a rational procedure where conclusions logically derive from given premises, progressing from broader concepts to more detailed aspects. The deductive technique is suitable for formulating theories and hypotheses and devising a research strategy to test those hypotheses.

The investigation established a theoretical framework and hypotheses derived from current literature. Using a deductive approach ensures that the research findings contribute to the validation or refinement of existing theories, thereby enhancing knowledge in a methodical and replicable manner.

In terms of the study's time horizon, cross-sectional studies involve gathering pertinent data at a specific point in time. These studies do not incorporate the time dimension, as all data is obtained simultaneously, mostly pertaining to the data collection period. Cross-sectional designs are often used to evaluate the occurrence of characteristics, attitudes, and knowledge, as well as in research related to validation and reliability (Kesmodel, 2018).

This study aims to gather data on supply chain dynamic capabilities, technological innovation, and resilience in the West Bank, Palestine industrial sector, rather than gauging long-term effects. Thus, snapshots or intersections between several suggested dimensions are adequate. Therefore, a cross-sectional study design is sufficient and can achieve the objective with less expense and effort compared to other research designs, such as longitudinal and panel studies.

In conclusion, this research is a cross-sectional, quantitative, ontological, and deductive inquiry driven by a dedication to revealing reality through empirical evidence. It takes an organized approach to hypothesis testing based on rigorous theoretical foundations and driven by realism and positivist principles. This paradigm strives to measure and analyze phenomena to contribute to scientific knowledge by validating or challenging established theories.

3.2 Study Population

The manufacturing sector aims to enhance economic prosperity by developing and commercializing products. However, all manufacturing firms must effectively regulate the flow of raw materials from suppliers through value-adding operations to end users (Hamidu et al., 2023). The study's empirical context focused on supply chain executives and managers overseeing supply chain operations within industrial enterprises. These enterprises, which are the unit of analysis, employ at least five individuals. The target population for the study consists of 2,994 Palestinian industrial firms operating in the West Bank of Palestine (PCBS, 2019).

Initially, a comprehensive list of all Palestinian industrial enterprises was compiled. The inclusion criteria were industrial enterprises employing at least five persons with diverse ownership structures in the West Bank of Palestine. Due to prevailing political circumstances, industrial enterprises in the Gaza Strip were excluded. Additionally, companies with fewer than five employees were excluded from the study sample.

3.3. Study Sample

The sample selection process is meticulously conducted to ensure it accurately and reliably reflects the characteristics of the entire population. The study sample, which targets the Palestinian industrial business population, consists of executives and managers within industrial enterprises. According to Sharma (2017), stratified sampling is a probability sampling technique for dividing a population into smaller, distinct groupings called strata. Stratified random sampling involves forming strata based on the shared traits or characteristics of the members. The stratified random sample aims to minimize human bias in case selection. The stratified random sample is highly representative of the population being investigated, assuming minimal missing data. Using probabilistic methods to choose sample units, stratified random sampling enables centralization (statistical inferences) from the sample to the population. On the other hand, this technique could be ineffective when the population cannot be divided into distinct subgroups. Thus, this cost-effective method for mitigating bias was employed to compute the study sample and provide a representative sample.

Structural Equation Modeling (SEM) is essential in empirical research due to its capacity to assess latent factors. Researchers consistently face the challenge of selecting an adequate sample size to ensure a reliable model, accurate estimations, and satisfactory statistical power. According to the popular 10-times rule, the minimum sample size in a partial least squares path model should be at least ten times the highest number of maximum numbers of structural paths in the structural model (Wagner & Grimm, 2023; Hair et al., 2017).

Furthermore, Hair (2009) suggests that the sample size should be a minimum of 200 and not exceed 500 to avoid overly sensitive SEM analysis. According to the 10-times rule, the minimum sample size for this study is 90 individuals, with nine structural paths in this investigation. However, if this number is less than 200, the minimum sample size should be 200, as Hair (2009) suggested. To ensure the SEM analysis is not overly sensitive, the sample size should not exceed 500. Therefore, the study's sample size should ideally be within the range of 200 to 500 to ensure robust and reliable results.

Utilizing Cochran's formula for finite populations to calculate the optimal sample size for a specified degree of accuracy. Cochran's method, a prominent technique introduced by statistician Cochran in 1963, is essential for calculating the appropriate sample size from a given population (Cochran, 1963). The population of this research consists of 2,994 industrial firms operating in the West Bank of Palestine (PCBS, 2019). Using the following formula below (Cochran, 1963), the research sample size is determined to be 340 industrial businesses. However, using Cochran's formula, the required sample size for a large population is 384 participants. To ensure the highest accuracy and reliability, using a larger sample size of 384 participants is safest. This larger number provides an extra buffer and reduces the risk of errors, ensuring more reliable results. We increase the larger sample size of 384 by 23% to account for potential non-responses or uncertainties. Thus, the new sample size would be approximately 472 individuals.

$$n = \frac{N \cdot Z^2 \cdot p \cdot (1-p)}{(N-1) \cdot E^2 + Z^2 \cdot p \cdot (1-p)}$$

$$n = \frac{2994 \cdot (1.96)^2 \cdot 0.5 \cdot (1-0.5)}{(2994-1) \cdot (0.05)^2 + (1.96)^2 \cdot 0.5 \cdot (1-0.5)}$$

Where:

- n is the sample size.
- N is the population size. (In our case, 2,994)
- Z is the Z-value (1.96 for 95% confidence level).
- p is the estimated proportion of the population (0.5 if unknown).
- E is the margin of error (alpha, 0.05).

3.4 Setting-The Palestinian Industrial Sector

The Palestinian Federation of Industries (PFI) represents and advocates for the interests of industries in the Palestinian territories. It was founded in 1999 by the presidents of thirteen specialized industrial associations, each with over twenty-four years of experience (PFI, 2023). PFI is the primary national entity representing the Palestinian industrial sector, utilizing its federated associations. This organization's primary objectives encompass the proficient administration of industrial policies to advance the interests of its members and foster the growth and progress of the domestic economy (PFI, 2023).

In this investigation, the selection of the industrial sector was based on its significant impact on the gross domestic product (GDP), with a contribution of (13%) to the GDP. It also played a crucial role in the overall exports, accounting for almost (73%) of the nation's exports. Additionally, the industrial sector in Palestine demonstrated a high level of employability, employing (57,776) individuals dispersed throughout various industrial activities. Furthermore, the proportion of employed people in the industrial sector in the West

Bank reached (80.8%) of the total working people, while it was (19.2%) in the Gaza Strip (PCBS, 2019).

However, the total number of industrial enterprises (employing at least five individuals) was (3,742) firms. These enterprises are geographically spread, with (80%) located in the West Bank and the remaining (20%) in the Gaza Strip. Most functioning firms, accounting for (94.8%) of the total, are concentrated in the manufacturing sector, followed by Mining and Quarrying, which accounts for (4%). Electricity, Gas, Steam, and Air Conditioning Supplies compromised (0.3%), and Water Supply, Sewage Management, and Remediation Activities account for (0.9%) (PCBS, 2019), as seen in Figure 3.1.

Thus, this study will use these industrial enterprises (specifically manufacturing) employing at least five individuals as a sampling frame. Nevertheless, the examination of industrial enterprises in the Gaza Strip will be excluded from this study owing to some particular circumstances.

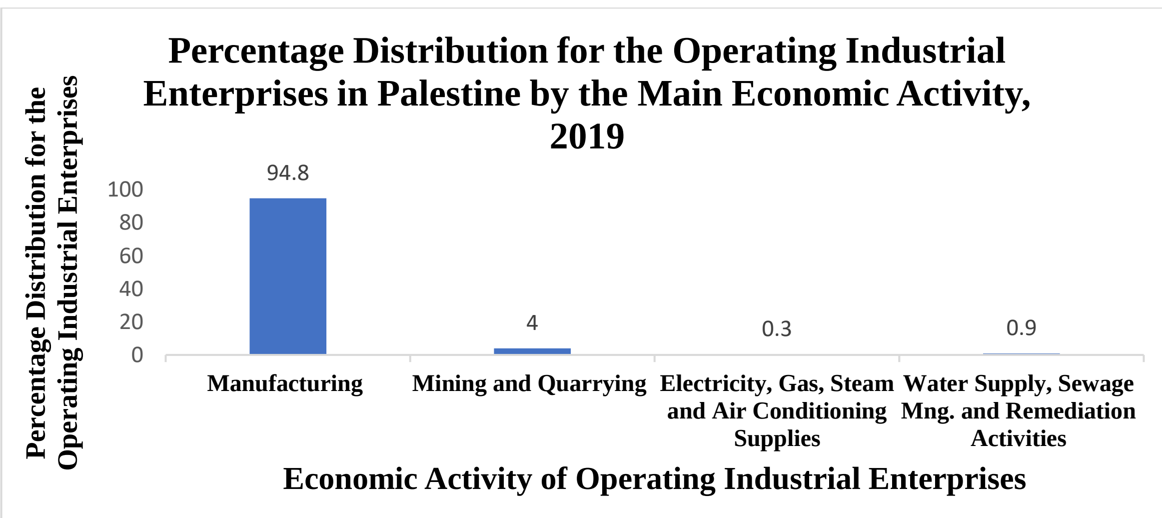

Figure (3.1): Percentage Distribution for the Operating Industrial Enterprises in Palestine by the Main Economic Activity (PCBS, 2019)

3.4.1. Percentage of Manufacturing Enterprises by the Highest Five Main Economic Activities-West Bank

The distribution of industrial enterprises in the West Bank, Palestine, specifically those employing five or more individuals engaged in manufacturing activities, reveals that manufacturing other non-metallic mineral products comprises the highest number of enterprises, accounting for (26.8%) of the total. Following this, the manufacture of food products represents (19.6%) of the enterprises, while the manufacture of furniture constitutes (13.3%). Enterprises are involved in the manufacturing of apparel makeup (10.3%). Lastly, the manufacture of fabricated metal products, except machinery and equipment, comprises (8.2%) of the total manufacturing enterprises in the West Bank. Other industries collectively account for (21.8%) (PCBS, 2019), as depicted in Figure 3.2

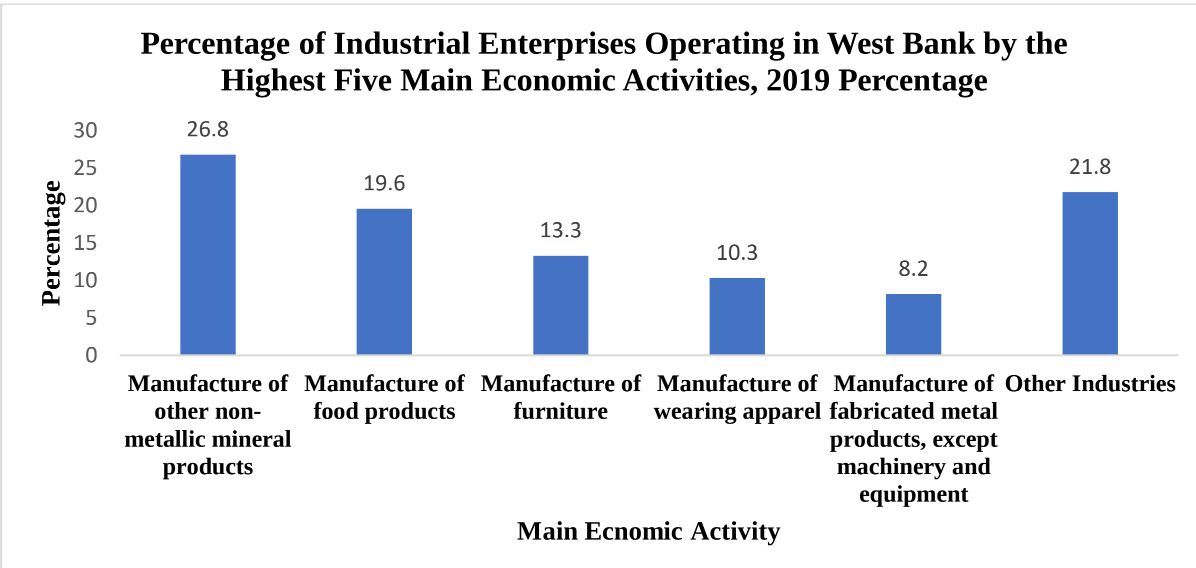

Figure 3.2: The Percentage of Manufacturing Enterprises Operating in the West Bank by the Highest Five Main Economic Activities (PCBS, 2019)

3.4.2 Geographical Distribution of the Industrial Firms by Governorate

The geographical distribution of industrial firms in the West Bank, Palestine, particularly those that employ five or more workers, reveals that Hebron has emerged as a prominent industrial hub, hosting 27.5% of all businesses. The significant concentration of industries in Hebron highlights the crucial role that the city plays in the region's industrial sector. This is primarily attributed to favorable economic policies, well-developed infrastructure, and a business climate that benefits growth. This is followed by Nablus, which exhibits a significant industrial presence of 19.7%. This region is a crucial center for industrial operations, potentially capitalizing on its advantageous geographical position, highly qualified workforce, and favorable industrial frameworks. The substantial portion it holds emphasizes its significance in the local industrial economy. Several governorates, such as Ramallah and Al-Bireh, Bethlehem, Jenin, and Tulkarm, have moderate industrial activity, contributing 6.2% to 11%. This reasonable representation shows that these locations have had balanced industrial growth, resulting in a varied economic structure that may benefit from proximity to urban centers and access to regional markets. With a proportion of 10.8%, Bethlehem likewise has a significant presence, surpassing numerous other governorates but falling short of the proportions recorded in Hebron or Nablus. This percentage indicates Bethlehem's considerable contribution to the dataset, emphasizing its importance. Jerusalem has a moderate presence, accounting for 5.2%. This implies that although Jerusalem has a significant location, it does not exert as much influence on the dataset as Hebron does. The data suggests that Jerusalem's contribution is substantial but less prominent than the top categories. While having smaller percentages than the larger governorates, Qalqilya and Salfit, 4.2% and 3.9%, respectively, still contribute notable percentages, reflecting their importance despite their lower representation. Among the mentioned governorates, Jericho and the Jordan Valley, Tubas, and the Northern Jordan Valley constitute the smallest portion, accounting for only 1.1%. The low percentage suggests a smaller presence compared to other governorates, indicating a lower population density or limited representation in the dataset from this region, as depicted in **Figure 3.3** (PCBS, 2019), which provides a comprehensive overview of the industrial firms' distribution across the governorates in the region.

Overall, the distribution of industrial enterprises among the governorates demonstrates a broad and dispersed industrial activity, with key localities such as Hebron and Nablus serving as main industrial hubs. This distribution pattern emphasizes Palestine's industrial sector's strengths and prospective growth regions, providing valuable insights for policymakers and investors looking to boost regional industrial development.

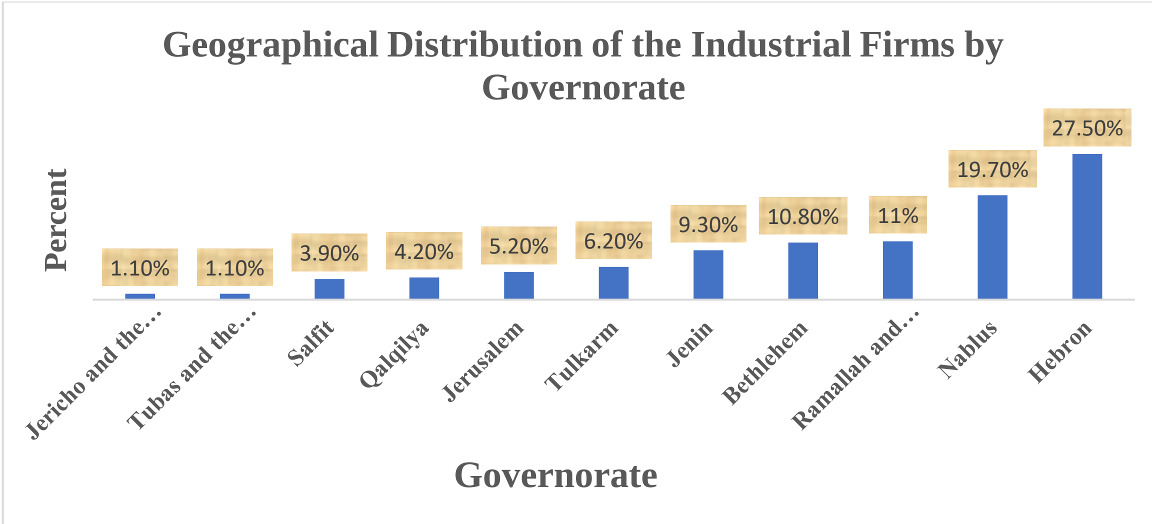

Figure (3.3): Geographical Distribution of the Industrial Firms by Governorate

3.5 Study Instruments

A self-administered digital survey is developed to collect data and test the proposed hypotheses. The constructs within the conceptual framework are assessed using validated scale items derived from previous studies known for their reliability and validity. The survey begins by introducing the study and concisely explaining supply chain resilience to ensure participants understand the questions clearly. To minimize the risk of misinterpretation, a panel of ten experts, including professors and practitioners specializing in supply chain resilience and technological innovation, reviews the survey questions for conceptual soundness and clarity. They evaluate the comprehensibility and provide feedback on the structure and utility of the concept evaluation measures.

Since Arabic is the Palestinians' primary language, the survey instrument is translated into Arabic through a cross-cultural adaptation process. Proficient linguists initially translated the research instrument from English to Arabic, followed by revisions by an Arabic translator. A panel of readers then reviews the Arabic version to ensure clarity and coherence. To verify accuracy, a group of bilingual individuals (N=5) proficient in both English and Arabic conducts a process involving forward-backward translation sequences between Arabic and English versions of the questionnaire.

3.5.1 Instruments Layout

The study employs survey data collected from industrial businesses located in the West Bank of Palestine to test the study's hypotheses. The survey instrument consists of four major components.

3.5.1.1 Socio-demographic Data

The first section of the structured questionnaire illustrates the respondents' and firms' profiles to collect socio-demographic data. The respondents' profiles include: (1) Gender (Male or Female), (2) Position (General Manager CEO/Director, Logistics/Supply Chain Executive/Manager, Production Executive/Manager, Marketing/Purchasing/Sales Executive/Manager, Senior Finance and HR Managers, and others), and (3) Managerial experience categorized into four ranges: 1-5 years, 5-10 years, 10-15 years, or more than 15 years.

The second part of the first section covers the firm's profile, which includes: (1) Age categorized into four groups: 1-5 years, 5-10 years, 10-15 years, and longer than 15 years, (2) Size based on the number of personnel within the organization, categorized into four groups: 5-10, 10-15, 15-20, and more than 20 individuals (3) Economic Activity categorized into Manufacturing, Mining and Quarrying, Electricity, Gas, Steam, and Air Conditioning Supplies, Water supply, sewage management, and remediation activities, among others (PCBS, 2019). (4) Governorate: The respondents were asked to choose from the eleven West Bank of Palestine governorates. Lastly, the participants were asked about the presence of a supply chain department inside the firm.

3.5.1.2 Study Main Constructs: SCDC, TI, and SCR

Section two of the survey assessed supply chain dynamic capabilities (SCDC) using the following measures: agility, information-sharing, collaboration, flexibility, leadership support, SCDO, and SC integration. **Section three** focused on technological innovation (TI), which was divided into two components: product and process innovation. **Section four** examined the dimensions of supply chain resilience.

Responses for each item in sections two, three, and four were rated on a five-point Likert scale ranging from 1 ("strongly agree") to 5 ("strongly disagree"). However, further details on the study items and measurements are provided in the subsequent section for a more comprehensive explanation.

3.6 Measurements and Items

The variables in the theoretical model were operationalized using established research instruments known for their reliability and validity. Drawing on scholarly sources, a set of constructs relevant to industrial firms was identified. The measurement scale was selected and adapted, with minor adjustments to item phrasing to suit the study's specific context, informed by pilot test results. The following sections detail how the study constructs were operationalized and the measurement scale employed, informed by a thorough literature review. However, the study utilizes three measuring scales. One for Supply Chain Dynamic Capabilities (SCDC). Another measurement scale is used for Technological Innovation (TI), while the last is focused explicitly on Supply Chain Resilience (SCR).

3.6.1 Supply Chain Dynamic Capabilities Measurement Scale:

The firm's ability to integrate, develop, and restructure internal and external resources, technology, and operations represents its Supply Chain Dynamic Capabilities (SCDC), enabling adaptive responses to changing circumstances (Teece et al., 1997). SCDC encompasses seven dimensions, each defined by specific measurable criteria:

3.6.1.1 SC Agility

Supply chain agility relates to the ability to efficiently and promptly manage suppliers, internal processes, and customer interactions (Dubey et al., 2018b). This capability was assessed through six items: velocity, which included three metrics: rapid response to supply chain decisions. Swift introduction of new products and timely delivery to customers (Kaufmann & Gaeckler, 2015; Vickery et al., 2015; Kaipia, 2008; Chiang et al., 2015).

Additionally, supply chain agility was measured by visibility using three criteria: clear visibility of inventory levels. Transparent demand visibility and consistent partner communication (Dubey et al., 2018b; Barrat & Oke, 2007). Respondents rated these items on a five-point Likert scale ranging from 1, "strongly agree," to 5, "strongly disagree."

3.6.1.2. SC Information Sharing

Premkumar and King (1994) conceptualized information sharing as organizational capital, a critical resource for transmitting and exchanging knowledge. The supply chain's information-sharing capability was assessed through four specific items: Knowledge sharing of core business processes. Sharing of information essential for business planning. Sharing critical issues that could impact/harm supply chain partners and sharing information about any changing needs. These dimensions were adopted from (Lee et al., 2018; Ju et al., 2016). Respondents rated their agreement with these items on a five-point Likert scale, ranging from 1, "strongly agree," to 5, "strongly disagree."

3.6.1.3. SC Flexibility

Supply chain flexibility can be defined as the ability to adeptly assume different postures to handle unusual conditions and swiftly adapt to significant changes (Lee, 2004). The flexibility of the supply chain was assessed using four dimensions: Sourcing flexibility. Operational flexibility. Distribution flexibility and SC information system flexibility. These dimensions were adapted from studies by Rojo et al. (2018), Can Saglam et al. (2021), and Juan et al. (2022). Respondents evaluated these dimensions on a five-point Likert scale, ranging from 1, "strongly agree," to 5, "strongly disagree."

3.6.1.4. Supply Chain Disruption Orientation (SCDO)

SCDO refers to a firm's strategic approach to anticipating and recognizing future disruptions and learning from past incidents (Ambulkar et al., 2015; Bode et al., 2011). SCDO was evaluated across four dimensions: Acknowledgment of the inevitability of disruptions. Vigilance in monitoring potential disruptions in the supply chain. Implementation of measures to address previous disruptions. Capability to thoroughly evaluate and derive insights from disruptions. These dimensions were adapted from studies by Bode et al. (2011) and Yu et al. (2019). Respondents rated their agreement with these statements on a five-point Likert scale, ranging from 1, "strongly agree," to 5, "strongly disagree."

3.6.1.5 Supply Chain Collaboration

It involves trade partners who jointly share responsibilities and goals, engaging in a mutual exchange of planning, management, execution, and performance assessment information (Salam, 2017). Collaboration was assessed through four key dimensions: Joint efforts to develop new markets and customer responses. Establishment of a comprehensive communication plan to maintain regular interaction during disruptions. Collaboration in process or product design and collaboration in implementing their operational processes. These dimensions were adapted from studies by Juan et al. (2022), Dubey et al. (2020), Yu et al. (2019), Srinivasan & Swink (2018), Ju et al. (2016), Simatupang & Sridharan (2008), and Cao & Zhang (2011). Respondents rated their agreement with these items on a five-point Likert scale, ranging from 1, "strongly agree," to 5, "strongly disagree."

3.6.1.6. SC Leadership Support

Supply Chain Leadership Support (SCLS) involves implementing management practices characterized by strong backing from top-level executives, active employee involvement, and the ability to make sound decisions (Han et al., 2020). SCLS was evaluated using four dimensions: Senior management's support during disruptions for effectively navigating chaotic environments.

Senior management's role in decision-making during unpredictable circumstances. Upper-level management's contribution to formulating supply chain resilience strategies and leadership's experience in managing volatile business settings. These dimensions were adapted from studies by Chatterjee & Chaudhuri (2021), Smart et al. (2017), Zhang et al. (2018), Le & Lei (2018), Donate & Guadamillas (2011), Venkatraman (1989), and Fiedler (1993). Respondents rated their agreement with these items on a five-point Likert scale ranging from 1, "strongly agree," to 5, "strongly disagree."

3.6.1.7 SC Integration

Supply Chain Integration involves strategically coordinating and managing collaborative efforts within and between enterprises (Hendijani & Saei, 2020). It was assessed using four dimensions: The departmental integration in the firm. The relationship between integration capability and collaboration within the firm. Involvement of key supply chain partners in goal-setting, planning, and problem-solving. Proactive response to changing demands (Demand forecast). These dimensions were adapted from studies by Muafi & Sulistio (2022), Eslami et al. (2021), and Ju et al. (2016). Respondents rated their agreement with these items on a five-point Likert scale ranging from 1, "strongly agree," to 5, "strongly disagree."

3.6.2 Technological Innovation Measurement Scale

Technological Innovation (TI) involves organizational efforts to restructure and integrate internal and external systems, infrastructure, human resources, and processes (Kissi et al., 2021). TI was assessed through two main dimensions measured by six items: **Product Innovation**: This dimension focuses on introducing new products, services, or programs to the market. It was measured using three criteria: Incorporation of cutting-edge technologies in new product development. Speed of new product development. Number of first-to-market new products. These criteria were adapted from studies by Lee et al. (2018) and Hamidu et al. (2023). Respondents rated their agreement on a five-point Likert scale ranging from 1, "strongly agree," to 5, "strongly disagree."

Furthermore, technological innovation is measured by **Process Innovation**: This dimension relates to enhancing techniques or procedures to improve service, cost efficiency, throughput, or processing (Kahn, 2018). Process innovation was measured using three criteria: Technological competitiveness of processes. Speed of adoption of process innovations. Rate of changes implemented in processes. These criteria were adopted from studies by Lee et al. (2018) and Hamidu et al. (2023). Respondents also rated their agreement on a five-point Likert scale ranging from 1, "strongly agree," to 5, "strongly disagree."

3.6.3 Supply Chain Resilience Measurement Scale

Supply Chain Resilience (SCR) refers to the dynamic capability that enables a supply chain to proactively plan for, mitigate, react to, restore from, and learn from disruptions (Hohenstein et al., 2015; Datta, 2017). SCR was measured using five items, assessing the supply chain's ability to: Respond effectively to unexpected disturbances. Restore and surpass the original operational state after disruptions. Manage the financial impacts of supply chain interruptions. Maintain control over operations and structure. Extract valuable insights from disruptions. These dimensions were adopted from studies by Yu et al. (2019), Altay et al. (2018), Golgeci & Ponomarov (2013), and Can Saglam et al. (2021). Responses were scored on a five-point Likert scale ranging from 1, "strongly agree," to 5, "strongly disagree."

However, **Table 3.1** synthesizes the scale items used to measure each construct and its source of measurement. A five-point Likert scale was used to measure the responses, with one indicating "strongly agree" and five indicating "strongly disagree."

Table (3.1): Scale Items for Measuring Constructs

Constructs	Measurements	Items	Source(s)
Supply Chain Dynamic Capabilities (SCDC)	**SC Agility (SCA)**	"SCA1. Stock levels are easily visible across the supply chain." "ASA2. Demand levels are visible throughout the supply chain." "SCA3. Our firm maintains constant and frequent contact with its partners." "SCA4. Our supply chain responds faster to SC decisions." "SCA5. Our SC can swiftly introduce new items to fulfill the needs of our clients." "SCA6. Our SC can provide items to the clients before the due date."	**Visibility** **SCA1-SCA3** are adopted from Dubey et al.(2018b). Barrat & Oke (2007). **Velocity** **SCA4-SCA6** are adopted from Kaufmann & Gaeckler (2015). Vickery et al. (2015). Kaipia (2008). Chiang et al. (2015).
	SC Information Sharing (SCIS)	"SCIS1. SC Partners are informed in advance of any changing needs."	**SCIS1- SCIS4** are adopted from Lee et al. (2018). Ju et al. (2016)

		"SCIS2. Our partners share their knowledge of core business processes with us." "SCIS3. We and our partners exchange information that aids in developing business plans." "SCIS4. We and our partners keep each other informed about events or changes that may affect the other partners."	
	SC Flexibility (SCF)	"SCF1. Our firm has several available suppliers." SCF2.The supply chain can modify production facilities and processes. "SCF3. The information systems inside the supply chain can facilitate transportation, distribution, and inventory management." "SCF 4. The supply chain can alter distribution modes."	**SCF1-SCF4** are adopted from Rojo et al. (2018). Can Saglam et al (2021). Juan et al. (2022). Moon et al. (2012).
	Supply Chain Disruption Orientation (SCDO)	"SCDO1. We maintain constant vigilance to anticipate any problems in the supply chain." "SCDO2. We anticipate Supply chain disruptions are constantly looming." "SCDO3. We consider how supply chain disruptions may have been prevented." "SCDO4. An in-depth analysis is performed when a disruption in the supply chain has occurred."	**SCDO1- SCDO4** are adopted from Bode et al. (2011). Yu et al. (2019). Stephens et al. (2022). Laguir et al. (2023).
	SC Collaboration (SCC)	"SCC1. Our Firm and SC partners work together to explore new markets and client responses." "SCC12. Our Firm and SC partners devised a communication plan for action. Especially during difficulties."	**SCC1-SCC4** are adopted from Juan et al. (2022). Ju et al. (2016). Cao & Zhang (2011). Simatupang & Sridharan (2008). Dubey et al. (2020).

		"SCC13. Our Firm and its SC partners work together to design their products or processes." "SCC14. Our firm and SC partners collaborate in implementing their operational processes."	Yu et al. (2019). Srinivasan & Swink (2018).
	SC Leadership Support (SCLS)	"SCLS1. The leadership team consistently offers sufficient support as required." "SCLS2. We assert that leadership support is crucial in developing resilient supply chain strategy(ies)." "SCLS3. We assert that the leadership team is crucial in decision-making during challenging circumstances." "SCLS4. We assert that our firm possesses an experienced leadership team well-equipped to navigate challenging or volatile circumstances effectively."	**SCLS1-SCLS4** are adopted from Chatterjee & Chaudhuri (2021). Smart et al. (2017). Zhang et al. (2018). Le and Lei (2018). Venkatraman (1989). Fiedler (1993). Donate & Guadamillas (2011).
	SC Integration (SCI)	"SCI1. The integration of many departments within a firm is a crucial capability." "SCI2. A firm's integration capability is closely associated with collaboration." "SCI3. We involve our main supply chain partners in goal-setting, planning, problem-solving, and demand forecasting in advance." SCI4. Our main supply chain partners and we communicate about changing needs in advance."	**SCI1-SCI4** are adopted from Muafi & Sulistio (2022). Eslami et al. (2021). Ju et al. (2016).
	Product Innovation (PDI)	"PDI1. Compared to our key rivals, "the use of latest technological	**PDI 1-PDI3** are adopted from Lee et al. (2018). Hamidu et al. (2023.)

Technological Innovation (TI)		innovations in new product development" is high." "PDI 2. The speed of new product development" is fast in comparison to our key rivals." "PDI 3. Compared to our key rivals, the number of new products that are first-to-market (early market entrants) is high."	
	Process Innovation (POI)	"POI 1. The technological competitiveness" of our processes is high in comparison to our key rivals." "POI 2. Compared to our key rivals, the speed of adopting the latest technological innovations in our processes is high." "POI 3. The rate of change in processes, techniques, and technology is higher than that of our key competitors."	**POI 1-POI 3** are adopted from Lee et al. (2018). Hamidu et al. (2023).
Supply Chain Resilience (SCR)	-Resuming product flow. -Surpass initial functional state. -Overseeing financial ramifications. -Retain control. -Derive lessons.	"SCR1. Our firm can respond properly to disruptions by promptly resuming product flow." "SCR2. Our firm can efficiently recover and surpass its initial state of function." "SCR 3. Our firm can effectively manage the financial consequences of disruptions." "SCR 4. Our firm can retain the desired control over structure and operation." "SCR5. Our firm can derive significance and valuable insights from interruptions and unanticipated occurrences."	**SCR1-SCR5** are adopted from Yu et al. (2019). Altay et al. (2018) Golgeci & Ponomarov, (2013). Can Saglam et al. (2021).

3.7 Instrument Validity and Reliability

Reliability and validity tests were conducted to assess the instrument quality used in this study. Instrument validity was essential for accurately measuring the study's concepts and constructs, employing both content and construct validity assessments.

As Kumar et al. (2022) described, content validity was subjectively validated using relevant literature and evaluation by a panel of eight experts in supply chain resilience and technological innovation. Experts assessed the instrument's relevance and clarity using the Content Validity Index (CVI), suggesting adjustments based on their feedback.

For construct validity, both convergent validity and discriminant validity were evaluated. Convergent validity was assessed through standardized factor loadings, Cronbach's alpha, composite reliability, and average variance extracted (AVE). Discriminant validity was tested by analyzing item loadings across constructs to ensure that each item correlated more strongly with its designated construct than with others (Hatcher & O'Rourke, 2013; Hair et al., 2013).

Reliability was assessed using Cronbach's alpha, which measures internal consistency. An average inter-item correlation was calculated to evaluate participants' consistency across all instrument items. A Cronbach's alpha value exceeding 0.70, as recommended by Hair et al. (2017), was achieved in the pilot sample, indicating satisfactory internal reliability and enabling further analysis. This version enhances clarity and organization while maintaining the technical details of the validity and reliability assessments conducted.

3.8 Pilot Study

A pilot study is a preliminary investigation conducted before large research to assess the efficacy and feasibility of the study's design and methodology. It involves pretesting, which refers to doing small-scale tests on research instruments or questionnaires to discover any possible issues or difficulties before using them in large-scale studies (Soori, 2024).

However, a pilot study is a crucial element of a well-designed study. The pilot study's primary objective is eradicating superfluous and inefficient inquiries (Aithal & Aithal, 2020). Conducting pilot research ensures that respondents consistently understand the instrument questions, provide suitable answers, accurately measure the intended variables, and that the survey is free from bias (Dillman, 2022). Generally, pilot research entails choosing a small group of participants, amounting to 10% of the whole sample, representing all sub-categories (Aithal & Aithal, 2020).

A preliminary iteration of the research questionnaire was examined on a subset of supply chain executives (N=35). The participants were asked to evaluate the questionnaire's coherence, relevance, and acceptability, find any uncommon, repetitive, irrelevant, or poorly phrased questions, and ascertain the duration needed to complete the survey. The information gathered during the pilot research was utilized to enhance the questionnaire. Additionally, the data obtained from the pilot group was excluded from the study results to avoid any potential data contamination.

3.9 Ethical Consideration

The Institutional Review Board (IRB) of Arab American University has provided clearance to protect the rights of human research participants and ensure the confidentiality of survey respondents. Participants were guaranteed confidentiality and instructed not to include personal details in their responses. Each participant received a consent letter- IRB approval form "**R-2024/A/117/N**" before completing the questionnaire. This letter included a survey declaration, information on the survey's duration, a statement affirming voluntary participation for research purposes only, assurances of participant safety, and a privacy statement guaranteeing confidentiality and privacy.

3.10 Data Collection

3.10.1 Exploratory and Model Building Phase

The data collection process for this study involved reviewing secondary sources across various databases, including Scopus, EBSCO, Academia, Taylor & Francis, among others. This approach enabled the collection of secondary data to construct the literature review and identify key study constructs, measurements, and items related to supply chain dynamic capabilities, technological innovation, and supply chain resilience.

3.10.2. The Quantitative Phase

The quantitative phase of this study involved administering a well-structured electronic survey to Palestinian industrial enterprises across the West Bank to collect primary data. After obtaining clearance from the Institutional Review Board (IRB) to protect the rights of human participants and ensure respondent anonymity, data collection was conducted using a meticulously designed online survey tool. This tool incorporated established and validated measurements from relevant literature. Surveys were distributed to participants via email, accompanied by a cover letter detailing the study's purpose, intended use of the data, and a robust assurance of data confidentiality.

3.11 Data Analysis

Structural Equation Modeling (SEM) encompasses various statistical methods to assess measurement, functional, predictive, and causal hypotheses (Jin et al., 2020). It is a valuable analytical technique for examining the interrelationships between one or more independent variables and dependent variables (Dubey et al., 2020; Jin et al., 2020), employing a set of regression analyses. SEM is widely used in business, social research, and various disciplines due to its ability to integrate complex path models with latent variables (Hox & Bechger, 1998).

This study utilized a second-generation methodology known as Partial Least Squares Structural Equation Modeling (PLS-SEM), akin to multiple regression analysis. The primary aim was to explain variation in the dependent constructs and assess data quality through measurement model attributes (Hair Jr et al., 2017a). PLS-SEM was chosen for constructing a conceptual model and testing proposed hypotheses, given the study's latent variables: agility, information sharing, flexibility, collaboration, leadership support, integration, and SCDO. PLS-SEM effectively assesses correlations between variables and identifies influential factors (Lowry & Gaskin, 2014), facilitating comprehensive model evaluation.

The data analysis proceeded in several stages. Confirmatory Factor Analysis (CFA) was initially employed to assess the measurement model's reliability and validity, including convergent and discriminant validity. Subsequently, the structural model was analyzed to evaluate clusters of elements relevant to the conceptual model. Additionally, data were examined for outliers, deviant cases, missing data, and adherence to normal distribution. Descriptive analysis characterized research participants and study variables using frequencies, percentages, means, standard deviations, and ranges. Hence, the data collected underwent the following statistical procedures:

3.11.1. Descriptive Analysis:

- Purpose: Summarize and describe characteristics of research participants and study variables.

- Example: Calculating frequencies, percentages, means, standard deviations, and ranges for variables such as agility, information sharing, and leadership support among Palestinian industrial enterprises.

3.11.2. Missing Data Handling:

- Purpose: Address and mitigate the impact of missing values on statistical analyses.

- Example: Imputing missing values in survey responses related to supply chain resilience constructs using multiple imputation techniques.

3.11.3. Outlier Analysis:

- Purpose: Identify and manage data points that significantly deviate from the rest of the dataset.

- Example: Using box plots and statistical tests to detect outliers in measures of technological innovation and SC integration among surveyed enterprises.

3.11.4. Normality Testing:

- Purpose: Assess whether continuous variables follow a normal distribution, which is crucial for parametric tests.

- Example: Conducting Shapiro-Wilk tests to check the normality of data distributions for variables like flexibility and collaboration in the supply chain.

3.11.5. Reliability Analysis:

- Purpose: Evaluate the consistency and stability of measurement instruments.
- Example: Calculating Cronbach's alpha for internal consistency of scales measuring SC leadership support and SC agility.

3.11.6. Validity Analysis:

- Purpose: Ensure that measurement instruments accurately measure intended constructs.
- Example: Assessing construct validity through Confirmatory Factor Analysis (CFA) for dimensions like SCDO and SC collaboration, confirming the relationships between observed and latent variables.

3.11.7. Regression Analysis:

- Purpose: Predict the relationship between dependent and independent variables.
- Example: Using regression models to predict the impact of SC collaboration and SC leadership support on supply chain resilience within the supply chain context.

3.11.8. Confirmatory Factor Analysis (CFA):

-The purpose is to assess the measurement model's reliability and validity by confirming the relationships between observed and latent variables.

- Example: Analyzing factor loadings, composite reliability, and average variance extracted (AVE) for indicators measuring technological innovation and SC resilience constructs.

3.11.9. Structural Equation Modeling (SEM):

- Purpose: Test and validate hypothesized relationships between latent variables and observed variables.
- Example: Using Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine paths between SC integration, technological innovation, and overall supply chain resilience, assessing model fit indices (e.g., RMSEA, CFI) and direct/indirect effects.

These steps represent a comprehensive approach to data analysis, ensuring thorough exploration and validation of research constructs in our study on supply chain dynamic capabilities and SC resilience.

3.12 Summary

This cross-sectional, quantitative study adopts an ontological and deductive approach, focusing on executives overseeing operations in industrial businesses across the West Bank of Palestine. Secondary data analysis contributed to developing the study's conceptual framework, complemented by primary data collected through a self-reported electronic questionnaire. The study employed the Partial Least Squares-Structural Equation Model (PLS-SEM), a second-generation technique, to test the measurement model and hypotheses. Particularly, to evaluate path coefficients representing the impact of Supply Chain Dynamic Capabilities SCDC and Technological Innovation TI on Supply Chain Resilience SCR among industrial enterprises in the West Bank of Palestine, excluding those in the Gaza Strip. Furthermore, a suitable statistical analysis was conducted to ensure extensive examination and validation of the study constructs

Chapter Four: Results of the Study

This chapter presents the data analysis outcomes, employing a meticulous methodology to guarantee the findings' validity, reliability, and accuracy. The analysis commences with descriptive statistics, offering a synthesis of key data characteristics and an overview of the sample's attributes. Subsequently, the validity and reliability of measurement instruments were assessed to confirm they accurately reflect constructs under investigation and yield consistent results across different contexts.

Structural equation modeling (SEM) was utilized to assess the study's hypotheses and investigate the relationships among variables, providing a comprehensive analysis of both measurement and structural models, thereby elucidating the theoretical framework and interrelations of the variables. Using SEM, the direct and indirect effects of variables were analyzed, elucidating the mediating role of technological innovation in the relationship between supply chain dynamic capabilities and supply chain resilience, while also assessing the impact of firm size and age on supply chain resilience.

This chapter concludes with a summary of key findings, including descriptive statistics, validity and reliability assessments, and SEM results. These collectively provide a comprehensive understanding of the study's constructs and their interactions. This systematic approach to data analysis reinforces the robustness of the study's conclusions and implications for theory and practice.

4.1 Descriptive Analytics- Respondents' Profile

As previously stated in Chapter Three, the study sample was determined using Cochran's formula (1963), yielding a total of 472 distributed using Google Forms. A total of 448 responses were obtained, resulting in a response rate of 94.9%. No surveys were eliminated, as all items were compulsory, hence precluding respondents from completing the questionnaire without addressing every item. The table below delineates the demographic and organizational attributes of the study sample.

Table (4.1): Demographic and Organizational Characteristics of the Study Sample

Variable	Category	Frequency	Percent
Gender	Male	385	85.9%
	Female	63	14.1%
	Total	448	100.0%
Job Title	Planning and International Relations	4	0.9%
	General Manager	167	37.3%
	Logistics Manager	33	7.4%
	Financial Manager	49	10.9%
	Company Owner	3	0.7%
	Marketing/Purchasing/Sales Manager	47	10.5%
	Operations Manager	110	24.6%
	Human Resources Manager	28	6.3%
	Operations Development Manager	3	0.7%
	Engineer	4	0.9%
	Total	448	100.0%
Years of Management Experience	5–10 Years	55	12.3%
	10–15 Years	220	49.1%
	15 Years and Above	173	38.6%
	Total	448	100.0%
Company Age	1-5	12	2.7%
	5-10	65	14.5%
	10-15	161	35.9%
	15 Years and Above	210	46.9%
	Total	448	100.0%
Number of Employees	5–10 Employees	69	15.4%
	10–15 Employees	70	15.6%
	15–20 Employees	102	22.8%
	20 Employees and Above	207	46.2%
	Total	448	100.0%
Governorate	Jericho and Jordan Valley	16	3.6%
	Hebron	90	20.1%
	Jerusalem	55	12.3%
	Bethlehem	22	4.9%
	Jenin	3	0.7%
	Ramallah and Al-Bireh	49	10.9%
	Salfit	35	7.8%
	Tubas	16	3.6%
	Tulkarm	66	14.7%
	Qalqilya	38	8.5%
	Nablus	58	12.9%
	Total	448	100.0%
Economic Activity/Field of Work	Timber	4	0.9%
	Electricity, Gas, and Steam Supply	3	0.7%
	Manufacturing (various industries)	349	77.9%

	Mining and Quarrying	70	15.6%
	Others	22	4.9%
	Total	448	100.0%
Supply Chain Department	Yes	159	35.5%
	No	289	64.5%
	Total	448	100.0%

Table 4.1 presents the demographic and organizational profile of the study sample within the Palestinian industrial sector. Regarding **gender**, it reveals a predominance of males (85.9%) and a minor representation of females (14.1%). This ratio may reflect the gender disparity within the industrial sector in Palestine and highlight possible areas for gender equality initiatives. The industrial sector in Palestine has a predominance of males in senior management posts due to social and cultural norms that influence gender roles within the labor market. The predominance of men in management roles reflects the Palestinian labor market, characterized by the underrepresentation of women in senior positions. Consequently, women in the industrial sector should be motivated and assisted to occupy senior positions through providing training and rehabilitation programs, enacting policies that enhance gender diversity in senior roles, and fostering community awareness of women's contributions to economic development.

The predominant **job titles** among respondents are General Manager (37.3%) and Operations Manager (24.6%). This is due to the nature of the study and the mentor of the sample, as general managers and operations managers are the most knowledgeable and familiar with supply chain resilience and dynamic capabilities due to their roles in strategic and operational planning, making them the best category to provide accurate and relevant responses. Furthermore, within the organizational framework of the industrial sector, general and operations managers frequently supervise and enhance supply chain efficiency.

Regarding **years of management experience**, approximately 49.1% of the participants possess 10–15 years of managerial experience, whereas 38.6% have more than 15 years. This would enhance the reliability of the study outcomes. This is because experienced managers have faced diverse challenges and possess a superior understanding of supply chain resilience and dynamic capabilities. This distribution helps to ensure that responses represent practical and in-depth insights rather than theoretical or limited responses.

Regarding **company age**, 46.9% are above 15 years old, while 35.9% are between 10 and 15 years old. This indicates that the study relies on data from organizations with extensive experience in supply chain management, hence enhancing the trustworthiness of the conclusions, as these companies have encountered various obstacles and implemented various resilience strategies over time. Furthermore, the distribution indicates that these enterprises play a crucial role in establishing the standards and performance of supply chains within the Palestinian industrial sector.

In terms of **the number of employees**, most organizations employ over 20 people (46.2%), with the remainder spread across smaller employee brackets. The distribution indicates that most of the responses originated from organizations with over 20 workers, indicating that the sample predominantly comprises medium- and large-sized enterprises, which are better positioned to implement dynamic supply chain capabilities and exhibit SC resilience. The proportion of smaller enterprises (22% with 15-20 employees, 15% each for 10-15 and 1-5 employees) demonstrates a balanced representation of SMEs, offering a thorough perspective on the varying effects of dynamic capabilities on supply chain resilience across different firm sizes within the Palestinian context.

Regarding the **geographical distribution of the governorates**, it is noted from **Table (4.1)** that the participants are geographically diverse, primarily based in Hebron (20.1%), Tulkarm (14.7%), and Jerusalem (12.3%). The findings indicate that these governorates serve as significant economic and industrial hubs in Palestine. This results from the intensity of industrial and service operations, including several large and medium enterprises that depend on intricate supply chains. This presents an opportunity to broaden the future study's scope to encompass greater representation from other governorates, such as Nablus, Jenin, and Bethlehem, thereby enhancing the comprehensiveness of the results, particularly as these regions may encounter distinct challenges or possess varying advantages in supply chain management.

In terms of **economic activity**, the majority of the firms are working in manufacturing (77.9%), while smaller percentages represent mining and quarrying (15.6%) and other fields. This indicates the pivotal role that manufacturing plays in the Palestinian economy, as it relies heavily on dynamic supply chains to ensure continuity of production and adapt to market challenges. 15.6% of mining, quarrying, and other activities reflect the importance of these sectors as a supporter of the economy, but are less dependent on complex supply chains compared to the industrial sector. It is recommended to conduct an in-depth analysis of the industrial sector to understand the challenges and opportunities facing its supply chains, with the study of other sectors included as a comparison to highlight the differences and requirements of each sector.

In terms of the **availability of a supply chain department**, only 35.5% of companies have a dedicated supply chain department, while 64.5% do not. These results report that this sector remains nascent within Palestinian enterprises, with few recognizing the importance of specialist management to improve efficiency and flexibility. Conversely, almost 65% of firms lacking a dedicated supply chain department may rely on general or traditional management functions to oversee supply chain management, impacting their performance and resilience. Organizations must recognize the need to create specialist supply chain divisions via seminars and training initiatives, offering governmental incentives to enterprises that invest in advancing supply chain management systems to bolster their competitiveness in local and international marketplaces. Thus, the analysis of the demographic and organizational respondents' profiles reveals a diverse distribution of job titles, levels of management experience, company age and size, as well as geographic and industrial backgrounds.

4.2 Analysis

This section presents an analysis of the sample answers documenting the mean, standard deviation, and percentage ranking for each dimension to assess the level of each variable and its application in the Palestinian industrial sector as depicted in the subsequent sections:

4.2.1 Supply Chain Dynamic Capabilities (SCDC)

Table (4.2): Descriptive Statistics and Percentage Rankings for Supply Chain Agility Indicators

No.	Item Code	Survey Statement	Mean	Std, Deviation	Percentage
1	**SCA2**	Demand levels are visible throughout the supply chain.	4.11	0.51	82.14%
2	SCA1	Stock levels are easily visible across the supply chain.	4.10	0.50	81.96%
3	SCA3	Our firm maintains constant and frequent contact with its partners.	4.03	0.61	80.54%
4	SCA5	Our SC can swiftly introduce new items to fulfill the needs of our clients.	4.00	0.54	80.00%
5	SCA4	Our supply chain responds faster to SC decisions.	3.95	0.60	78.93%
6	**SCA6**	Our SC can provide items to clients before the due date.	3.66	0.62	73.21%
	SCA	SC Agility (SCA)	3.97	0.39	79.46%

The supply chain agility domain, as assessed through various indicators, had an overall mean score of (3.97) with a standard deviation of (0.39), achieving an average agility percentage of (79.46%). Among six specific indicators, "Demand levels are visible throughout the supply chain" (SCA2) was the highest-rated item with a mean of (4.11) and a percentage of (82.14%), "Our SC can provide items to clients before the due date" (SCA6) had lowest mean at (3.66) and percentage of (73.21%), indicating variability in agility capabilities across different aspects of supply chain responsiveness and visibility.

Table (4.3): Descriptive Statistics and Percentage Rankings for Supply Chain Information Sharing Indicators

Rank	Item Code	Survey Statement	Mean	Std, Deviation	Percentage
1	**SCIS3**	We and our partners exchange information that aids in developing business plans.	3.82	0.57	76.43%
2	SCIS4	We and our partners keep each other informed about events or changes that may affect other partners.	3.60	0.71	71.96%
3	SCIS1	SC Partners are informed in advance of any changing needs.	3.38	0.79	67.68%

4	**SCIS2**	Our partners share their knowledge of core business processes with us.	3.24	0.87	64.82%
	SCIS Total	Supply Chain Information Sharing (SCIS)	3.51	0.58	70.23%

The domain of supply chain information sharing, as reflected through its indicators, showed an overall mean score of (3.51) with a standard deviation of (0.58), achieving an average percentage of (70.23%). Among the indicators, "We and our partners exchange information that aids in developing business plans" (SCIS3) received the highest rating with a mean of (3.82) and a percentage of (76.43%). On the other hand, "Our partners share their knowledge of core business processes with us" (SCIS2) was rated lowest with a mean of (3.24) and a percentage of (64.82%), highlighting some areas with greater and lesser levels of information sharing within the supply chain.

Table (4.4): Descriptive Statistics and Percentage Rankings for Supply Chain Flexibility Indicators

Rank	**Item Code**	**Survey Statement**	**Mean**	**Std, Deviation**	**Percentage**
1	**SCF1**	Our firm has several available suppliers.	3.93	0.46	78.57%
2	SCF3	Information systems inside the supply chain can facilitate transportation, distribution, and inventory management.	3.89	0.60	77.86%
3	SCF4	Supply chain can alter distribution modes.	3.82	0.60	76.43%
4	**SCF2**	Supply chain can modify production facilities and processes.	3.57	0.74	71.43%
	SCF Total	Supply Chain Flexibility (SCF)	3.80	0.47	76.07%

The supply chain flexibility domain, based on its indicators, recorded an overall mean score of (3.80) with a standard deviation of (0.47), achieving an average flexibility percentage of (76.07%). The highest-rated indicator was "Our firm has several available suppliers" (SCF1) with a mean of (3.93) and a percentage of (78.57%), indicating strong supplier flexibility. Conversely, the lowest-rated indicator, " supply chain can modify production facilities and processes" (SCF2), had a mean of (3.57) and a percentage of (71.43%), showing that adaptability in production adjustments was relatively lower compared to the other flexibility aspects in the supply chain.

Table (4.5): Descriptive Statistics and Percentage Rankings for Supply Chain Disruption Orientation

Rank	Item Code	Survey Statement	Mean	Std, Deviation	Percentage
1	**SCDO1**	We maintain constant vigilance to anticipate any problems in the supply chain.	3.90	0.52	78.04%
2	SCDO4	An in-depth analysis is performed when a disruption in the supply chain has occurred.	3.73	0.67	74.64%
3	SCDO3	We consider how supply chain disruptions may have been prevented.	3.48	0.71	69.64%
4	**SCDO2**	We anticipate that supply chain disruptions are constantly looming.	3.28	0.81	65.54%
	SCDO Total	Supply Chain Disruption Orientation (SCDO)	3.60	0.52	71.96%

The supply chain disruption orientation domain, as assessed by various indicators, showed an overall mean score of (3.60) with a standard deviation of (0.52), achieving an average percentage of (71.96%). The top-rated item was "We maintain constant vigilance to anticipate any problems in the supply chain" (SCDO1), with a mean of (3.90) and a percentage of (78.04%), indicating a strong focus on proactive monitoring. "We anticipate supply chain disruptions are constantly looming" (SCDO2) was rated the lowest, with a mean of (3.28) and a percentage of (65.54%), reflecting a slightly lower emphasis on expecting frequent disruptions, which is reasonable within the Palestinian context.

Table (4.6): Descriptive Statistics and Percentage Rankings for Supply Chain Collaboration (SCC)

Rank	Item Code	Survey Statement	Mean	Std, Deviation	Percentage
1	**SCC4**	Our firm and SC partners collaborate in implementing their operational processes.	3.51	0.73	70.18%
2	SCC2	Our firm and SC partners devised a communication plan for action, especially during difficulties.	3.37	0.87	67.32%
3	SCC1	Our firm and SC partners work together to explore new markets and client responses.	3.34	0.82	66.79%

4	**SCC3**	Our firm and its SC partners work together to design their products or processes.	3.20	0.81	63.93%
	SCC Total	Supply Chain Collaboration (SCC)	3.35	0.69	67.56%

The supply chain collaboration domain achieved an overall mean score of (3.35) with a standard deviation of (0.69), resulting in an average collaboration percentage of (67.56%). The highest-rated indicator was "Our firm and SC partners collaborate in implementing their operational processes" (SCC4), with a mean of (3.51) and a percentage of (70.18%), showing strong collaboration in operational execution. However, "Our firm and its SC partners work together to design their products or processes" (SCC3) received the lowest rating, with a mean of (3.20) and a percentage of (63.93%), suggesting relatively lower collaboration in product or process design.

Table (4.7): Descriptive Statistics and Percentage Rankings for Supply Chain Leadership Support (SCLS)

Rank	**Item Code**	**Survey Statement**	**Mean**	**Std, Deviation**	**Percentage**
1	**SCLS2**	We assert that leadership support is crucial in developing a resilient supply chain strategy(ies).	4.35	0.61	86.96%
2	SCLS4	We assert that our firm possesses an experienced leadership team well-equipped to navigate challenging or volatile circumstances.	4.34	0.56	86.79%
3	SCLS3	We assert that a leadership team is crucial in decision-making during challenging circumstances.	4.30	0.61	86.07%
4	**SCLS1**	The leadership team consistently offers sufficient support as required.	4.23	0.60	84.64%
	SCLS Total	Supply Chain Leadership Support (SCLS)	4.31	0.51	86.12%

The supply chain leadership support domain demonstrated strong scores, with an overall mean of (4.31) and a standard deviation of (0.51), achieving an average percentage of (86.12%). The highest-rated statement was "We assert that leadership support is crucial in developing a resilient supply chain strategy(ies)" (SCLS2), with a mean of 4.35 and a percentage of 86.96%, underscoring the significance of leadership's involvement in attaining supply chain resilience. The lowest-rated indicator was "leadership team consistently offers sufficient support as required" (SCLS1), which still achieved a high mean of 4.23 and a percentage of 84.64%, indicating a constant acknowledgment of leadership's supporting role across the supply chain.

Table (4.8): Descriptive Statistics and Percentage Rankings for Supply Chain Integration (SCI)

Rank	**Item Code**	**Survey Statement**	**Mean**	**Std, Deviation**	**Percentage**
1	**SCI2**	A firm's integration capability is closely associated with collaboration.	4.23	0.60	84.64%
2	SCI1	The integration of many departments within the firm is a crucial capability.	4.19	0.49	83.75%
3	SCI4	Our main supply chain partners and we communicate about changing needs in advance.	3.84	0.58	76.79%
4	**SCI3**	We involve our main supply chain partners in goal-setting, planning, problem-solving, and demand forecasting in advance.	3.37	0.84	67.32%
	SCI Total	Supply Chain Integration (SCI)	3.91	0.48	78.13%

The supply chain integration domain exhibited robust overall performance, with a mean of 3.91 and a standard deviation of 0.48, yielding a percentage of 78.13%. The highest-rated indicator was "A firm's integration capability is closely associated with collaboration" (SCI2), which achieved a mean score of 4.23 and a ranking percentage of 84.64%, underscoring the value placed on collaboration for integration. Conversely, the lowest-rated statement, "We involve our main supply chain partners in goal-setting, planning, problem-solving, and demand forecasting in advance" (SCI3), recorded a mean of 3.37 and a percentage of 67.32%, indicating that early engagement in strategic activities with partners is a relatively less emphasized aspect of integration.

Table (4.9): Descriptive Statistics for Supply Chain Dynamic Capabilities

Capability Domain	Mean	Std, Deviation	Variance	Skewness	Kurtosis
SC Agility (SCA)	3.97	0.39	0.15	0.54	0.61
SC Information Sharing (SCIS)	3.51	0.58	0.33	0.04	-0.24
SC Flexibility (SCF)	3.80	0.47	0.22	-0.94	2.46
Supply Chain Disruption Orientation (SCDO)	3.60	0.52	0.27	0.01	-0.13
SC Collaboration (SCC)	**3.35**	0.69	0.47	-0.13	-0.60
SC Leadership Support (SCLS)	**4.31**	0.51	0.26	-0.04	-0.83
SC Integration (SCI)	3.91	0.48	0.23	-0.03	0.28
Supply Chain Dynamic Capabilities (SCDC)	**3.78**	0.41	0.17	0.33	0.10

The evaluation of supply chain dynamic capabilities shows that **Supply Chain Leadership Support (SCLS)** leads with the highest mean score of (4.31), underscoring the importance and strong presence of leadership support within the supply chain. **Supply Chain Agility (SCA)** follows closely with a mean of (3.97), reflecting robust capability for quick adaptation to market changes. Next is **Supply Chain Integration (SCI)** with a mean of (3.91), highlighting the effectiveness of cohesive interactions between departments and partners. **Supply Chain Flexibility (SCF)** ranks fourth with a mean of (3.80), demonstrating an adaptive capacity within processes to adjust to new conditions. **Supply Chain Disruption Orientation (SCDO)**, with a mean of (3.60), indicates a moderate focus on disruption management and anticipation. **Supply Chain Information Sharing (SCIS)** scores (3.51), pointing to some potential for enhancement in communication across partners. Finally, **Supply Chain Collaboration (SCC)**, with the lowest mean of (3.35), suggests that joint planning, operations, and problem-solving could benefit from increased focus, revealing an area for improvement within the supply chain framework. Thus, the overall **Supply Chain Dynamic Capabilities (SCDC)** score stands at (3.78), aggregating performance across domains. As seen in **Table (4.9),** the ranking emphasizes strengths in leadership and agility, while collaboration and information sharing present growth opportunities.

4.2.2 Technological Innovation (TI)

Table (4.10): Descriptive Statistics and Percentage Rankings for Technological Innovation (TI)

Rank	**Item Code**	**Survey Statement**	**Mean**	**Std, Deviation**	**Percentage**
1	**TI1**	"Compared to our key rivals, the use of the latest technological innovations in new product development is high."	4.06	0.56	81.25%
2	TI2	"The speed of new product development is fast in comparison to our key rivals."	4.02	0.61	80.36%
3	TI4	"The technological competitiveness of our processes is high in comparison to our key rivals."	3.94	0.62	78.75%
4	TI5	"Compared to our key rivals, the speed of adopting the latest technological innovations in our processes is high."	3.86	0.67	77.14%
5	TI6	"The rate of change in processes, techniques, and technology is higher than that of our key competitors."	3.85	0.68	76.96%
6	**TI3**	"Compared to our key rivals, a number of new products that are first-to-market (early market entrants) is high."	3.81	0.68	76.25%
	TI Total	Technological Innovation (TI)	3.92	0.56	78.45%

The technological innovation domain showed strong overall performance, with an average mean score of (3.92) and a standard deviation of (0.56), achieving a total percentage of (78.45%). The highest-rated item was "Compared to our key rivals, the use of latest technological innovations in new product development is high" (TI1), with a mean of (4.06) and a percentage of (81.25%), reflecting a competitive edge in adopting innovations for product development. However, the lowest-rated statement was "Compared to our key rivals, the number of new products that are first-to-market (early market entrants) is high" (TI3), recording a mean of (3.81) and a percentage of (76.25%), indicating that while technological innovation is strength, being first-to-market with new products is comparatively less emphasized.

4.2.3 Supply Chain Resilience (SCR)

Table (4.11): Descriptive Statistics and Percentage Rankings for Supply Chain Resilience (SCR)

Rank	Item Code	Survey Statement	Mean	Std, Deviation	Percentage
1	**SCR5**	Our firm can derive significance and valuable insights from interruptions and unanticipated occurrences.	3.96	0.51	79.11%
2	SCR4	Our firm can retain desired control over structure and operation.	3.85	0.55	76.96%
3	SCR1	Our firm can respond properly to disruptions by promptly resuming product flow.	3.59	0.79	71.79%
4	SCR3	Our firm can effectively manage the financial consequences of disruptions.	3.58	0.74	71.61%
5	**SCR2**	Our firm can efficiently recover and surpass its initial state of function.	3.47	0.77	69.46%
	SCR Total	Supply Chain Resilience (SCR)	**3.69**	0.56	73.79%

The supply chain resilience domain reflected a moderate level of resilience, with an overall mean score of (3.69) and a standard deviation of (0.56), resulting in a total resilience percentage of (73.79%). The highest-rated item was "Our firm can derive significance and valuable insights from interruptions and unanticipated occurrences" (SCR5), achieving a mean of (3.96) and a percentage of (79.11%), indicating strength in learning from disruptions. Conversely, the lowest-rated item, "Our firm can efficiently recover and surpass its initial state of function" (SCR2), had a mean of (3.47) and a percentage of (69.46%), highlighting that while resilience is present, reaching a level beyond the original state post-disruption is less emphasized.

4.3 Hypotheses Testing

Structural Equation Modeling (SEM) encompasses various statistical methods to assess measurement, functional, predictive, and causal hypotheses (Jin et al., 2020). It is a valuable analytical technique for examining interrelationships between one or more independent variables and dependent variables (Dubey et al., 2020; Jin et al., 2020), employing a set of regression analyses, SEM is widely used in various disciplines due to its ability to integrate complex path models with latent variables (Hox & Bechger, 1998). The study utilized a second-generation methodology known as Partial Least Squares Structural Equation Modeling (PLS-SEM), akin to multiple regression analysis, primary aim to explain variation in dependent constructs and assess data quality through measurement model attributes (Hair Jr et al., 2017a). PLS-SEM was chosen for constructing a conceptual model and testing proposed hypotheses. Given the study's latent variables: agility, information sharing, flexibility, collaboration, leadership support, integration, and SCDO, PLS-SEM effectively assesses correlations between variables and identifies influential factors (Lowry & Gaskin, 2014), facilitating comprehensive model evaluation.

Thus, utilizing the Smart-PLS4, the study examines two models: the ***measurement model*** (outer model) that illustrates the relationship between factors or latent variables and indicators, multiple domains were evaluated for the measurement model including reliability, convergent validity, and discriminant validity, collinearity statistics (VIF), and model fit indices.

Furthermore, the ***structural model*** (inner model), which illustrates the relationship among variables or latent variables, was examined. Several tests were undertaken to assess the validation of the structural model, including the determination coefficient (R^2), blindfolding, predictive relevance (Q^2), effect size (F^2), goodness of fit (GoF), and path coefficients (β values) (Hair et al., 2017).

4.3.1 Assessment of the Measurement Model

To evaluate the reliability and validity of constructs in the measurement model, a series of tests were conducted, including assessments of reliability, convergent validity, discriminant validity, collinearity statistics, and model fit indices. According to Hair et al. (2010) convergent validity, or the extent of consistency, could be assessed using the following three indicators: Factor Loading or Internal Consistency, Composite Reliability (CR), and Average Variance Extracted (AVE). The subsequent sections elucidate the criteria for convergent validity in further depth.

- **4.3.1.1. Factor Loading**

Factor loading is a statistical technique that indicates the strength of association between an observed variable and a latent factor in the factor analysis. The generally recognized threshold for factor loading differs based on the study discipline, study sample, and context. Factor loading values of > 0.50 are deemed robust and are favored for the interpretation of factor structure. A value of > 0.70 is deemed very strong, signifying a clear relationship between the factor and the variable (Hair et al., 2010).

- **4.3.1.2 Composite Reliability**

Composite reliability, commonly known as construct reliability, is an assessment of internal consistency among scale items, analogous to Cronbach's alpha. Alternatively, it serves as an "indicator of the shared variance among the observed variables utilized as a measure of a latent construct" (Fornell & Larcker, 1981). The thresholds for composite reliability are controversial, with suitable values ranging from .60 and upwards, since several authors have different threshold suggestions. However, the outcome is contingent upon the number of scale items. According to (Hair et al., 2016), the accepted value for Composite Reliability is ≥0.7.

- **4.3.1.3 Average Variance Extracted (AVE)**

AVE signifies a measure that quantifies the proportion of variation attributed to a construct compared to the variance resulting from measurement error. It quantifies the extent to which changes in the scale items can be elucidated by the construct or latent variable (Hair Jr et al., 2021). It was first suggested by Fornell and Larcker (1981). However, the accepted threshold for AVE is ≥0.5 (Hair et al., 2016).

Table **(4.12)** provides reliability and convergent validity statistics, showing that all constructs demonstrate adequate internal consistency, with Cronbach's alpha and composite reliability values exceeding 0.7. Average Variance Extracted (AVE) values for each construct are above 0.5, confirming that each construct explains more than half of the variance of its indicators, thus establishing convergent validity. Additionally, **Table (4.13)** elucidates Outer Loadings (Factor Loadings) or Internal Consistency for indicators of constructs in the measurement model where Factor Loadings for all indicators reach or surpass the frequently recognized criterion of 0.7, indicating strong reliability in measuring respective constructs.

Table (4.12) Reliability and Convergent Validity Statistics for Constructs: Cronbach's Alpha, Composite Reliability (rho_a and rho_c), and Average Variance Extracted (AVE)

Construct	**Cronbach's Alpha**	**Composite Reliability (rho_a)**	**Composite Reliability (rho_c)**	**AVE**
Supply Chain Agility (SCA)	0.798	0.823	0.856	0.502
Supply Chain Collaboration (SCC)	0.869	0.883	0.911	0.721
Supply Chain Disruption Orientation (SCDO)	0.762	0.802	0.845	0.580
Supply Chain Flexibility (SCF)	0.780	0.781	0.859	0.603
Supply Chain Integration (SCI)	0.768	0.780	0.851	0.589
Supply Chain Information Sharing (SCIS)	0.774	0.801	0.856	0.602
Supply Chain Leadership Support (SCLS)	0.876	0.879	0.916	0.731
Supply Chain Resilience (SCR)	0.879	0.883	0.913	0.679
Technological Innovation (TI)	0.945	0.953	0.956	0.784

Table (4.12) Reliability and validity measures indicate strong internal consistency and convergent validity across all constructs. **Cronbach's alpha** values are above 0.7 for all constructs, supporting internal reliability. **Composite reliability (rho_c)** values are also above the accepted threshold of 0.7 (ideally between 0.7 and 0.95), confirming strong internal consistency for each construct. **Average Variance Extracted (AVE)** values for all constructs exceed 0.5 demonstrating adequate convergent validity, as each construct explains more than half of the variance of its indicators.

Specifically, **Technological Innovation** shows exceptionally high reliability and validity (Cronbach's alpha = 0.945, rho_c = 0.956, AVE = 0.784), reflecting strong internal consistency and a high degree of shared variance among its indicators. Similarly, **Supply Chain Collaboration (SCC)** and **Supply Chain Leadership Support (SCLS)** display robust composite reliability and AVE values, indicating that they are well-measured by respective indicators. Overall, these results provide confidence in the reliability and validity of the measurement model, supporting its use in structural analysis.

Table (4.13): Outer Loadings (Factor Loadings)- Internal Consistency for Indicators of Constructs in Measurement Model

Construct	**Indicator**	**Outer Loading**
Technological Innovation (TI)	PDI1	0.819
	PDI2	0.899
	PDI3	0.878
	POI1	0.**933**
	POI2	0.903
	POI3	0.877
Supply Chain Agility (SCA)	SCA1	0.761
	SCA2	0.832
	SCA3	0.671
	SCA4	0.785
	SCA5	0.635
	SCA6	0.521
Supply Chain Collaboration (SCC)	SCC1	0.838
	SCC2	0.**886**
	SCC3	0.**915**
	SCC4	0.748
Supply Chain Disruption Orientation (SCDO)	SCDO1	0.779
	SCDO2	0.611
	SCDO3	0.801
	SCDO4	0.834
Supply Chain Flexibility (SCF)	SCF1	0.740
	SCF2	0.765
	SCF3	0.817
	SCF4	0.783
Supply Chain Integration (SCI)	SCI1	0.806
	SCI2	0.774
	SCI3	0.791
	SCI4	0.695
Supply Chain Information Sharing (SCIS)	SCIS1	0.770
	SCIS2	0.863
	SCIS3	0.613
	SCIS4	0.835
Supply Chain Leadership Support (SCLS)	SCLS1	0.782
	SCLS2	0.882
	SCLS3	0.892
	SCLS4	0.860
Supply Chain Resilience (SCR)	SCR1	0.887
	SCR2	0.898

	SCR3	0.832
	SCR4	0.792

Table (4.13) indicates that factor loadings for most indicators meet or exceed the commonly accepted threshold of 0.7 (Hair et al., 2010) indicating good reliability in measuring respective constructs. High loadings were observed for constructs like Technological Innovation (TI) and Supply Chain Collaboration (SCC), with values above 0.8 for most indicators, reflecting strong internal consistency. Supply Chain Resilience (SCR) also shows high loadings, ranging from 0.694 to 0.898; although SCR5 falls slightly below 0.7, it remains close enough to be retained for the theoretical alignment, few indicators, such as SCA6 (0.521) in Supply Chain Agility (SCA) and SCIS3 (0.613) in Supply Chain Information Sharing (SCIS), have loadings slightly below 0.7, which is tolerable in exploratory research and the theoretically justified. Additionally, SCDO2 (0.611) and SCI4 (0.695) are retained to ensure a comprehensive representation of constructs, despite being below the ideal threshold. However, retaining these indicators allows for capturing the full dimensionality of each construct, especially in the context of complex, multidimensional capabilities in supply chains. Overall, factor loadings affirm the reliability and validity of constructs, providing a solid foundation for structural model analysis in line with the study's theoretical framework.

- **Discriminant Validity**

Discriminant validity is a subcategory of construct validity. It indicates the efficacy of a test in assessing the notion it was intended to measure. In other words, it refers to the degree to which a test is unrelated to other tests that evaluate distinct constructs. Discriminant validity particularly assesses whether constructs that are theoretically expected to be unrelated are, in reality, unrelated. It assesses the extent to which an indicator exclusively represents one construct (Hair et al., 2010). The Fornell-Larcker criterion and the Heterotrait-Monotrait Ratio Test (HTMT) were employed to assess discriminant validity (Hair et al., 2017). **Table (4.14)** presents discriminant validity among study constructs.

Table (4.14) Discriminant Validity – Heterotrait-Monotrait Ratio (HTMT) Matrix

	SCA	SCC	SCDO	SCF	SCI	SCIS	SCLS	SCR	TI
SCA		0.626	0.580	0.705	0.765	0.738	0.763	0.585	0.650
SCC	0.626		0.866	0.636	0.856	0.915	0.540	0.647	0.569
SCDO	0.580	0.866		0.636	0.744	0.726	0.382	0.773	0.506
SCF	0.705	0.636	0.636		0.746	0.684	0.624	0.651	0.620
SCI	0.765	0.856	0.744	0.746		0.684	0.793	0.729	0.613
SCIS	0.738	0.915	0.726	0.684	0.684		0.574	0.573	0.544
SCLS	0.763	0.540	0.382	0.624	0.793	0.574		0.511	0.511
SCR	0.585	0.647	0.773	0.651	0.729	0.573	0.511		0.564
TI	0.650	0.569	0.506	0.620	0.613	0.544	0.511	0.564	

Heterotrait-Monotrait Ratio (HTMT) matrix results generally support discriminant validity among constructs (Henseler et al., 2015), as most HTMT values fall below the commonly accepted threshold of 0.85, indicating that constructs are distinct from each other, validating inclusion as separate entities in the model. However, few values slightly exceed 0.85, specifically between **Supply Chain Collaboration (SCC) and Supply Chain Information Sharing (SCIS)** (0.915), and **SCC and Supply Chain Integration (SCI)** (0.856), suggesting some conceptual overlap among these constructs, while minor overlap does not undermine model's discriminant validity, it may warrant theoretical consideration to ensure clear differentiation between these constructs. Overall, these results provide a strong basis for proceeding with structural model analysis.

Table (4.15) Discriminant Validity – Fornell-Larcker Criterion

	SCA	SCC	SCDO	SCF	SCI	SCIS	SCLS	SCR	TI
SCA	**0.709**	0.538	0.473	0.580	0.605	0.584	0.641	0.507	0.585
SCC	0.538	**0.849**	0.715	0.528	0.714	0.757	0.470	0.573	0.522
SCDO	0.473	0.715	**0.761**	0.528	0.594	0.577	0.351	0.636	0.466
SCF	0.580	0.528	0.528	**0.777**	0.577	0.533	0.517	0.639	0.534
SCI	0.605	0.714	0.594	0.577	**0.768**	0.632	0.647	0.614	0.531
SCIS	0.584	0.757	0.577	0.533	0.632	**0.776**	0.574	0.481	0.471
SCLS	0.641	0.470	0.351	0.517	0.647	0.574	**0.855**	0.447	0.588
Supply Chain Resilience (SCR)	0.507	0.573	0.636	0.639	0.614	0.481	0.447	**0.824**	0.528

Fornell-Larcker Criterion results indicate acceptable levels of **discriminant validity,** which determines if the test is valid for the constructs in the model. According to the Fornell-Larcker criterion, each construct should have a square root of **Average Variance Extracted (AVE)** greater than correlations with other constructs (Fornell & Larcker, 1981). Diagonal values (in bold) in **Table 4.15** represent the square root of AVE for each construct. In the model, all constructs meet the Fornell-Larcker criterion; each construct's diagonal value is higher than its correlations with other constructs in the same row and column, indicating that each construct is distinct from the others. For example, **Supply Chain Agility (SCA)** has a square root of AVE of **0.709**, which is greater than its correlations with other constructs, such as **Supply Chain Collaboration (SCC)** at **0.538** and **Supply Chain Flexibility (SCF)** at **0.580**. Similarly, **Supply Chain Resilience (SCR)** has a square root of AVE of **0.824**, which is higher than all other correlations in its row and column.

Overall, these results support the discriminant validity of the constructs in the model, confirming that each construct is sufficiently distinct from the others. The finding provides confidence in the measurement model and allows for the analysis of structural relationships among the study constructs.

- **Collinearity Statistics (VIF)**

Multicollinearity arises in regression analysis when two or more independent variables exhibit a strong correlation, resulting in redundant or overlapping information. This may result in inaccurate estimations of regression coefficients, complicating the assessment of each variable's genuine impact on the dependent variable. However, the Variance Inflation Factor (VIF) is utilized to detect multicollinearity. Table **4.16** presents the collinearity statistics via (VIF) for the relationships among the inner model.

Table (4.16): Collinearity Statistics (VIF) for Inner Model

Path	VIF
SCA → Supply Chain Dynamic Capabilities	2.233
SCC → Supply Chain Dynamic Capabilities	3.668
SCDO → Supply Chain Dynamic Capabilities	2.261
SCF → Supply Chain Dynamic Capabilities	1.875
SCI → Supply Chain Dynamic Capabilities	2.943
SCIS → Supply Chain Dynamic Capabilities	2.667
SCLS → Supply Chain Dynamic Capabilities	2.163
Supply Chain Dynamic Capabilities → Supply Chain Resilience	2.093
Supply Chain Dynamic Capabilities → Technological Innovation	1.000
Technological Innovation → Supply Chain Resilience	2.093

As presented in **Table 4.16,** the collinearity statistics (VIF) for the inner model demonstrate that all pathways exhibit acceptable levels of collinearity. The Variance Inflation Factor (VIF) values for the relationships between constructions and Supply Chain Dynamic Capabilities range from 1.875 to 3.668, with Supply Chain Collaboration (SCC → Supply Chain Dynamic Capabilities) exhibiting the highest VIF of 3.668. Nevertheless, the value is below the widely accepted threshold of 5 (O'brien, 2007), indicating that multicollinearity is not a concern. The paths from Supply Chain Dynamic Capabilities to Supply Chain Resilience and Technological Innovation exhibit VIF values of 2.093 and 1.000, respectively, while the path from Technological Innovation to Supply Chain Resilience has a VIF of 2.093. These results affirm that collinearity among predictor constructs in the inner model is minimal, suggesting that the model is devoid of multicollinearity issues and appropriate for analysis.

- **Model Fit Indices for Saturated and Estimated Models**

In Structural Equation Modeling (SEM), assessing model fit is crucial for ensuring correct data representation. Evaluating model fit entails utilizing multiple metrics, referred to as fit indices, which help gauge the alignment between the theoretical model and the observable data. These indices facilitate the assessment of the alignment between the suggested theoretical framework and the empirical evidence. **Table 4.17** elucidates the Model Fit Indices for Saturated and Estimated Models.

Table (4.17): Model Fit Indices for Saturated and Estimated Models

Fit Index	**Saturated Model**	**Estimated Model**
SRMR	0.016	0.017
d_ULS	34.410	34.966
d_G	n/a	n/a
Chi-square	∞	∞
NFI	n/a	n/a

It could be noted from **Table (4.17)** that the model fit indices for both Saturated Model and the Estimated Model indicate an acceptable fit, Standardized Root Mean Square Residual (SRMR) values were 0.016 for the Saturated Model and 0.017 for the Estimated Model, both well below the commonly accepted threshold of 0.08, suggesting good model fit, d_ULS values were 34.410 for Saturated Model and 34.966 for Estimated Model, d_G values were not applicable (n/a) in output, and Chi-square values were reported as infinite (∞), which may reflect specific limitations in PLS-SEM fit estimation, Additionally, Normed Fit Index (NFI) was not available (n/a) in analysis, Overall, low SRMR values suggest that model has a good fit with data.

4.3.2 Assessment of the Structural Model

This section presents an assessment of the structural model by performing path analysis and examining each hypothesis model using various metrics, including the determination coefficient (R^2), blindfolding and predictive relevance (Q^2), effect size (F^2), and path coefficient (β values), among other tests.

4.3.2.1 Coefficient of Determination (R^2) is a widely utilized metric for assessing the structural model. It pertains to the extent to which the predictor constructs can elucidate the variability in the endogenous construct. It is utilized to predict the model's accuracy (Wright, 1921). Elevated values of the Coefficient R^2 indicate enhanced predictive accuracy, with the established range of the coefficient of determination spanning from zero to one (Hair et al., 2012). Henseler et al. (2015, p. 67) state that the accepted values of the coefficient R^2 are substantial (0.67), moderate (0.33), and weak (0.19). Nonetheless, R^2 should not serve as the sole criterion for model assessment (Wooldridge, 2016).

4.3.2.2 Blindfolding and Predictive Relevance (Q^2), this measurement relies on the blindfolding criteria, which remove specific data points from the data matrix, substitute the excluded data points with the mean, and calculate the model parameters (Hair Jr et al., 2017). The exogenous constructs have predictive relevance for the endogenous construct under examination when the Q^2 is greater than zero (Hair et al., 2019).

4.3.2.3 Effect Size (F^2) measures the impact on endogenous constructs when a specific exogenous construct is excluded from the structural model (Hair Jr et al., 2017). Cohen (1988) categorized F^2 as exhibiting no effect size below 0.02. Minimal effect size ranging from 0.02 to 0.15. Medium effect size ranges from 0.15 to 0.35, while large effect size exceeds 0.35.

4.3.2.4 Path Coefficient (β values) indicates how strongly one factor or latent variable affects another, it aims to measure the strength and direction of the relationship between two latent variables. A high path coefficient suggests that an exogenous variable has a significant influence on an endogenous variable (Kaplan, 2008), path analysis values should fall between -1 and +1 when the value of β is close to +1, it indicates a positive association between model elements, whereas value around -1 indicates negative relationship, and no significant relationship if the value is zero or close to zero. However, this study tested five main hypotheses and 21 subordinate hypotheses. The subsequent sections present Path Coefficient (β), Effect Type, R^2, Adjusted R^2, F^2, t (Essentially exceeds 1.96), and P-value tests for all tested hypotheses.

4.4 Results of Hypotheses Testing: Path Coefficient

4.4.1 First Main Hypothesis

There is a Positive Relationship between Supply Chain Dynamic Capabilities and Technological Innovation.

Hypothesis H1: "There is a positive relationship between Supply Chain Dynamic Capabilities (SCDC) and Technological Innovation (TI)," which was tested using Structural Equation Modeling (SEM) through Smart PLS 4, a tool for Partial Least Squares Structural Equation Modeling (PLS-SEM). This approach allows for the analysis of complex relationships 4.4.1.1 Results Related to the Sub-Hypothesis.

Table (4.18): Direct Effects of Supply Chain Dynamic Capabilities Dimensions on Technological Innovation (TI) -Path Analysis

Path	B	SE	t	P	95% CI for B
SC Agility → Technological Innovation	0.263	0.053	4.917	< .001	[0.162, 0.372]
SC Collaboration → Technological Innovation	0.141	0.058	2.451	0.014	[0.029, 0.252]
SC Flexibility → Technological Innovation	0.141	0.056	2.519	0.012	[0.025, 0.246]
SC Information Sharing → Technological Innovation	-0.066	0.056	1.183	0.237	[-0.175, 0.045]
SC Integration → Technological Innovation	-0.063	0.057	1.099	0.272	[-0.172, 0.056]

SC Leadership Support → Technological Innovation	0.281	0.046	6.065	< .001	[0.187, 0.368]
Supply Chain Disruption Orientation → Technological Innovation	0.191	0.043	4.469	< .001	[0.109, 0.277]

Model Summary:

Metric	**Value**
R^2 Technological Innovation	0.512
R^2 adjusted Technological Innovation	0.504
f^2 (SC Agility -> Technological Innovation)	0.065
f^2 (SC Collaboration -> Technological Innovation)	0.012
f^2 (SC Flexibility -> Technological Innovation)	0.021
f^2 (SC Information Sharing -> Technological Innovation)	0.003
f^2 (SC Integration -> Technological Innovation)	0.003
f^2 (SC Leadership Support -> Technological Innovation)	0.075
f^2 (Supply Chain Disruption Orientation -> Technological Innovation)	0.034
Q^2 (Technological Innovation)	0.493
GoF	**0.612**

The analysis of the direct effects of Supply Chain Dynamic Capabilities dimensions on Technological Innovation (TI) reveals varying degrees of influence across dimensions, as summarized in **Table (4.18)**, Supply Chain Leadership Support demonstrates the strongest positive effect, with the highest path coefficient ($\beta = 0.281$, $p < .001$, $f^2 = 0.075$), indicating that strong leadership commitment significantly fosters technological innovation within the supply chain.

Supply Chain Agility follows closely, with a positive path coefficient ($\beta = 0.263$, $p < .001$, $f^2 = 0.065$), underscoring the importance of agility in responding swiftly to market changes to support technological innovation. Supply Chain Disruption Orientation also has a substantial positive impact on TI ($\beta = 0.191$, $p < .001$, $f^2 = 0.034$), suggesting that being proactive in identifying and managing disruptions contributes effectively to technological innovation.

Both Supply Chain Flexibility and Supply Chain Collaboration show moderate positive relationships with TI, Supply Chain Flexibility ($\beta = 0.141$, $p = 0.012$, $f^2 = 0.021$) and Supply Chain Collaboration ($\beta = 0.141$, $p = 0.014$, $f^2 = 0.012$) reinforce the value of adaptability and cooperative partnerships in enhancing technological innovation within supply chains.

Supply Chain Information Sharing and Supply Chain Integration display weak negative effects on TI, with path coefficients of (β = -0.066, p = 0.237, f^2 = 0.003) and (β = -0.063, p = 0.272, f^2 = 0.003), respectively, indicates that while they are integral aspects of supply chain practices, these dimensions may not directly support the technological innovation as strongly as other capabilities.

Model's explanatory power for Technological Innovation, as indicated by R^2 and Adjusted R^2 values, is moderate, with R^2 = 0.512 and Adjusted R^2 = 0.504, predictive relevance (Q^2 = 0.493) supports model's effectiveness in predicting Technological Innovation, indicating that the analyzed Supply Chain Dynamic Capabilities dimensions account for about half of variance in Technological Innovation, emphasizing the critical role of certain capabilities particularly -leadership support, agility, and SC disruption orientation- in promoting technological innovation within the supply chain. The GoF value of (0.612)indicates a good model fit, as values above 0.36 are acceptable.

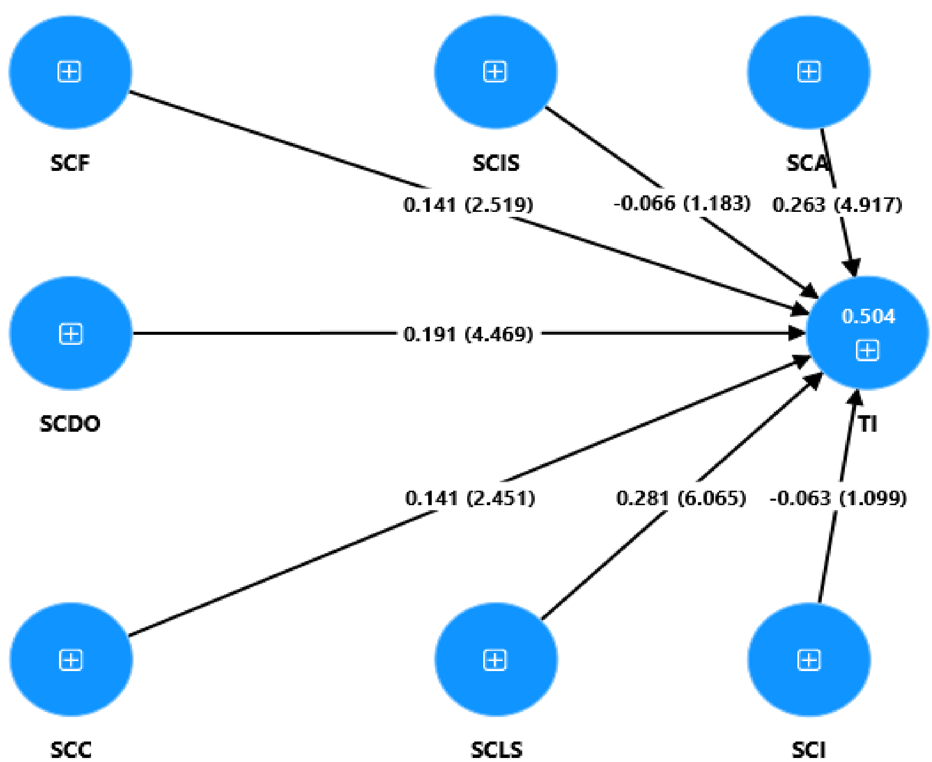

Figure (4.1): Key Supply Chain Dynamic Capabilities Factors Contributing to Technological Innovation (TI)

Thus, the hypotheses testing results for the relationships between various supply chain dynamic capabilities factors and Technological Innovation (IT) are presented as follows:

Hypothesis 1a: There is a positive relationship between SC Agility and Technological Innovation." The results support this hypothesis, as SC Agility shows a significant positive path coefficient ($\beta = 0.263$, $p < .001$), indicating that agility within the supply chain contributes positively to technological innovation.

- **Hypothesis 1b**: "There is a positive relationship between SC Collaboration and Technological Innovation." This hypothesis is confirmed with SC Collaboration demonstrating a positive path coefficient ($\beta = 0.141$, $p = 0.014$), suggesting that collaborative practices in the supply chain foster technological innovation.
- **Hypothesis 1c**: "There is a positive relationship between SC Disruption Orientation and Technological Innovation." The findings support this hypothesis as SC Disruption Orientation displays a positive path coefficient ($\beta = 0.191$, $p < .001$), highlighting the crucial role of a proactive approach to disruptions in driving technological innovation.
- **Hypothesis 1d**: "There is a positive relationship between SC Flexibility and Technological Innovation." This hypothesis is upheld, as evidenced by the positive path coefficient for SC Flexibility ($\beta = 0.141$, $p = 0.012$), showing that adaptability within the supply chain enhances technological innovation.
- **Hypothesis 1e**: "There is a positive relationship between SC Information Sharing and Technological Innovation." This hypothesis is not supported, as SC Information Sharing exhibits a negative path coefficient ($\beta = -0.066$, $p = 0.237$), suggesting that, contrary to expectations, information sharing alone may not directly foster technological innovation in the supply chain.
- **Hypothesis 1f**: "There is a positive relationship between SC Integration and Technological Innovation." The results do not support this hypothesis, as SC Integration shows a negative path coefficient ($\beta = -0.063$, $p = 0.272$), indicating that integration efforts may not have a direct positive impact on technological innovation.
- **Hypothesis 1g**: "There is a positive relationship between SC Leadership Support and Technological Innovation." The results strongly support this hypothesis, with SC

Leadership Support having a significant positive path coefficient (β = 0.281, $p < .001$). Thus, the finding underscores the importance of leadership commitment in driving technological advancement within the supply chain.

4.4.2 Second Main Hypothesis

H2: There is a Positive Relationship between Supply Chain Dynamic Capabilities and Supply Chain Resilience

To test **Hypothesis H2** "There is a positive relationship between Supply Chain Dynamic Capabilities (SCDC) and Supply Chain Resilience (SCR)" " structural Equation Modeling (SEM) was applied using Smart PLS 4 by evaluating path coefficients, R^2 values, and significance levels, which provide insight into strength, direction, and reliability of these between latent variables by estimating path coefficients, thus indicating the strength and direction of these relationships.

Table (4.19): Summary of the Effects between Supply Chain Dynamic Capabilities and Technological Innovation

Path	**Effect Type**	**B**	**SE**	**T**	**P**	**95% CI for B**
Supply Chain Dynamic Capabilities → Technological Innovation	Total Effect	0.690	0.024	28.233	< .001	[0.643, 0.739]

Model Summary:

Metric	Value
R^2 Technological Innovation	0.477
R^2 adjusted Technological Innovation	0.476
f^2 (Supply Chain Dynamic Capabilities -> Technological Innovation)	0.911
Q^2 (Technological Innovation)	0.470
GoF	**0.612**

The main result demonstrates the significant positive effect of Supply Chain Dynamic Capabilities on Technological Innovation (β = 0.690, $p \leq 0.05$). The relationship explains a substantial portion of the variance in Technological Innovation ($R^2 = 0.477$), indicating that 47.7% of the variability in Technological Innovation can be attributed to Supply Chain Dynamic Capabilities. Predictive relevance ($Q^2 = 0.470$) supports the model's ability to predict Technological Innovation effectively, and effect size ($f^2 = 0.911$) suggests a large impact, highlighting the critical role of dynamic capabilities in driving technological innovation within the supply chain. The GoF value of 0.612 indicates a good model fit, as values above 0.36 are acceptable in PLS-SEM (Wetzels et al., 2009), the authors established that the basic values for the Goodness of Fit of the Model (GoF) are small at .10, medium at .25, and large at .36. Nonetheless, these may function as foundational parameters for the global validation of the PLS model.

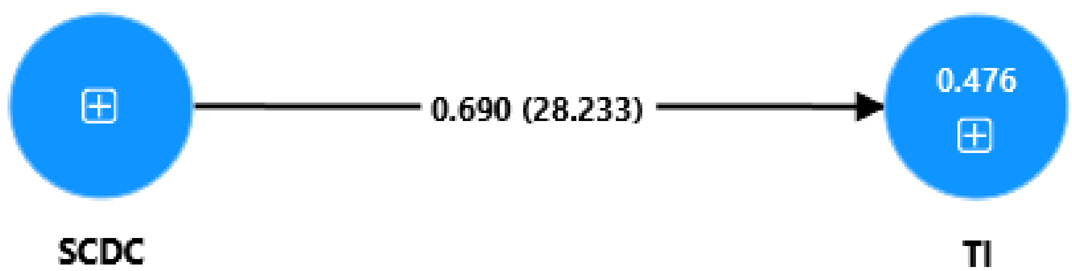

Figure (4.2): Path Coefficient (β) of Supply Chain Dynamic Capabilities (SCDC) on Technological Innovation (TI)

associations, the analysis involved assessing the direct effect of SCDC on SCR, and quantifying how well dynamic capabilities within supply chain contribute to its resilience in the face of potential disruptions.

Table (4.20): Direct Effects of Supply Chain Dynamic Capabilities on Supply Chain Resilience- Path Analysis

Path	B	SE	T	P	95% CI for B
SC Dynamic Capabilities → SC Resilience	0.703	0.021	32.980	< .001	[0.662, 0.746]

Model Summary:

Metric	Value
R^2 Supply Chain Resilience	0.494
R^2 adjusted Supply Chain Resilience	0.493
f^2 (Supply Chain Dynamic Capabilities -> Supply Chain Resilience)	0.977
Q^2 (Supply Chain Resilience)	0.487
GoF	**0.579**

The analysis indicates a strong and significant direct effect of Supply Chain Dynamic Capabilities on Supply Chain Resilience ($\beta = 0.703$, $p < .001$), explaining 49.4% of variance in Supply Chain Resilience ($R^2 = 0.494$), predictive relevance ($Q^2 = 0.487$) supports model's ability to predict resilience outcomes effectively, large effect size ($f^2 = 0.977$) emphasizes critical role of dynamic capabilities in enhancing resilience within supply chain, finding underscores that robust supply chain capabilities substantially contribute to the resilience of supply chain, enabling it to withstand and adapt to disruptions effectively. The GoF value of (0.579) indicates a good model fit, as values above 0.36 are acceptable in PLS-SEM.

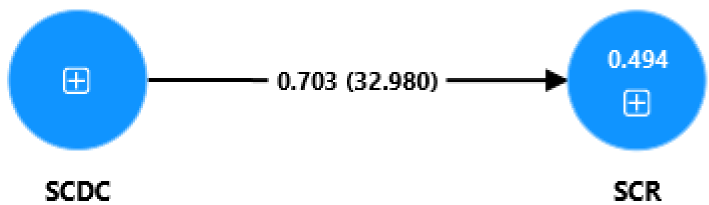

Figure (4.3): The Impact of Supply Chain Dynamic Capabilities (SCDC) on Supply Chain Resilience (SCR)

4.4.2.1 Results Related to Sub-Hypotheses

Table (4.21): Correlation Coefficients of Supply Chain Dynamic Capabilities Factors with Supply Chain Resilience (SCR)

Supply Chain Dynamic Capabilities (SCDC)	**Supply Chain Resilience (SCR)**
SC Agility	0.551
SC Collaboration	0.578
SC Disruption Orientation	0.644
SC Flexibility	0.551
SC Information Sharing	0.492
SC Integration	0.630
SC Leadership Support	0.448

As summarized in **Table 4.21,** analysis shows that **SC Disruption Orientation** has the strongest correlation with Supply Chain Resilience (SCR), with a coefficient of $r = 0.644$, indicating that a proactive approach to managing disruptions is highly related to supply chain resilience. **SC Integration** also has a substantial correlation with SCR (r = 0.630), suggesting that integrated supply chain processes are closely linked to SC resilience outcomes. **SC Collaboration** follows, with a correlation of r = 0.578, implying that cooperation between supply chain partners contributes positively to SC resilience. Additionally, **SC Agility** and **SC Flexibility** each have strong correlations with SCR (r = 0.551), highlighting flexibility and responsiveness within the supply chain are beneficial for SC resilience. **SC Information Sharing** has a moderate positive correlation with SCR (r = 0.492), underscoring the importance of communication among supply chain partners. Lastly, **SC Leadership Support** exhibits the lowest correlation with SCR (r = 0.448), suggesting that while leadership support is beneficial, it may have a smaller direct impact on SC resilience compared to the other supply chain factors according to Cohen (1988) who asserted that the commonly accepted thresholds for interpreting the strength of a correlation (r) exhibit slight variations across disciplines. The author regarded a correlation coefficient between 0.1 and 0.3 as a small correlation. Moderate correlation is indicated when r ranges between 0.3 and 0.5, and a strong correlation is present if r exceeds 0.5.

Table (4.22): Summary of Supply Chain Dynamic Capabilities Effect on Supply Chain Resilience (SCR)-Path Analysis

Path	B	SE	T	P	95% CI for B
SC Agility → SCR	0.141	0.048	2.922	0.003	[0.046, 0.237]
SC Collaboration → SCR	0.013	0.066	0.201	0.841	[-0.126, 0.138]
SC Disruption Orientation → SCR	0.366	0.043	8.556	< .001	[0.279, 0.447]
SC Flexibility → SCR	0.150	0.043	3.464	0.001	[0.065, 0.234]
SC Information Sharing → SCR	-0.059	0.066	0.902	0.367	[-0.179, 0.078]
SC Integration → SCR	0.242	0.062	3.895	< .001	[0.129, 0.370]
SC Leadership Support → SCR	0.032	0.052	0.624	0.533	[-0.074, 0.125]

Model Summary:

Metric	Value
R^2 SCR	0.541
R^2 adjusted SCR	0.534
f^2 (SC Agility -> SCR)	0.019
f^2 (SC Collaboration -> SCR)	0.000
f^2 (SC Disruption Orientation -> SCR)	0.130
f^2 (SC Flexibility -> SCR)	0.026
f^2 (SC Information Sharing -> SCR)	0.003
f^2 (SC Integration -> SCR)	0.042
f^2 (SC Leadership Support -> SCR)	0.001

Q^2 (SCR)	0.520
GoF	**0.606**

As noted from **Table 4.22,** the analysis indicates the range of direct effects from various supply chain dynamic capabilities on Supply Chain Resilience (SCR), with Supply Chain Disruption Orientation showing the strongest influence. Specifically, Supply Chain Disruption Orientation ($\beta = 0.366$, $p < .001$) has the highest path coefficient and notable effect size ($f^2 = 0.130$), underscoring its significant role in enhancing SCR.

Supply Chain Integration also exhibits a strong positive impact on SCR ($\beta = 0.242$, $p < .001$) with an effect size ($f^2 = 0.042$), indicating that effective coordination and alignment within the supply chain contribute meaningfully to the SC resilience outcomes.

Similarly, Supply Chain Agility ($\beta = 0.141$, $p = 0.003$) and Supply Chain Flexibility ($\beta = 0.150$, $p = 0.001$) show moderate positive effects on SCR, with effect sizes of 0.019 and 0.026, respectively, the findings suggest that agility and flexibility enable the supply chain to adapt to changes and thus enhance its resilience.

Supply Chain Information Sharing has a small negative effect on SCR ($\beta = -0.059$, $p = 0.367$) with minimal to no effect size ($f^2 = 0.003$), indicating that while information sharing is important, it may not directly enhance SC resilience.

Supply Chain Collaboration ($\beta = 0.013$, $p = 0.841$) and Supply Chain Leadership Support ($\beta = 0.032$, $p = 0.533$) show weaker positive effects, with effect sizes close to zero ($f^2 = 0.000$ and $f^2 = 0.001$), respectively, suggesting that direct contribution to SCR may be limited.

The model explains a substantial portion of the variance in SCR, with $R^2 = 0.541$ and Adjusted $R^2 = 0.534$, predictive relevance ($Q^2 = 0.520$) supports the model's capability to predict resilience outcomes effectively, highlighting the overall importance of these supply chain dynamic capabilities dimensions in supporting resilience. The GoF value of (0.606) indicates a good model fit, as values above 0.36 are acceptable in PLS-SEM.

Consequently, the hypotheses testing results for the relationships between various supply chain dynamic capabilities factors and Supply Chain Resilience (SCR) are presented as follows:

- **H2a**: "Agility Positively Influences Supply Chain Resilience." The results **support** this hypothesis, as SC Agility demonstrates a positive effect on SCR ($\beta = 0.141$, $p \leq 0.05$), suggesting that agility within the supply chain enhances its resilience.
- **H2b:** "Collaboration Positively Influences Supply Chain Resilience." This hypothesis is **weakly supported**, with SC Collaboration showing minimal positive effect on SCR ($\beta = 0.013$, $p \leq 0.05$) and negligible effect size ($f^2 = 0.000$), indicating limited direct impact.
- **H2c:** "Disruption Orientation Positively Influences Supply Chain Resilience." This hypothesis is **strongly supported**, as SC Disruption Orientation has the highest positive effect on SCR ($\beta = 0.366$, $p \leq 0.05$) with a notable effect size ($f^2 = 0.130$), highlighting the critical role of a proactive approach to managing disruptions in enhancing SC resilience.
- **H2d**:" Flexibility Positively Influences Supply Chain Resilience." The findings **support** this hypothesis, as SC Flexibility shows a positive impact on SCR ($\beta = 0.150$, $p \leq 0.05$) with small effect size ($f^2 = 0.026$), suggesting flexibility within the supply chain contributes positively to SC resilience.
- **H2e**: "Information Sharing Positively Influences Supply Chain Resilience." This hypothesis **is not supported**, as SC Information Sharing demonstrates a slight negative effect on SCR ($\beta = -0.059$, $p \leq 0.05$) with very small to no effect size ($f^2 = 0.003$), indicating information sharing alone may not directly enhance SC resilience.
- **H2f:** "Integration Positively Influences Supply Chain Resilience." The results **support** this hypothesis, as SC Integration shows a strong positive effect on SCR ($\beta = 0.242$, $p \leq 0.05$) with a substantial effect size ($f^2 = 0.042$), indicating integrated supply chain enhances its resilience.
- **H2g**: "Leadership Support Positively Influences Supply Chain Resilience." This hypothesis is **weakly supported**, with SC Leadership Support exhibiting minimal positive effect in SCR ($\beta = 0.032$, $p \leq 0.05$) and negligible effect size ($f^2 = 0.001$),

suggesting that while leadership support is beneficial, its direct impact on SC resilience may be limited.

4.4.3 Third Main Hypothesis-The Mediation Analysis

H3: The Relationship between Supply Chain Dynamic Capabilities and Supply Chain Resilience is Mediated by Technological Innovation.

Hypothesis 3 "explores whether Technological Innovation (TI) mediates the relationship between Supply Chain Dynamic Capabilities (SCDC) and Supply Chain Resilience (SCR)." This hypothesis was tested using Smart PLS 4 to analyze the structural model and assess the indirect effects of SCDC on SCR through TI. In mediation analysis, the model examines both the direct pathway from SCDC to SCR and the indirect pathway, where SCDC impacts TI, which in turn influences SCR. By evaluating path coefficients, indirect effects, and significance levels, the analysis identifies whether TI serves as a full or partial mediator, or if it has no mediating effect. The significant indirect effect would suggest TI plays a mediating role, while the strength of the direct effect would determine if mediation is partial (where both direct and indirect paths are significant) or full (where only the indirect path remains significant).

Table (4.23): Correlation Between Supply Chain Dynamic Capabilities (SCDC), Supply Chain Resilience (SCR), and Technological Innovation (TI).

	Supply Chain Resilience	**Technological Innovation**
Supply Chain Dynamic Capabilities	0.682	0.671

The correlation results indicate a significant positive relationship between Supply Chain Dynamic Capabilities (SCDC) and both Supply Chain Resilience (SCR) and Technological Innovation (TI). Specifically, the correlation coefficient between Supply Chain Dynamic Capabilities and Supply Chain Resilience is ($r = 0.682$), indicating a strong positive association, suggesting that as organizations improve their dynamic capabilities, their supply chains tend to become more resilient.

The correlation between Supply Chain Dynamic Capabilities and Technological Innovation is similarly high, with ($r = 0.671$), strong positive correlation suggests that the companies with greater supply chain dynamic capabilities are more likely to engage in technological innovation. These findings highlight the interconnectedness of dynamic capabilities with resilience and technological innovation in supply chains.

Table (4.24): Mediation Role of Technological Innovation in the Relationship between Supply Chain Dynamic Capabilities (SCDC) and Supply Chain Resilience (SCR)

Path	**Effect Type**	**B**	**SE**	**T**	**P**	**95% CI for B**
SC Dynamic Capabilities → SC Resilience	**Direct Effect**	**0.594**	0.036	16.464	<.001	[0.523, 0.667]
SC Dynamic Capabilities → Technological Innovation	Direct Effect	0.671	0.028	24.363	<.001	[0.614, 0.723]
Technological Innovation → SC Resilience	Direct Effect	0.131	0.043	3.049	0.002	[0.044, 0.214]
SC Dynamic Capabilities → SC Resilience	**Total Effect**	**0.682**	0.025	27.337	<.001	[0.631, 0.730]
SC Dynamic Capabilities → SC Resilience (via Technological Innovation)	**Indirect Effect**	**0.088**	0.029	2.998	0.003	[0.030, 0.146]

Model Summary:	**Value**
R^2 (Supply Chain Resilience)	0.474
R^2 (Technological Innovation)	0.450
R^2 adjusted	0.472
R^2 adjusted	0.448
Q^2predict (Supply Chain Resilience)	0.460
Q^2predict (Technological Innovation)	0.444
f^2	
Supply Chain Dynamic Capabilities -> Supply Chain Resilience	0.369
Supply Chain Dynamic Capabilities -> Technological Innovation	0.817
Technological Innovation -> Supply Chain Resilience	0.018
GoF	**0.581**

The mediation analysis examined whether Technological Innovation (TI) mediates the relationship between Supply Chain Dynamic Capabilities (SCDC) and Supply Chain Resilience (SCR). The results indicate that SCDC has both direct and indirect effects on SCR, with TI acting as a partial mediator. The direct effect of SCDC on SCR is substantial, with a path coefficient of $\beta = 0.594$, $p < .001$, and an effect size of $f^2 = 0.369$, showing that SCDC strongly enhances SCR, direct pathway significantly contributes to the model, explaining 47.4% of the variance in SCR ($R^2 = 0.474$, Adjusted $R^2 = 0.472$).

SCDC also shows a positive indirect effect on SCR through TI, the path coefficient for SCDC on TI is $\beta = 0.671$, $p < .001$, with a large effect size ($f^2 = 0.817$), accounting for 45% of the variance in TI ($R^2 = 0.450$, Adjusted $R^2 = 0.448$). TI, in turn, positively influences SCR with a path coefficient of $\beta = 0.131$, $p = 0.002$, although the effect is small ($f^2 = 0.018$).

The indirect effect of SCDC on SCR through TI is calculated at 0.088 ($p = 0.003$), **supporting the mediation hypothesis**. Indicating that while SCDC directly enhances SCR, its impact is also partially channeled through improvements in TI. Thereby, bolstering SCR indirectly, the total effect of SCDC on SCR, combining both direct and indirect pathways, is 0.682, underscoring the significant role of TI in mediating the SCDC-SCR relationship.

These findings suggest that Technological Innovation serves as an important mediator, amplifying the positive influence of Supply Chain Dynamic Capabilities on Supply Chain Resilience. The GoF value of (0.581) indicates a good model fit, as values above 0.36 are acceptable in PLS-SEM.

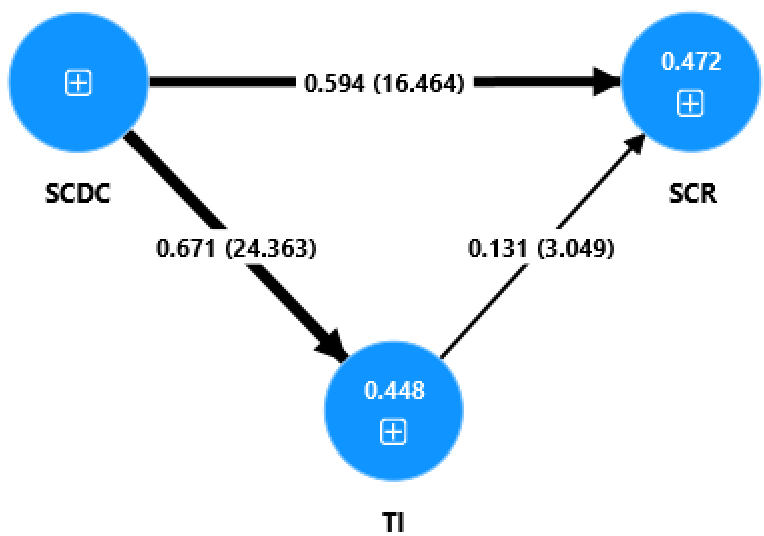

Figure (4.4): Mediation Model of Supply Chain Dynamic Capabilities (SCDC) on Supply Chain Resilience (SCR) through Technological Innovation (TI)

4.4.3.1 Results Related to the Sub Hypothesis

This section examines the mediating role of Technological Innovation in the relationship between Supply Chain Dynamic Capabilities (SCDC) and Supply Chain Resilience (SCR). Table (4.25) provides correlations between various dimensions of SCDC, Technological Innovation (TI), and SCR, highlighting how dynamic capabilities such as agility, collaboration, and integration influence both TI and SCR. These results are essential for understanding whether Technological Innovation acts as a bridge that enhances the impact of SCDC on SCR, thereby strengthening the supply chain's ability to adapt and recover effectively.

Table (4.25): Correlation Between Supply Chain Dynamic Capabilities (SCDC) Dimensions, Supply Chain Resilience (SCR), and Technological Innovation (TI)

	Supply Chain Resilience	**Technological Innovation**
SC Agility	0.505	0.591
SC Collaboration	0.574	0.522
SC Disruption Orientation	0.639	0.463
SC Flexibility	0.539	0.535
SC Information Sharing	0.484	0.471
SC Integration	0.620	0.531
SC Leadership Support	0.446	0.588

As noted in **Table (4.25)** SC Disruption Orientation has the strongest correlation with SCR (r = 0.639), underscoring its role in enhancing SC resilience. Similarly, SC Integration shows a significant correlation with SCR (r = 0.620), suggesting that well-integrated processes are crucial for SC resilience. SC Agility is moderately correlated with both SCR (r = 0.505) and TI (r = 0.591), indicating agility supports SC resilience while also promoting technological innovation. SC Leadership Support, although positively correlated with SCR (r = 0.446), shows a stronger relationship with TI (r = 0.588), emphasizing its important role in driving technological innovation.

SC Flexibility displays balanced, moderate correlations with both SCR (r = 0.539) and TI (r = 0.535), pointing to its value in both SC resilience and innovation efforts. SC

Collaboration also has moderate correlations with SCR (r = 0.574) and TI (r = 0.522), indicating cooperation among supply chain partners aids both SC resilience and technological innovation. Lastly, SC Information Sharing shows moderate correlations with SCR (r = 0.484) and TI (r = 0.471), highlighting the importance of open communication for both SC resilience and technological innovation. Based on the study's findings, the hypotheses that are related to the mediating role of Technological Innovation (TI) in the relationship between various supply chain dynamic capabilities and Supply Chain Resilience (SCR) are discussed in more depth in the subsequent sections:**H3a:** "The relationship between SC Agility and Supply Chain Resilience is Mediated by Technological Innovation." Analysis shows an indirect effect of $\beta = 0.206$, $p \leq 0.05$, indicating partial mediation, as the direct effect of agility on resilience remains significant even after including technological innovation as a mediator.

Table (4.26): The Mediation Analysis Results for SC Agility, Technological Innovation, and Supply Chain Resilience (SCR)

Path	Effect Type	B	SE	t	P	95% CI for B
SC Agility → SCR	**Direct Effect**	**0.305**	0.050	6.073	<.001	[0.206, 0.401]
SC Agility → Technological Innovation	Direct Effect	0.592	0.031	19.243	<.001	[0.531, 0.653]
Technological Innovation → SCR	Direct Effect	0.348	0.050	6.929	<.001	[0.249, 0.447]
SC Agility → SCR	**Total Effect**	**0.511**	0.037	13.974	<.001	[0.440, 0.580]
SC Agility → SCR (via Technological Innovation)	**Indirect Effect**	**0.206**	0.032	6.540	<.001	[0.148, 0.272]

Model Summary:

Metric	Value
R^2 SCR	0.340
R^2 adjusted SCR	0.337
R^2 Technological Innovation	0.351
R^2 adjusted Technological Innovation	0.349
f^2 (SC Agility -> SCR)	0.092
f^2 (SC Agility -> Technological Innovation)	0.541
f^2 (Technological Innovation -> SCR)	0.119
Q^2 (SCR)	0.254
Q^2 (Technological Innovation)	0.346
GoF	**0.503**

The results presented in **Table 4.26** show that SC Agility has a direct positive effect on SCR (β = 0.305, $p < .001$), as well as a significant indirect effect through Technological Innovation (β = 0.206, $p < .001$), ***supporting the partial mediation hypothesis***. SC Agility also shows a strong direct effect on Technological Innovation (β = 0.592, $p < .001$) with a large effect size ($f^2 = 0.541$), indicating that agility enhances both technological innovation and resilience within the supply chain. Predictive relevance (Q^2) for SCR is 0.254, and for Technological Innovation is 0.346, validating the model's capacity to predict effectively SC resilience and technological innovation outcomes.

Overall, analysis reveals that while SC Agility directly strengthens SCR, its impact is also partly mediated by Technological Innovation, amplifying the positive influence of agility on SC resilience. The combined total effect of SC Agility on SCR is 0.511, underscoring dual pathways through which agility contributes to SC resilience. The GoF value of 0.502 indicates a good model fit, as values above 0.36 are acceptable in PLS-SEM.

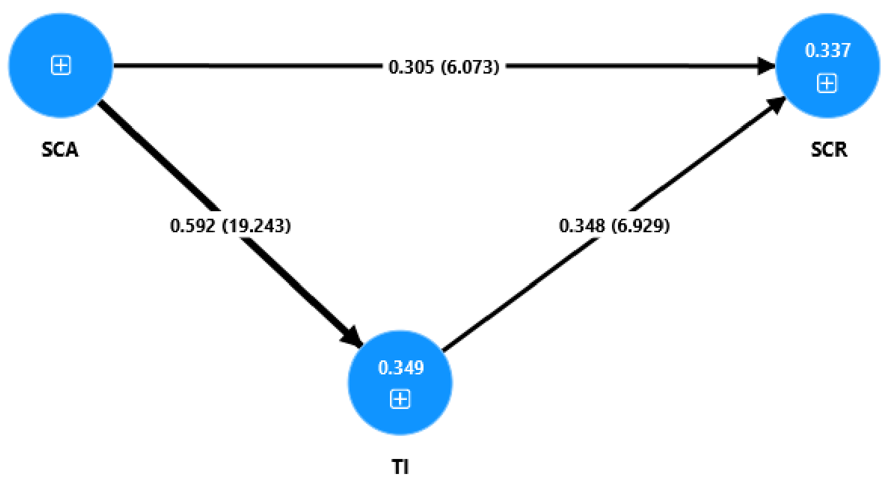

Figure (4.5): Mediation Model of SC Agility (SCA) on Supply Chain Resilience (SCR) through Technological Innovation (TI)

H3b: SC Collaboration and Supply Chain Resilience have an indirect relationship mediated by Technological Innovation. The results reveal an indirect effect of β = 0.169, $p \leq 0.05$, suggesting partial mediation where collaboration’s influence on SC resilience is partially explained through technological innovation.

Table (4.27): Mediation Analysis Results for SC Collaboration, Technological Innovation, and Supply Chain Resilience (SCR)

Path	**Effect Type**	**B**	**SE**	**T**	**P**	**95% CI for B**
SC Collaboration → SCR	**Direct Effect**	**0.407**	0.039	10.347	<.001	[0.328, 0.480]
SC Collaboration → Technological Innovation	Direct Effect	0.526	0.034	15.594	<.001	[0.458, 0.591]
Technological Innovation → SCR	Direct Effect	0.320	0.039	8.243	<.001	[0.247, 0.399]
SC Collaboration → SCR	**Total Effect**	**0.576**	0.033	17.675	<.001	[0.508, 0.638]
SC Collaboration → SCR (via Technological Innovation)	**Indirect Effect**	**0.169**	0.024	6.978	<.001	[0.126, 0.220]

Model Summary:

Metric	Value
R^2 SCR	0.405
R^2 adjusted SCR	0.403
R^2 Technological Innovation	0.277
R^2 adjusted Technological Innovation	0.275
Q^2 (SCR)	0.328
Q^2 (Technological Innovation)	0.273
f^2 (SC Collaboration -> SCR)	0.201
f^2 (SC Collaboration -> Technological Innovation)	0.383
f^2 (Technological Innovation -> SCR)	0.125
GoF	**0.499**

The results presented in **Table (4.27)** show that SC Collaboration has a direct positive effect on SCR ($\beta = 0.407$, $p < .001$) as well as a significant indirect effect through Technological Innovation ($\beta = 0.169$, $p < .001$), ***confirming partial mediation***. SC Collaboration also shows a strong direct effect on Technological Innovation ($\beta = 0.526$, $p < .001$) with a large effect size ($f^2 = 0.383$), indicating that collaboration promotes both technological innovation and resilience within the supply chain. The predictive relevance (Q^2) values of 0.328 for SCR and 0.273 for Technological Innovation validate the model's ability to predict SC resilience and technological innovation outcomes effectively. The GoF value of 0.499 indicates a good model fit, as values above 0.36 are acceptable in PLS-SEM (Wetzels et al., 2009).

Overall, the analysis suggests that while SC Collaboration directly strengthens SCR, its impact is also partly mediated by Technological Innovation. Thus, enhancing SC resilience through collaborative-driven innovation. The combined total effect of SC Collaboration on SCR is 0.576, underscoring dual pathways through which collaboration contributes to SC resilience.

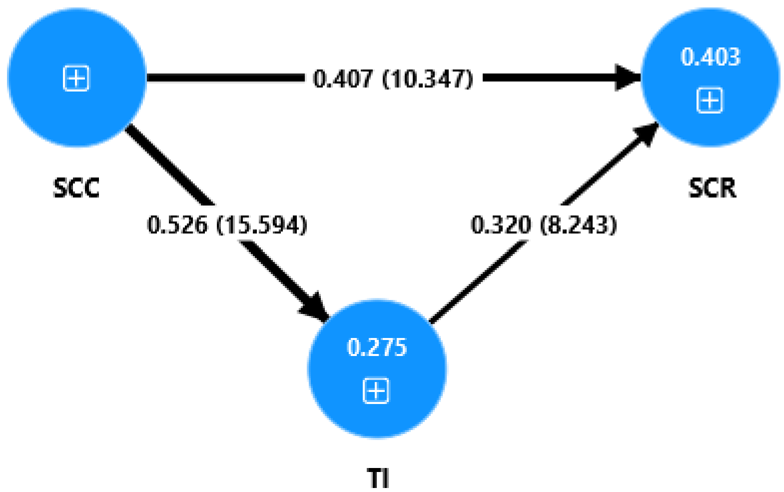

Figure (4.6): The Mediation Model of SC Collaboration (SCC) on Supply Chain Resilience (SCR) through Technological Innovation (TI)

H3c: The relationship between SC Disruption Orientation and Supply Chain Resilience is mediated by Technological Innovation. The results revealed that the indirect effect is $\beta = 0.141$, $p \leq 0.05$, again pointing to partial mediation, as a direct pathway between disruption orientation and SC resilience remains significant.

Table (4.28): Mediation Analysis Results for SC Disruption Orientation, Technological Innovation, and Supply Chain Resilience (SCR)

Path	**Effect Type**	**B**	**SE**	**t**	**P**	**95% CI for B**
SC Disruption Orientation → SCR	**Direct Effect**	**0.499**	0.037	13.557	<.001	[0.423, 0.570]
SC Disruption Orientation → Technological Innovation	Direct Effect	0.469	0.033	14.256	<.001	[0.406, 0.534]
Technological Innovation → SCR	Direct Effect	0.301	0.037	8.086	<.001	[0.230, 0.376]

SC Disruption Orientation → SCR	**Total Effect**	**0.640**	0.029	21.949	<.001	[0.582, 0.696]
SC Disruption Orientation → SCR (via Technological Innovation)	**Indirect Effect**	**0.141**	0.021	6.663	<.001	[0.103, 0.186]

Model Summary:

Metric	**Value**
R^2 SCR	0.480
R^2 adjusted SCR	0.477
R^2 Technological Innovation	0.220
R^2 adjusted Technological Innovation	0.219
Q^2 (SCR)	0.405
Q^2 (Technological Innovation)	0.216
f^2 (SC Disruption Orientation -> SCR)	0.372
f^2 (SC Disruption Orientation -> Technological Innovation)	0.283
f^2 (Technological Innovation -> SCR)	0.135
GoF	**0.506**

It could be noted from the results shown in **Table (4.28)** that SC Disruption Orientation has a direct positive effect on SCR ($\beta = 0.499$, $p < .001$), as well as significant indirect effect through Technological Innovation ($\beta = 0.141$, $p < .001$), ***supporting partial mediation***. SC Disruption Orientation also shows a strong direct effect on Technological Innovation ($\beta = 0.469$, $p < .001$) with a moderate effect size ($f^2 = 0.283$), indicating that a proactive approach to disruptions enhances both technological innovation and resilience within the supply chain.

The model's predictive relevance (Q^2) is implied to be high for SCR and Technological Innovation, with an R^2 of 0.480 for SCR and 0.220 for Technological Innovation, validating the model's capacity to predict SC resilience and technological innovation outcomes. The predictive relevance values indicate that the model effectively predicts Supply Chain Resilience ($Q^2 = 0.405$) and Technological Innovation ($Q^2 = 0.216$), with stronger predictive relevance observed for SCR. The GoF value of 0.506 indicates a good model fit, as values above 0.36 are acceptable in PLS-SEM.

Overall, the analysis suggests that while SC Disruption Orientation directly strengthens SCR, its impact is also partly mediated by Technological Innovation. Thus, enhancing SC resilience through disruption-oriented driven innovation. The combined total effect of SC Disruption Orientation on SCR is 0.640, emphasizing dual pathways through which disruption orientation contributes to SC resilience.

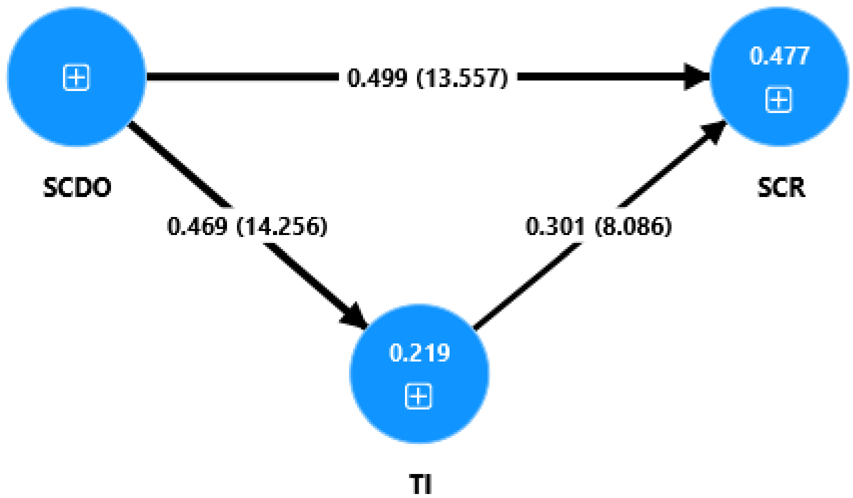

Figure (4.7): Mediation Model of SC Disruption Orientation (SCDO) on Supply Chain Resilience (SCR) through Technological Innovation (TI)

H3d: The impact of SC Flexibility on Supply Chain Resilience is mediated by Technological Innovation, with an indirect effect of $\beta = 0.181$, $p \leq 0.05$, which suggests partial mediation, as flexibility contributes to SC resilience both directly and indirectly through innovation.

Table (4.29): Mediation Analysis Results for SC Flexibility, Technological Innovation, and SCR

Path	Effect Type	B	SE	T	p	95% CI for B
SC Flexibility → SCR	**Direct Effect**	**0.359**	0.043	8.384	<.001	[0.276, 0.443]
SC Flexibility → Technological Innovation	Direct Effect	0.536	0.038	13.921	<.001	[0.458, 0.610]
Technological Innovation → SCR	Direct Effect	0.337	0.042	8.052	<.001	[0.257, 0.420]
SC Flexibility → SCR	**Total Effect**	**0.540**	0.034	15.684	<.001	[0.474, 0.609]
SC Flexibility → SCR (via Technological Innovation)	**Indirect Effect**	**0.181**	0.027	6.669	<.001	[0.132, 0.237]

Model Summary:

Metric	Value
R^2 SCR	0.373
R^2 adjusted SCR	0.370
R^2 Technological Innovation	0.287
R^2 adjusted Technological Innovation	0.285
f^2 (SC Flexibility -> SCR)	0.147

f^2 (SC Flexibility -> Technological Innovation)	0.402
f^2 (Technological Innovation -> SCR)	0.129
Q^2 (SCR)	0.287
Q^2 (Technological Innovation)	0.280
GoF	**0.491**

The results shown in **Table 4.29** demonstrate that SC Flexibility has a direct positive effect on SCR ($\beta = 0.359$, $p < .001$) as well as a significant indirect effect through Technological Innovation ($\beta = 0.181$, $p < .001$), ***confirming partial mediation***. SC Flexibility also shows a strong direct effect on Technological Innovation ($\beta = 0.536$, $p < .001$) with a substantial effect size ($f^2 = 0.402$), indicating that flexibility promotes both technological innovation and resilience within the supply chain.

The predictive relevance (Q^2) for SCR is 0.287, and for Technological Innovation is 0.280, supporting the model's ability to predict SC resilience and technological innovation outcomes effectively. The GoF value of 0.491 indicates a good model fit, as values above 0.36 are acceptable in PLS-SEM.

In summary, SC Flexibility enhances SCR both directly and indirectly through Technological Innovation, amplifying the positive influence of flexibility on SC resilience. The combined total effect of SC Flexibility on SCR is 0.540, highlighting dual pathways through which flexibility contributes to the resilience of the supply chain.

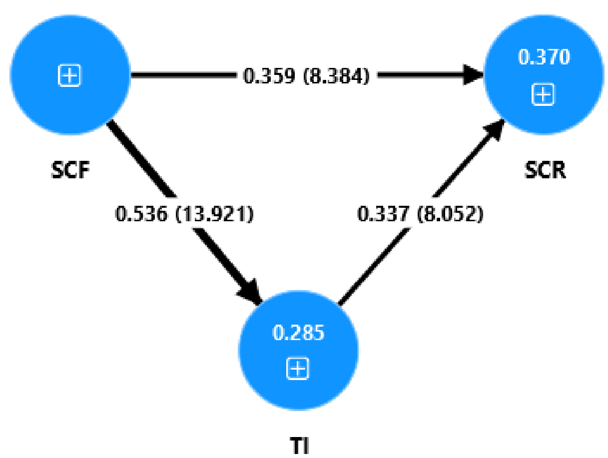

Figure (4.8): Mediation Model of SC Flexibility (SCF) on Supply Chain Resilience (SCR) through Technological Innovation (TI)

H3e: SC Information Sharing and Supply Chain Resilience are connected through Technological Innovation as a mediator. The indirect effect is positive, β = 0.186, $p \leq 0.05$, indicating that information sharing's contribution to SC resilience is moderated when accounting for technological innovation, suggesting a weaker indirect relationship.

Table (4.30): Mediation Analysis Results for SC Information Sharing, Technological Innovation, and SCR

Path	Effect Type	B	SE	T	p	95% CI for B
SC Information Sharing → SCR	**Direct Effect**	**0.300**	0.043	6.951	< .001	[0.218, 0.387]
SC Information Sharing → Technological Innovation	Direct Effect	0.473	0.037	12.698	< .001	[0.398, 0.546]
Technological Innovation → SCR	Direct Effect	0.392	0.041	9.592	< .001	[0.313, 0.473]
SC Information Sharing → SCR	**Total Effect**	**0.486**	0.040	12.091	< .001	[0.406, 0.565]
SC Information Sharing → SCR (via Technological Innovation)	**Indirect Effect**	**0.186**	0.023	7.916	< .001	[0.142, 0.234]

Model Summary:

Metric	Value
R^2 SCR	0.355
R^2 adjusted SCR	0.352
R^2 Technological Innovation	0.224
R^2 adjusted Technological Innovation	0.222
f^2 (SC Information Sharing -> SCR)	0.108
f^2 (SC Information Sharing -> Technological Innovation)	0.289
f^2 (Technological Innovation -> SCR)	0.185
Q^2 (SCR)	0.230
Q^2 (Technological Innovation)	0.219
GoF	**0.460**

As depicted in **Table (4.30)** results show that SC Information Sharing has direct positive effect on SCR (β = 0.300, $p < .001$) as well as significant indirect effect through Technological Innovation (β = 0.186, $p < .001$), ***indicating partial mediation***, SC Information Sharing also shows strong direct effect on Technological Innovation (β = 0.473, $p < .001$) with moderate effect size (f^2 = 0.289), suggesting that information sharing promotes both innovation and resilience within supply chain.

The predictive relevance (Q^2) values of 0.230 for SCR and 0.219 for Technological Innovation support the model's capacity to predict SC resilience and technological innovation outcomes effectively. The GoF value of 0.460 is a good model fit, as values above 0.36 are acceptable in PLS-SEM.

In summary, SC Information Sharing positively impacts SCR both directly and indirectly through Technological Innovation, amplifying the overall contribution of information sharing to the resilience of the supply chain. The combined total effect of SC Information Sharing on SCR is 0.486, highlighting dual pathways through which information sharing supports SC resilience.

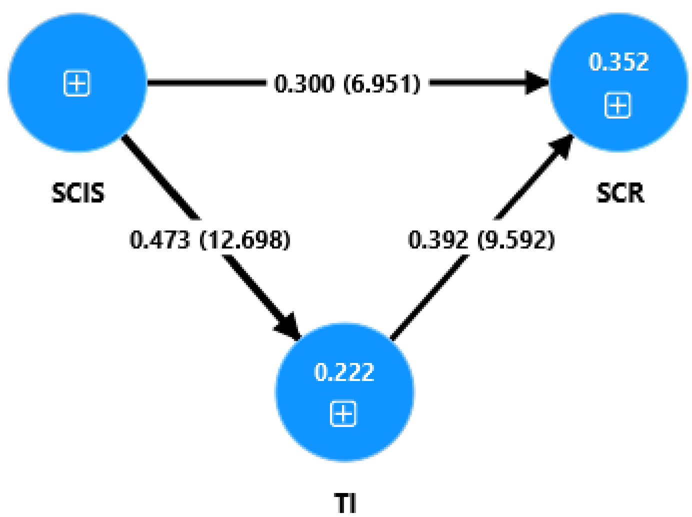

Figure (4.9): Mediation Model of SC Information Sharing (SCIS) on Supply Chain Resilience (SCR) through Technological Innovation (TI)

H3f: SC Integration influences Supply Chain Resilience through Technological Innovation with an indirect effect of β 0.151, $p \leq 0.05$, effect indicates partial mediation, with a strong direct contribution of integration to the resilience independent of technological innovation.

Table (4. 31): Mediation Analysis Results for SC Integration, Technological Innovation, and SCR

Path	**Effect Type**	**B**	**SE**	**T**	**P**	**95% CI for B**
SC Integration → SCR	**Direct Effect**	**0.471**	0.037	12.895	< .001	[0.400, 0.543]
SC Integration → Technological Innovation	Direct Effect	0.536	0.036	14.895	< .001	[0.463, 0.605]
Technological Innovation → SCR	Direct Effect	0.283	0.040	7.123	< .001	[0.204, 0.359]
SC Integration → SCR	**Total Effect**	**0.622**	0.028	21.969	< .001	[0.569, 0.678]
SC Integration → SCR (via Technological Innovation)	**Indirect Effect**	**0.151**	0.024	6.353	< .001	[0.107, 0.200]

Model Summary:

Metric	**Value**
R^2 SCR	0.444
R^2 adjusted SCR	0.442
R^2 Technological Innovation	0.287
R^2 adjusted Technological Innovation	0.285
f^2 (SC Integration -> SCR)	0.284
f^2 (SC Integration -> Technological Innovation)	0.402
f^2 (Technological Innovation -> SCR)	0.103
Q^2 (SCR)	0.380
Q^2 (Technological Innovation)	0.281
GoF	**0.517**

Table (4.31) results demonstrate that SC Integration has a direct positive effect on SCR ($\beta = 0.471$, $p < .001$) as well as a significant indirect effect through Technological Innovation ($\beta = 0.151$, $p < .001$), ***supporting partial mediation***. SC Integration also shows a strong direct effect on Technological Innovation ($\beta = 0.536$, $p < .001$) with a substantial effect size ($f^2 = 0.402$), indicating that integration contributes to both technological innovation and resilience within the supply chain.

The predictive relevance (Q^2) values of 0.380 for SCR and 0.281 for Technological Innovation support the model's ability to predict resilience and technological innovation outcomes effectively.

In summary, SC Integration enhances SCR both directly and indirectly through Technological Innovation, amplifying the impact of integration on SC resilience. The combined total effect of SC Integration on SCR is 0.622, underscoring dual pathways through which integration supports resilience in the supply chain. A value GoF of 0.517 falls into the range of large or good fit, as it exceeds the commonly used threshold of 0.36 for a substantial model fit (Wetzels et al. 2009).

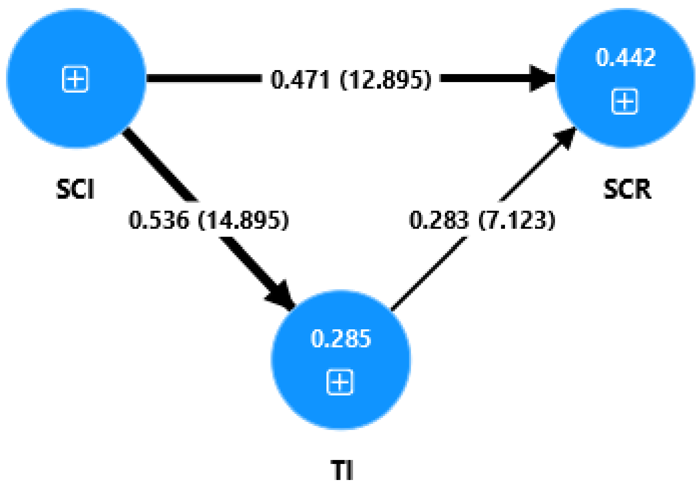

Figure (4.10): Mediation Model of SC Integration (SCI) on Supply Chain Resilience (SCR) through Technological Innovation (TI)

H3g: The Effect of SC Leadership Support on Supply Chain Resilience is mediated by Technological Innovation. The indirect effect of β = 0.237, p ≤ 0.05, signifies partial mediation, where leadership support influences SC resilience both directly and indirectly through technological innovation.

Table (4.32): Mediation Analysis Results for SC Leadership Support, Technological Innovation, and SCR

Path	**Effect Type**	**B**	**SE**	**t**	**P**	**95% CI for B**
SC Leadership Support → SCR	**Direct Effect**	**0.214**	0.047	4.581	< .001	[0.117, 0.299]
SC Leadership Support → Technological Innovation	Direct Effect	0.589	0.026	22.709	< .001	[0.536, 0.639]
Technological Innovation → SCR	Direct Effect	0.402	0.044	9.192	< .001	[0.318, 0.490]
SC Leadership Support → SCR	**Total Effect**	**0.451**	0.037	12.076	< .001	[0.376, 0.521]

SC Leadership Support → SCR (via Technological Innovation)	**Indirect Effect**	**0.237**	0.030	7.874	< .001	[0.183, 0.299]

Model Summary:

Metric	**Value**
R^2 SCR	0.309
R^2 adjusted SCR	0.305
R^2 Technological Innovation	0.347
R^2 adjusted Technological Innovation	0.345
f^2 (SC Leadership Support -> SCR)	0.043
f^2 (SC Leadership Support -> Technological Innovation)	0.531
f^2 (Technological Innovation -> SCR)	0.153
Q^2 (SCR)	0.197
Q^2 (Technological Innovation)	0.343
GoF	**0.490**

As illustrated in **Table (4.32)** results indicate that SC Leadership Support has a direct positive effect on SCR ($\beta = 0.214$, $p < .001$) and a significant indirect effect through Technological Innovation ($\beta = 0.237$, $p < .001$), ***supporting partial mediation***. SC Leadership Support also shows a strong direct effect on Technological Innovation ($\beta = 0.589$, $p < .001$) with a substantial effect size ($f^2 = 0.531$), emphasizing that leadership support enhances both technological innovation and resilience within the supply chain. The predictive relevance (Q^2) values of 0.197 for SCR and 0.343 for Technological Innovation validate the model's predictive capability for SC resilience and innovation outcomes. GoF value of 0.49 falls into the range of large or good fit, as it exceeds the commonly used threshold of 0.36 for a substantial model fit (Wetzels et al. 2009).

In summary, SC Leadership Support positively impacts SCR both directly and indirectly through Technological Innovation, amplifying the overall contribution of leadership to SC resilience. The combined total effect of SC Leadership Support on SCR is 0.451, illustrating dual pathways through which leadership enhances resilience in the supply chain.

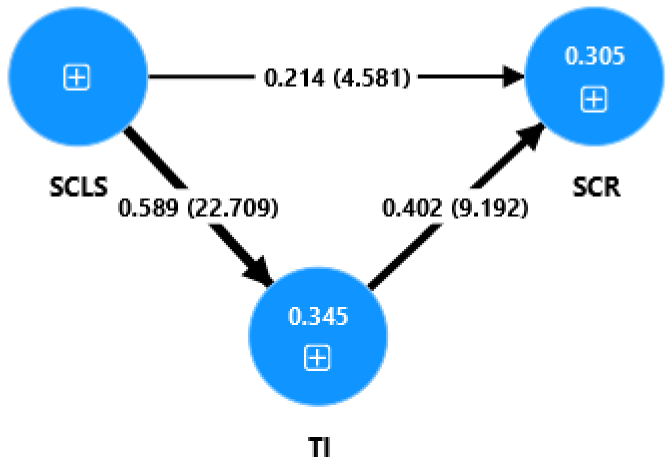

Figure (4.11): Mediation Model of SC Leadership Support (SCLS) on Supply Chain Resilience (SCR) through Technological Innovation (TI)

Consequently, the mediation analysis highlights that Technological Innovation (TI) partially mediates the relationship between Supply Chain Dynamic Capabilities (SCDC) and Supply Chain Resilience (SCR), while SCDC directly strengthens SCR; its impact is amplified when mediated through TI, showcasing interconnectedness between dynamic capabilities, technological innovation, and resilience. Each dimension of SCDC contributes to SCR both directly and through the development of technological innovation, emphasizing their dual pathways of influence. The findings confirm the critical role of technological advancements in maximizing the effectiveness of dynamic capabilities, reinforcing the importance of integrating technological innovation to build resilient supply chains.

4.4.4 Fourth Main Hypothesis

H4: Technological Innovation Has a Positive Impact on Supply Chain Resilience

Hypothesis 4 proposes that "Technological Innovation (TI) has a positive impact on Supply Chain Resilience (SCR)." To test this hypothesis, Smart PLS 4 was used to analyze the structural model and assess the direct relationship between TI and SCR. The analysis involved calculating the path coefficient for a direct effect of TI on SCR, along with the associated significance level (p-value), significant and positive path coefficient would indicate support for H4, demonstrating that increased levels of technological innovation contribute positively to enhancing supply chain resilience.

Table (4.33): Correlation Analysis between Supply Chain Resilience (SCR) and Technological Innovation (TI)

	Supply Chain Resilience	**Technological Innovation**
Supply Chain Resilience	1.000	0.542
Technological Innovation	0.542	1.000

According to **Table (4.33),** the correlation analysis shows a moderate positive association between Supply Chain Resilience (SCR) and Technological Innovation (TI) with an observed correlation coefficient of 0.542. The results indicate that as technological innovation increases within the supply chain, SC resilience also tends to improve, suggesting that technological innovation supports supply chain's ability to handle disruptions effectively.

Table (4.34): Path Analysis Results for Technological Innovation and SCR

Path	**Effect Type**	**B**	**SE**	**T**	**P**	**95% CI for B**
Technological Innovation → SCR	Direct Effect	0.542	0.033	16.666	< .001	[0.479, 0.608]
Model Summary:			**Value**			
R^2 SCR			0.294			
R^2 adjusted SCR			0.292			
f^2 (Technological Innovation -> SCR)			0.416			
Q^2 (SCR)			0.288			
GoF			**0.447**			

As noted from **Table (4.34)** results show a strong and significant direct effect of Technological Innovation on SCR ($\beta = 0.542$, $p < .001$), **supporting H4**. Additionally, a positive path coefficient indicates that higher levels of technological innovation are associated with greater supply chain resilience. The effect size ($f^2 = 0.416$) highlights the substantial contribution of TI to SC resilience outcomes.

The predictive relevance (Q^2) value of 0.288 supports the model's capacity to predict SCR effectively, confirming the positive role of Technological Innovation in strengthening resilience within the supply chain.

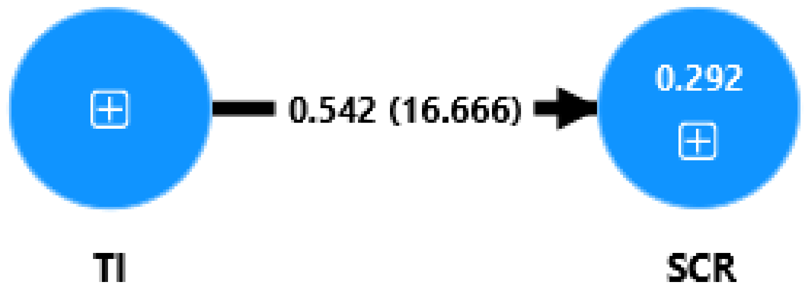

Figure (4.12): The Influence of Technological Innovation (TI) on Supply Chain Resilience (SCR) with Path Coefficient

4.4.5 Fifth Main Hypothesis

H5: "Firm Size and Firm Age Dimensions Exhibit Controlling Impact on Supply Chain Resilience."

Table (4.35): Analysis Results for Firm Age, Firm Size, and Supply Chain Resilience

Metric	B Value	Mean	STDEV	T-value	p-value	95% CI
Unstandardized Coefficients						
Company Age	0.050	0.049	0.041	1.223	0.221	[-0.033, 0.129]
Firm Size	-0.050	-0.050	0.027	1.855	0.064	[-0.104, 0.003]
Intercept	3.727	3.727	0.089	41.659	< .001	[3.552, 3.903]
Standardized Coefficients						
Company Age	0.071	0.070	0.058	1.233	0.218	[-0.047, 0.183]
Firm Size	-0.099	-0.099	0.053	1.882	0.060	[-0.202, 0.006]
Quality Criteria						
R^2	0.008	0.013	0.010	0.839	0.401	[0.001, 0.038]
R^2 adjusted	0.004	0.009	0.010	0.387	0.699	[-0.004, 0.033]
VIF						
Company Age	1.283	1.290	0.070	18.236	< .001	[1.168, 1.443]
Firm Size	1.283	1.290	0.070	18.236	< .001	[1.168, 1.443]

As noted from **Table 4.35** results indicate that Firm Age has a positive but weak effect on SCR, with an unstandardized coefficient (β) of 0.050 and standardized coefficient of 0.071, though effect does not reach statistical significance ($p = 0.221$), suggests that while older firms may have some enhanced SC resilience, their age alone does not substantially strengthen supply chain resilience, effect size for Firm Age is minimal ($f^2 = 0.005$), reinforcing its limited contribution.

Conversely, firm size has a negative association with SCR, with an unstandardized coefficient (β) of -0.050 and a standardized coefficient of -0.099, approaching statistical significance ($p = 0.064$). However, a negative trend implies that larger firms may experience slight reductions in SC resilience. However, the effect size for Firm Size ($f^2 = 0.008$) also points to a minimal impact.

The model explains only 0.8% of the variance in SCR, with an R^2 of 0.008 and an Adjusted R^2 of 0.004, highlighting the limited explanatory power of both Firm Age and Firm Size in predicting supply chain resilience within the model.

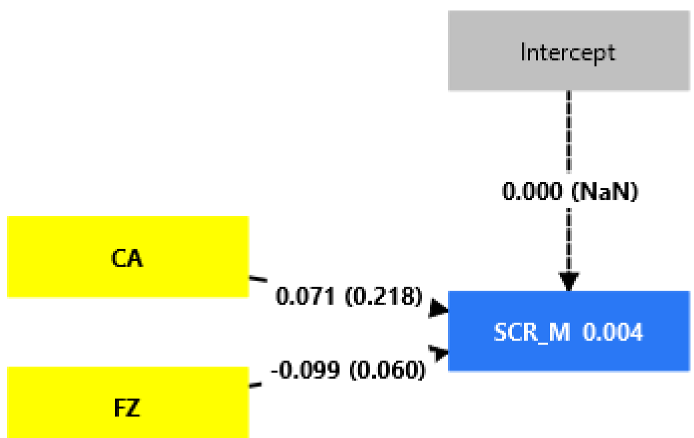

Figure (4.13): Effects of Firm Age (FA) and Firm Size (FZ) on Supply Chain Resilience (SCR)

4.5 Summary

Findings from 448 executives in industrial enterprises in the West Bank of Palestine demonstrate that the study's measurement models were valid and reliable, affirming the robustness of the constructs involved. The results indicate that supply chain resilience exists at a moderate level.

The analysis revealed that supply chain dynamic capabilities positively influence both technological innovation and supply chain resilience. Furthermore, technological innovation was identified as having a substantial positive effect on supply chain resilience, indicating that technological advancements within the supply chain are crucial for fostering SC resilience.

Additionally, technological innovation serves as a partial mediator in the relationship between supply chain dynamic capabilities and supply chain resilience. Highlighting those dynamic capabilities enhances SC resilience more effectively when coupled with technological innovation. Furthermore, the analysis demonstrated that neither firm age nor size significantly influences SCR. These findings indicate that the resilience of supply chains in the Palestinian industrial sector is relatively independent of the firm's size or longevity. Emphasizing that both nascent and established firms, regardless of size, can achieve comparable levels of SC resilience by leveraging dynamic capabilities and technological innovations within their supply chains.

Chapter Five: Discussion of Results and Recommendations

Introduction

This chapter analyzes the findings in relation to the research questions, within the framework of the study's objectives, theoretical foundation, and relevant prior research. It further explores the justifications for the observed relationship within the context of Palestinian industry. In alignment with the theoretical framework and the interpretation of the results, the researcher has formulated recommendations for Palestinian industrial firms and policymakers that are consistent with the study's findings. Furthermore, the theoretical and practical implications of implementing these major findings are discussed. The researcher also highlights the study's limitations and offers avenues for future research, concluding the dissertation with a comprehensive summary.

5.1 Discussion of the Study Questions

As stated in Chapter One, the study concentrates on five research questions. The primary inquiry is, "Does technological innovation mediate the relationship between supply chain dynamic capabilities and supply chain resilience?" The subsequent parts will present the primary research question and sub-questions and discuss the statistical analysis results for each question.

A- The First Question: "How do supply chain dynamic capabilities impact technological innovation?" Regarding the study of the impact of **supply chain dynamic capabilities** on **technological innovation** represented in the hypotheses (**H1a, H1b, H1c, H1d, H1e, H1f, and H1g**), and referring to **Table (4.18)** it was found that there is a significant positive effect of Supply Chain Dynamic Capabilities on Technological Innovation ($\beta = 0.690$, $p \leq 0.05$). The relationship explains a substantial portion of the variance in Technological Innovation ($R^2 = 0.477$), indicating that 47.7% of the variability in Technological Innovation can be attributed to Supply Chain Dynamic Capabilities. This result is consistent with the results of (Li et al., 2024), (Hamidu et al., 2023), (Sabahi & Parast, 2020), (Parast et al., 2019), (Gružauskas and Vilkas, 2017), and (Ju et al., 2016). The authors declared that businesses may improve their innovation and supply chain resilience by allocating resources toward developing essential organizational capabilities that are prerequisites for fostering innovation and resilience.

According to the dynamic capabilities perspective (Teece et al., 1997), supply chain dynamic capabilities could be characterized as the ability of an organization to effectively incorporate, construct, and restructure technology, resources, and functions both within and outside the organization. This ability enables the business to adapt and respond to constantly evolving circumstances. These Supply Chain Dynamic Capabilities have the potential to exert an impact on technological innovation and supply chain resilience. Additionally, SCDCs such as leadership, information sharing, and collaboration capabilities have enhanced both business innovation and firm resilience when confronted with supply chain disruption.

In the Palestinian context, where businesses often face political, economic, and logistical uncertainties (World Bank Group, 2017), the favorable correlation between SCDCs and technological innovation arises from the need to navigate a challenging business environment, as well as the strategic benefits that innovation provides in overcoming these obstacles. By developing dynamic supply chain capabilities that enhance technological innovation through opportunity identification and disruption response, this interaction is crucial for promoting sustainable growth and competitiveness in the Palestinian context. The interplay between a volatile business environment and the necessity for adaptability fosters innovation, with SCDCs serving as essential enablers. Nonetheless, SCDCs were assessed across seven dimensions, as detailed in **Table 4.19.** The subsequent sections present the analysis of results for each SCDC dimension concerning the theoretical framework, its justification, and implications within the Palestinian industrial sector.

Supply Chain Leadership Support dimension demonstrates the strongest positive effect, with the highest path coefficient ($\beta = 0.281$, $p < .001$, $f^2 = 0.075$), indicating that strong leadership commitment significantly fosters technological innovation within the supply chain, this finding corresponds with the empirical insights presented by Manchidi (2024), who suggests that companies should incorporate and utilize strategic actions in supply chain leadership to influence sustainable innovation and competitiveness in an emerging economy. Furthermore, the results align with the findings of (Chatterjee et al., 2022), (Pham et al., 2023), (Bag et al., 2021), (Shin & Park, 2021), (Oeij et al., 2022), (Ndonye & Odiyo, 2022), (Mamula et al., 2019), (Le & Lei, 2018), and (Demmer et al., 2011). The authors asserted that leadership plays a crucial role in augmenting the influence of company dynamic capabilities on innovation and supply chain resilience. Additionally, the authors emphasized that fostering environments conducive to innovation is a crucial leadership responsibility. The authors argue that leadership support significantly impacts a firm's innovative capabilities in effectively navigating turbulent environments. In this case, the organization requires financial aid, which can be obtained with the leadership team's support. In conclusion, companies that exhibit resilience necessitate cultivating innovation, which is facilitated by leadership with the requisite power and willingness to take risks.

Leadership support is particularly crucial in Palestinian enterprises, which face numerous challenges. Leadership support helps overcome obstacles, promotes technology adoption, and fosters collaboration, thereby enhancing the relationship between SCDCs and technological innovation. Statistical evidence underscores the reliability of this impact, emphasizing that leadership development, strengthening leadership networks, and empowering decision-makers are essential catalysts for enhancing supply chain capabilities and technological innovation in Palestine.

Supply Chain Agility follows closely, with a positive path coefficient ($\beta = 0.263$, $p < .001$, $f^2 = 0.065$), underscoring the importance of agility in responding swiftly to market changes to support technological innovation. The results are consistent with the findings of (Ayoub & Abdallah, 2019), (Rojo et al., 2018), (Dubey et al., 2018b), (Ju et al., 2016), (Kaufmann & Gaeckler, 2015), (Vickery et al., 2015), (Kaipia, 2008), (Chiang et al., 2015), (Barrat & Oke, 2007), (Chopra & Sodhi, 2004), and (Swafford et al., 2008). The authors revealed that supply chain agility has a favorable impact on firm performance and technological innovation. Moreover, Supply Chain Agility fosters innovation by empowering businesses to explore and integrate new technologies in response to these changes.

The agility of the supply chain significantly enhances technological innovation in Palestine by allowing businesses to swiftly respond to unexpected challenges and leverage these adjustments as opportunities for innovation. The statistical results underscore the necessity of agility in improving the efficacy of supply chain dynamic capabilities, propelling technological progress in resource-limited and unstable contexts such as Palestine. Consequently, in light of the established significance of supply chain agility, Palestinian industrial firms should invest in adaptable infrastructure by deploying digital tools to enhance SC velocity and visibility. Enhance employees' agility skills in rapid decision-making and adaptable problem-solving, while also establishing agile networks with distributors and suppliers to enable swift adaptations and collaborative innovations.

Supply Chain Disruption Orientation also has a substantial positive impact on TI ($\beta = 0.191$, $p < .001$, $f^2 = 0.034$), suggesting that being proactive in identifying and managing disruptions contributes effectively to technological innovation. The findings are in line with the results of (Yu et al., 2019), (Ambulkar et al., 2015), (Bode et al., 2011), (Wieland & Wallenburg, 2013), and (Hurley & Hult, 1998). The authors revealed that disruption orientation is essential for reconfiguring and reorganizing dynamic capabilities to maintain firm operations in the modern information era characterized by massive disruptions. Organizations with high levels of SCDO are more equipped to be more resilient and innovative during disruptions. Furthermore, the authors declared a positive relationship between the degree of innovativeness within an organization and the presence of a learning-oriented approach. The Palestinian context is characterized by significant disruption, resource constraints, and export pressures. Industrial enterprises that adopt a proactive approach to mitigate and capitalize on these disruptions may bypass these constraints and propose innovative solutions. Thus, Industrial Palestinian firms are advised to cultivate a culture of learning from past disruptions, adaptability, and resilience, thereby enhancing their competitive advantages in an uncertain setting.

Supply Chain Flexibility shows moderate positive relationships with TI ($\beta = 0.141$, $p = 0.012$, $f^2 = 0.021$) suggesting that the ability to successfully assume various postures to address unusual conditions and swiftly adjust to significant changes contributes moderately to technological innovation. The findings are in line with the results of (Tiwari et al., 2024), (Issa et al., 2024), (Can Saglam et al., 2021), (Siagian et al., 2021), (Juan et al., 2022), (Rojo et al., 2018), and (Ju et al., 2016). The authors revealed that the likelihood of a firm successfully creating and implementing innovative solutions to disruptions is higher when the firm's network exhibits greater flexibility. This flexibility enables the firm to leverage its network to foster innovativeness effectively. Additionally, the authors emphasize the significance of flexibility in responding to fluctuations in demand and production obstacles, which promotes innovation systems. The authors underscore the significance of flexible supply chains for ongoing innovation in unpredictable contexts. Additionally, flexibility is essential for converting innovation strategies into enhanced supply chain resilience and consequently, technological innovation, emphasizing that dynamic capabilities such as flexibility reduce complexity and promote sustainable innovation. Flexibility enables companies to adapt their processes to changing technological and market demands, serving as a vital catalyst for technological innovation.

In the Palestinian context, the moderate influence of supply chain flexibility on TI can be ascribed to logistical challenges, political constraints, underdeveloped infrastructure, low level of digital tools adoption, and resource scarcity. Despite these constraints, industrial enterprises could adjust their resource allocation strategy to prioritize local resources over international ones, adapt to supply chain disruptions by altering suppliers and schedules, enhance their customization and responsiveness to local and global consumer demands, and efficiently utilize existing resources to foster technological innovation.

Likewise, the Supply Chain Collaboration dimension exhibits small positive relationships with TI ($\beta = 0.141$, $p = 0.014$, $f^2 = 0.012$). The results are inconsistent with the outcomes of (Yang et al., 2024), (Hamidu et al, 2023), and (Ju et al., 2016). The authors revealed that the coordinated activities among SC players are a dynamic capability that has a favorable influence on technological innovation and firms' performance. Additionally, SC collaboration assists managers in effectively addressing current challenges and improving overall performance by leveraging the role of technological innovation practices. Furthermore, the authors asserted that collaborative practices, such as joint research and development initiatives and shared technological investments, directly enhance innovation outcomes. However, the findings are in line with Feng & Jalali (2024) who asserted that the impact of SCC on technological innovation may be negligible in environments characterized by limited technological readiness or fragmented supply chains, as commonly observed in developing nations.

Notably, Palestine's economy is fragmented and constrained by geopolitical factors, limited market access, resource scarcity, high reliance on imported raw materials, inadequate technological readiness necessary for innovation, restricted movement of goods and services, and the absence of strong institutional frameworks with effective policies to promote collaborative innovation. These factors complicate collaboration among supply chain participants, yielding a minimal positive effect of SCC on technological innovation. This indicates that although SCC positively impacts technological innovation, factors such as technological readiness, external funding, competitive pressures, and enhanced infrastructure may play more significant roles in influencing the level of technological innovation in Palestine than SCC itself. Consequently, collaboration by itself cannot overcome systemic obstacles to innovation in developing economies. The Dynamic Capability View (Teece et al., 1997) asserts that although collaboration improves adaptability, its influence on innovation is contingent upon the firm's capacity to reconfigure external resources, which may be limited in a developing context such as Palestine. Consequently, it is recommended that industrial firms tackle these challenges through strong policy support, improved infrastructure, and capacity-building programs to strengthen the relationship between SSC and TI.

On the other hand, ***Supply Chain Information Sharing*** dimension displays weak negative effects on TI, with path coefficients of (β = -0.066, p = 0.237, f^2 = 0.003) contrary to expectations, this suggests that although supply chain information sharing is a crucial component of supply chain practices, it may not directly facilitate technological innovation as effectively as other capabilities. The results are inconsistent with the findings of (Mehmood et al., 2024), (Issa et al., 2024), (Li et al., 2024), (Lee et al., 2018), and (Ritala et al., 2015). The authors revealed that effective sharing of information on events, difficulties, or modifications that might potentially impact SC partners will enhance the dissemination of information, optimize the efficiency of supply chains, and enhance an organization's rate of technology adoption, therefore fostering a competitive edge in the technological landscape and ultimately providing a prompt reaction to the evolving demands of customers. Furthermore, the act of sharing external information has a beneficial impact on innovation performance.

The minimal and negligible impact of SCIS on TI in Palestine could stem from various distinct factors associated with organizational and regional contextual challenges confronting industrial firms. These factors entail fragmented relationships and diminished trust. Limited trust may prevent companies from sharing essential information due to concerns about misuse or leakage to competitors. The Palestinian economy is significantly affected by geopolitical challenges, such as erratic border regulations, limited resource access, and logistical disruptions stemming from political instability (Alimahomed-Wilson & Potiker, 2017). Technological innovation necessitates substantial investment in human capital, skills, and research and development. Industrial firms operate with constrained resources, prioritizing survival over innovation strategies. The implementation of advanced technological tools and complex systems for the analysis and utilization of shared information remains in its early phases in Palestine. Moreover, numerous Palestinian enterprises depend on external markets and resources, lacking the economic independence necessary for innovation. These factors impede organizations' ability to fully leverage shared information for technological advancement. Consequently, industrial enterprises should prioritize the enhancement and establishment of trust among supply chain stakeholders via explicit legal and protection agreements. Improving institutional support to address these operational challenges. Augment investment in digital transformation to optimize data utilization. Providing building capacity programs on the significance of technological innovation. Therefore, this may amplify the influence of SCIS on TI in the future.

Likewise, Supply Chain Integration displays weak negative effects on TI, with path coefficient ($\beta = -0.063$, $p = 0.272$, $f^2 = 0.003$), indicating that while SC integration is an integral aspect of supply chain practices, this dimension may not directly support the technological innovation as strongly as other capabilities. The findings contradict the results of (Liu et al., 2020), (Siagian et al., 2021), and (Ju et al., 2016). The authors asserted that integrating suppliers will provide enhanced collaboration between the involved parties, enabling them to jointly innovate regarding product innovation, process innovation, and material requirements. Furthermore, the integration of information systems inside firms has been found to have a favorable impact on both process and product innovation. Additionally, the integration among supply chain partners has a favorable influence on technological innovation and firm operational performance. Furthermore, the authors stressed the importance of supply chain integration as a strategy to boost business results by fostering innovation, flexibility, and resilience.

A potential explanation for these results is that the fragmented Palestinian supply chain may lack strong inter-organizational integration, hindered by resource scarcity and political instability, which are essential for facilitating technological innovation. Moreover, industrial firms may prioritize operational efficiency or survival to minimize redundancy and improve synchronization (Flynn et al., 2010) instead of fostering creativity and technological innovation. The insufficient adoption of technological tools and research and development diminishes the advantages that supply chain integration can offer for technological innovation, particularly as supply chain integration generally necessitates a robust IT infrastructure and environments conducive to innovation.

Tian et al. (2021) assert that organizational structure and culture are essential for establishing a robust foundation for supply chain integration. Nonetheless, an alternative explanation could be the cultural and organizational barriers, which may result in resistance to the collaborative nature of SCI within the Palestinian context due to a deficiency in trust and risk-sharing methodologies that obstruct the efficient exchange of information and co-innovation. Therefore, intervention from decision-makers in the supply chain is necessary to address these challenges by promoting a culture of innovation, improving IT infrastructure, providing incentives for organizations that adopt technological tools, and strengthening trust among supply chain participants.

To summarize the results of <u>Question One</u>, it was found from the previous discussion that the analysis of the direct effects of Supply Chain Dynamic Capabilities dimensions on Technological Innovation (TI) reveals varying degrees of influence across dimensions, as summarized in **Table 4.19**. Supply Chain Leadership Support demonstrates the strongest positive effect. Supply Chain Agility follows closely. Supply Chain Disruption Orientation has a moderate positive impact on TI. Both Supply Chain Flexibility and Supply Chain Collaboration show small positive relationships with TI. Supply Chain Information Sharing and Supply Chain Integration display weak negative effects on TI. The model's explanatory power for Technological Innovation, as presented by $R^2 = 0.512$, indicates that the analyzed Supply Chain Dynamic Capabilities dimensions account for about half of the variance in

Technological Innovation, emphasizing the critical role of certain capabilities particularly -leadership support, agility, and SC disruption orientation- in promoting technological innovation within the supply chain.

This means that other factors might affect technological innovation within the Palestinian context rather than SCDCs. These factors might include government and institutional support including policies, regulations, tax incentives for research and development, innovation, and a legal framework such as intellectual property and rights protection. Another factor might be the enhanced technological infrastructure, encompassing digital tools, high-speed internet, and advanced manufacturing technologies. Another driver is human capital, encompassing quality education, capacity-building initiatives, training programs offered by professional and technical experts, and brain drain, which refers to the emigration of skilled workers abroad in search of opportunities. The availability of capital for innovative initiatives and the cost-effectiveness of financing alternatives for technology projects might be critical factors impacting TI. Another factor is collaboration, including university-industry partnerships, access to international market expertise and technologies, and local business hubs that foster innovation. An additional factor might be the economic ecosystem, such as the percentage of GDP designated for innovative initiatives. Furthermore, there exists a market demand for innovative products. Additional social and cultural factors, such as the propensity to embrace risks and initiate innovative products, as well as the adoption of new technologies within communities. In addition to the external factor of international aid for innovation, geopolitical factors may also impact technological innovation.

According to the author's best knowledge, there are no direct studies examining the influence of supply chain dynamic capabilities on technological innovation in Palestine. Nevertheless, there are related studies that provide valuable insights, including the study by Dwikat et al. (2022), the authors examined the impact of systematic strategic planning (SSP) and strategic business innovation (SBI) on Palestinian manufacturing SMEs' sustainable performance (SP). The findings show that several factors can improve manufacturing SMEs' sustainability performance, including supportive national policies to promote sustainability. Effective systematic strategic planning (SSP) and strategic business innovation (SBI) in a collaborative culture and participatory management style improve manufacturing SMEs' sustainable performance.

Furthermore, Dwikat et al. (2023), conducted another study to examine the influence of competent human capital (CHC), strategic flexibility (SF), and turbulent environment (TE) on the sustainable performance (SP) of SMEs in Palestine. The findings indicate that multiple enablers may improve the sustainability performance of SMEs in Palestinian industries. One aspect entails the implementation of supportive governmental policies to advance sustainability within the industrial sector and encourage industries to adopt circular and greening practices.

B- The Second Question "How do supply chain dynamic capabilities impact supply chain resilience?" is represented in the hypotheses (**H2a, H2b, H2c, H2d, H2e, H2f, and H2g)**, and referring to **Table 4.20**. The analysis indicates that Supply Chain Dynamic Capabilities have a strong and significant direct effect on Supply Chain Resilience ($\beta = 0.703$, $p <.001$), explaining 49.4% of the variation in Supply Chain Resilience ($R^2 = 0.494$). The large effect size ($f^2 = 0.977$) underscores the crucial role of SC dynamic capabilities in enhancing the supply chain's resilience. This finding underlines that robust supply chain capabilities substantially contribute to its resilience, enabling it to withstand and adapt to disruptions effectively. This result aligns with the findings of (Parast et al., 2019), (Sabahi and Parast, 2020), (Gružauskas & Vilkas, 2017), (Junaid et al., 2023), (Hopkins, 2021), and (Scholten et al., 2014). According to (Liao et al., 2010; Blackhurst et al., 2011), a company must develop and identify the necessary capabilities to effectively execute the appropriate strategies required for dynamic and unpredictable contexts and improve its response to supply chain disruptions. The authors demonstrate that supply chain dynamic capabilities positively impact supply chain resilience, resulting in a competitive advantage and improved performance.

In the Palestinian context, characterized by political instability and resource constraints, industrial enterprises rely on Supply Chain Dynamic Capabilities (SCDCs) such as agility, information sharing, disruption orientation, collaboration, integration, and leadership support to endure disruptions effectively (Teece, 2007). These SCDCs empower firms to confront disruptions and ensure their operational viability.

Another explanation might be the constrained resources that compel industrial firms to integrate and collaborate to enhance resource utilization and attain supply chain resilience. These SCDCs empower firms to confront disruption and ensure their operational continuity. Consequently, the significant effect size (f^2= 0.977) and the considerable explanatory power (R^2 = 0.494) indicate that SCDCs are especially influential in contexts where resilience is heavily reliant on dynamic responses to both chronic and acute disruptions.

It is therefore advised that industrial enterprises cultivate their dynamic capabilities by improving information exchange and promoting collaborative networks with various supply chain participants, ensuring agility through digital transformation tools to improve disruptions adaptation, maintaining flexible operations, integrating their processes, fostering a disruption-oriented culture through risk awareness training programs, and enhancing leadership support. These tools collectively assist industrial firms in mitigating supply chain risks, enhancing supply chain resilience, and improving competitiveness. The subsequent sections present the analysis of results for each SCDC impact on SC resilience concerning the theoretical framework, its justification, and implications within the Palestinian industrial sector.

Supply Chain Disruption Orientation shows the strongest influence on SCR with the highest path coefficient (β = 0.366, $p < .001$) and effect size (f^2 = 0.130), as shown in **Table (4.22),** underscoring its significant role in enhancing SCR. This result is in line with the results of (Matas et al., 2024), (Do et al., 2022), (Dovbischuk, 2022), (Queiroz et al., 2022), (Stephens et al., 2022), (Ambulkar et al., 2015), and (Bode et al., 2011). According to the authors, enterprises focused on supply-chain disruption orientation can acquire knowledge from past disruptions and develop proactive capabilities to handle SC disruptions effectively in circumstances characterized by intense competition. Additionally, the authors emphasized the importance of supply chain disruption orientation in assisting firms in building supply chain resilience. However, greater SCDO is correlated with larger buffers and a risk appetite (Bode et al., 2011). Nevertheless, the COVID-19 pandemic has introduced the notion of adaptive resilience, which asserts that a complex and interconnected supply chain cannot sustain a state of equilibrium. Resilience can be regarded as a contextualized ability developed through continuous adaptation and learning (Belhadi et al., 2021).

One possible explanation for these results might be the distinctive nature of the Palestinian context, marked by resource constraints, political instability, external dependency, and a complex institutional and regulatory framework. Consequently, industrial enterprises have cultivated distribution orientation capabilities to address these challenges and guarantee operational efficiency. This aligns with the dynamic capability perspective that emphasizes a proactive approach in turbulent environments (Wieland & Wallenburg, 2013). Moreover, this aligns with contingency theory, (Fiedler, 1993), which posits that there is no universally optimal strategy for maintaining a supply chain in a volatile environment. Thus, contingency theory offers a valuable framework for comprehending the significance of SCDO in bolstering supply chain resilience within the Palestinian context. Therefore, it is recommended that industrial enterprises invest in risk management and identification technologies. Promote regulatory reform and formulate policy support that improves trade and logistical efficiency. Additionally, industrial firms should cultivate local resources to diminish dependence on external ones.

Supply Chain Integration also exhibits a strong positive impact on SCR ($\beta = 0.242$, $p < .001$) with an effect size ($f^2 = 0.042$), as shown in **Table (4.22)** indicating that effective coordination and alignment within the supply chain contribute meaningfully to the SC resilience outcomes. This result aligns with the results of (Siagian et al., 2021), (Muafi & Sulistio, 2022), and (Eslami et al., 2021). The authors emphasized the significance of supply chain integration as a strategy to enhance business outcomes by promoting innovation, flexibility, and resilience. Stakeholders' integration within the supply chain enables the coordination of activities including planning, production, delivery, and information exchange.

The unique definition of supply chain integration by Zhao et al. (2013) relates to a company's management ability to efficiently coordinate and integrate all internal processes and external partners, including distributors, retailers, and suppliers, to guarantee the seamless delivery of the final product to the end customer, alongside the fragmented Palestinian supply chain, which is characterized by a lack of industrial infrastructure and a heavy reliance on imported goods. Additionally, the Palestinian economy regularly encounters external disruptions due to border closures and trade restrictions stemming from political instability, alongside limited resources; all these factors render supply chain integration an essential capability for bolstering supply chain resilience. The robust association between SCR and SCI corresponds with dynamic capability theory, which underscores the significance of sensing, seizing, and reconfiguring resources to respond to environmental alterations (Teece et al., 1997). It is therefore advised that industrial firms improve their collaborative culture and establish long-term partnerships with external entities, thereby enhancing joint problem-solving and developing contingency plans. In light of resource scarcity, industrial firms should optimize resource utilization and synchronize their internal processes with external partners to facilitate the smooth flow of information and goods. Moreover, industrial companies must foster their strategic investment in supply chain technological tools, thereby improving a proactive strategy to mitigate risks and address demand fluctuations.

Supply Chain Flexibility shows a moderate positive effect on SCR, indicated by a path coefficient of ($\beta = 0.150$, $p = 0.001$), with an effect size of ($f^2 = 0.026$), the finding suggests that SC flexibility enables the supply chain to adapt to changes and thus enhance its resilience. The outcome corresponds with the findings of (Piprani et al., 2022) the authors investigated the relationship between multi-dimensional supply chain flexibility (MDSCF) and supply chain resilience in a high supply chain risk environment. In this context, MDSCF was found to significantly impact SC resilience. Furthermore, (Piprani et al., 2020c) and (Ali et al., 2017), recognized flexibility as a crucial element in alleviating and managing supply chain risk, as well as enhancing supply chain resilience. Additionally, Brusset and Teller (2017) averted that the mechanisms of adaptation and reconfiguration facilitated by flexibility are essential for improving SC resilience.

However, the moderate influence of SC flexibility on SCR in the Palestinian context could be attributed to economic factors, structural issues, and a disrupted supply chain resulting from political instability, inadequate infrastructure, restricted border access, and trade limitations. Limited access to alternative suppliers results in a heavy dependence on regional or international suppliers, which undermines supply chain autonomy, which is a prerequisite for enhancing supply chain flexibility. Resource limitations and insufficient adoption of technological tools may serve as an additional potential explanation. The absence of systematic risk management practices renders supply chain flexibility essential yet diminishes its effectiveness, thereby impeding industrial firms' ability to adjust their processes and resources.

These findings are consistent with the dynamic capability perspective, which states that a firm's ability to respond and adapt to change is critical for resilience but is dependent on the firm’s resource allocation and external conditions (Teece, 2007). Furthermore, the findings are consistent with contingency theory, which suggests that the effectiveness of SC flexibility is determined by contextual factors such as political instability and infrastructure deficiencies. Thus, industrial firms should invest in improving their risk management practices, promoting technology adoption, and strengthening their partnerships with local and regional partners.

Likewise, ***Supply Chain Agility*** demonstrates moderate positive effects on SCR, indicated by a path coefficient ($\beta = 0.141$, $p = 0.003$) and effect sizes of ($f^2 = 0.019$). The results correspond with those of Sabahi and Parast (2020), who demonstrated that agility facilitates the supply chain's adaptation to changes, thereby improving its resilience. Additionally, this result aligns with the findings of Ashrafi et al. (2019), who asserted that the adoption of innovation can improve an organization's agility, flexibility, and information-sharing capabilities, these capabilities significantly contribute to enhancing supply chain resilience, emphasizing that during disruptions and emergencies, effective response is closely associated with agility, which can be improved through innovative practices. Furthermore, this finding aligns with Humdan et al. (2023), who demonstrated that integrating innovativeness and agility enhances performance prediction.

The results correspond with resource-based and dynamic capability theories, indicating that firms in resource-constrained settings may find it challenging to fully utilize dynamic capabilities, such as agility, to improve resilience (Barney, 1991; Teece, 2007). The minimal effect size further corroborates the contingency theory, which asserts that the efficacy of organizational capabilities is significantly contingent upon context.

However, the moderate influence of SC agility on SCR within the Palestinian context could stem from various contextual, organizational, economic, and infrastructural deficiencies, geopolitical factors, fragmented supply chains, and significant dependence on external suppliers, undermining local firms' autonomy and adaptability. Additionally, constraints in financial, technological, and human capital, coupled with insufficient experience in implementing agility strategies. These factors collectively influence the relationship between supply chain agility and supply chain resilience. Therefore, industrial Palestinian enterprises should cultivate regional and international collaborative partnerships, invest in supply chain technology, and promote favorable policies that could improve infrastructure and mitigate resource accessibility constraints. Consequently, improving supply chain agility and supply chain-resilience association.

However, Supply Chain Collaboration has a weak positive effect ($\beta = 0.013$, $p = 0.841$) with an effect size close to zero ($f^2 = 0.000$) suggesting that direct contribution to SCR may be limited. This finding contradicts the findings of Ali et al. (2024) who asserted that supply chain collaboration is crucial to supply chain resilience. Likewise, Hamidu et al. (2023), proposed SC collaboration as a strategy for improving SCR. Furthermore, this result contradicts the findings of Yu et al. (2022), who found that inter-functional coordination plays a significant role in mediating the relationship between openness to technological innovation and SCR.

Additionally, Hopkins et al. (2021) stated that collaboration is an essential capability of supply chain resilience. Furthermore, Parast et al. (2019) discovered that SC collaboration capability improves both business innovation and firm resilience when confronting supply chain disruptions. Gružauskas and Vilkas (2017) identified collaboration as a crucial aspect of supply chain resilience. The authors contend that combining this capability with emerging Industry 4.0 technologies can lead to supply chain resilience.

However, this finding may align with the results of Kamalahmadi & Parast (2016). The authors demonstrated that the formation of collaborative partnerships between parties necessitates two essential factors: trust and information sharing. Despite that the authors recommended collaboration as a strategy for building resilience; they indicated that in developing countries, the effectiveness is frequently constrained by contextual factors such as cultural barriers, resource limitations, and poor infrastructure.

In the Palestinian context, these outcomes may be ascribed to various structural and contextual factors that characterize developing economies, including inadequate infrastructure, a lack of trust, and shortcomings in supply chain integration, alongside the geopolitical challenges confronting industrial firms (Sawayfa, 2023). Furthermore, the prevalence of SMEs in Palestine is characterized by a deficiency in capabilities and resources necessary for investing in advanced collaborative practices, such as joint planning or supply chain integration technologies (Fawcett et al., 2008). Furthermore, the cultural aspect may serve as an additional explanation for why Palestinian firms prioritize short-term survival over long-term partnerships with supply chain participants. The self-reliance approach adopted by Palestinian firms emphasizes internal strategies to manage risk instead of collaborative approaches. All these factors collectively reduce the influence of supply chain collaboration on supply chain resilience.

Therefore, augmenting investment in ICT infrastructure is advisable to improve communication and collaboration among supply chain participants. Establishing standardized and transparent contracts can improve relationships. Capacity-building initiatives can assist SEMs in implementing collaborative practices. Ultimately, systematic risk can be tackled through the reinforcement of public-private partnerships to alleviate external challenges**.**

Likewise, ***Supply Chain Leadership Support*** exhibits a weak positive effect ($\beta = 0.032$, $p = 0.533$) and an effect size of ($f^2 = 0.001$), indicating that its direct contribution to SCR may be constrained. This outcome didn't align with the finding of the systematic literature review conducted by Parast et al. (2019) who identified leadership as one of the critical characteristics that improved organizations' capability to withstand and recover from supply chain disruptions. Yamin (2021) demonstrated that leadership commitment positively influences supply chain resilience. Bag et al. (2021) demonstrated that leadership plays a crucial role in augmenting the influence of company dynamic capabilities on innovation and supply chain resilience. Similarly, the study conducted by Shin & Park (2021) provided empirical evidence supporting a favorable association between a firm's leadership, supply chain capabilities, and the overall supply chain resilience outcome.

However, this finding corresponds with the results of a systematic literature review conducted by Hohenstein et al. (2015), who indicated that while leadership is frequently recognized as a crucial enabler, its direct influence may be constrained by the overarching contextual and systemic challenges confronting developing economies, which cannot be alleviated only through leadership.

This outcome in Palestine may be ascribed to the contextual factors inherent in developing economies, including the restricted financial, human, and technological resources available for SC leaders to implement and direct resilience strategies. Furthermore, political instability and external shocks diminish leadership's ability to anticipate and mitigate risks. Insufficient developmental and training programs that foster leadership skills to improve proactive approaches to risk management in supply chains. Additionally, Palestinian leaders prioritize short-term problem-solving over long-term planning due to the volatile operating environment. Moreover, the absence of coordination among stakeholders, including suppliers, customers, and government entities, is attributable to the fragmented systems in Palestine, which is deemed essential for effective leadership. These factors constrain the ability of leadership in Palestinian industrial firms to enhance supply chain resilience.

Consequently, it is advisable to promote investment in leadership skills development programs. Strengthen collaborations with international, regional, and local universities to provide training programs designed to improve the competencies of supply chain leaders. SC leaders ought to embrace a proactive strategy through the utilization of data analytics. Establishing partnerships and networks with external entities can improve coordination and amplify leadership roles in supply chain resilience building.

Contrary to expectations, ***Supply Chain Information Sharing*** has a small negative effect on SCR ($\beta = -0.059$, $p = 0.367$) with minimal to no effect size ($f^2 = 0.003$), indicating that while information sharing is important, it may not directly enhance SC resilience. This finding is inconsistent with the outcomes of Ali et al. (2024), who revealed that practical information-sharing activities are essential for achieving supply chain resilience. Furthermore, this finding contradicts the results of Hopkins (2021) and Sabahi and Parast (2020), who asserted that information sharing is an integral capability of supply chain resilience and plays a substantial role in bolstering supply chain resilience. Additionally, Parast et al. (2019) found that SC information sharing enhances business innovation and firm resilience when confronted with supply chain disruption.

However, this finding corresponds with the findings of Coşkun & Erturgut (2023), indicating that although SC information sharing is essential for mitigating uncertainties, extensive information sharing with suppliers in high-uncertainty conditions negatively affects supply chain resilience. The authors ascribed this restricted impact to factors including inconsistent data quality, lack of trust among supply chain actors, and inadequate integration of information systems.

In the Palestinian context, these findings may be ascribed to the same factors identified by Coşkun & Erturgut (2023), especially in environments marked by considerable uncertainty and fragmented supply chains. Factors encompass political instability, economic limitations, fragmented supply chains, inadequate infrastructure, insufficient access to advanced technological resources, and a deficiency of trust among supply chain participants. These factors impede the capability for information sharing to enhance SC resilience outcomes.

Consequently, industrial firms ought to enhance their technological competencies by implementing enterprise resource planning (ERP) systems to improve real-time information dissemination. Advocating for increased investment in training programs that emphasize the significance of information sharing. Foster trust among supply chain partners through cooperative initiatives, and clear, transparent communication. Augment cooperation between governmental and industrial entities. Governmental entities can significantly influence the formulation of policies and incentives that encourage information sharing, thereby improving the capability for information exchange to bolster supply chain resilience against persistent disruptions.

To summarize the results of <u>Question Two</u>, from the previous discussion, it was found that the analysis of the direct effects of Supply Chain Dynamic Capabilities dimensions on supply chain resilience indicates varying degrees of influence, as detailed in **Table (4.22),** with Supply Chain Disruption Orientation showing the strongest influence. Supply Chain Integration also exhibits a strong positive impact on SCR. Supply Chain Agility and Supply

Chain Flexibility show moderate positive effects on SCR. Supply Chain Collaboration and Supply Chain Leadership Support show weaker positive effects, suggesting that direct contribution to SCR might be limited. Unexpectedly, Supply Chain Information Sharing has a small negative effect on SCR indicating that while information sharing is an integral dimension of SCDC, it may not directly enhance SC resilience.

The model accounts for a significant portion of the variance in SCR, with $R^2 = 0.541$, demonstrating its effectiveness in predicting resilience outcomes and underscoring the critical role of these dimensions of supply chain dynamic capabilities in supporting resilience. This indicates that there are additional factors that may influence SC resilience in the Palestinian context as a developing nation, rather than SCDCs.

These factors may either complement or override the influence of SCDCs on SCR, encompassing uncertainties such as economic and political instability, natural disasters (e.g., COVID-19), and global supply chain disruptions. The implementation of advanced technological tools, automation, data analytics, and the enhancement of technological infrastructure may also affect supply chain resilience. Additionally, regulatory and institutional factors encompass governmental trade, customs policies, regulations, and procedures. The cultural and organizational factors that prioritize a proactive risk management approach and the internal decision-making process that are crucial for improving supply chain resilience might be another potential driver for SC resilience. Another factor might be the availability of human capital and skills, as well as the ability to train employees in risk and crisis management. Another factor might be the accessibility of human capital and expertise, along with the capacity to empower employees in risk and crisis management. A crucial element may be financial resources, as firms with substantial financial assets or enhanced access to credit are more capable of absorbing disruption costs and facilitating investments in resilience and diversification strategies.

According to the author's knowledge, there are no direct studies examining the influence of supply chain dynamic capabilities on supply chain resilience in Palestine. However, Badwan (2024) investigated the roles that supply chain partnerships, cross-functional integration, responsiveness, and resilience play in achieving competitive advantages in Palestinian industrial firms. The author revealed that cross-functional integration in inventory data and immediate operations enhances supply chain responsiveness, resilience, and cooperation. Additionally, the company's ability to respond quickly to demand fluctuations improves supply chain resilience and competitiveness.

Furthermore, another study was conducted in Jordan by Ali et al. (2024) to explore the combined influence of AI technology, supply chain collaboration, and information sharing on supply chain resilience. Findings revealed that practical information-sharing activities are essential for achieving supply chain resilience. It presents how technology adoption and supply chain collaboration are crucial to supply chain resilience. However, information sharing is shown to be an essential mediator, as clear communication and knowledge exchange amongst supply chain partners are fundamentally important in achieving supply chain resilience.

C-The Third Question "Does technological innovation mediate the nexus between supply chain dynamic capabilities and supply chain resilience?" represented in the hypotheses (**H3a, H3b, H3c, H3d, H3e, H3f, and H3g**), the mediation analysis examined whether Technological Innovation (TI) mediates the relationship between Supply Chain Dynamic Capabilities (SCDC) and Supply Chain Resilience (SCR). Referring to **Table (4.24)**, it was found that all SCDC dimensions employed in the study have a significant positive relationship with supply chain resilience when taking technological innovation as a mediator.

The direct effect of SCDC on SCR is substantial, with a path coefficient of ($\beta = 0.594$, $p < .001$), and an effect size of ($f^2 = 0.369$), showing that SCDC strongly enhances SCR and is inherently important for SCR by enabling the industrial firms to anticipate, respond to, and recover from SC disruptions effectively (Teece et al., 1997). SCDC also shows a positive indirect effect on SCR through TI, the path coefficient for SCDC on TI is ($\beta = 0.671$, $p < .001$), with a large effect size ($f^2 = 0.817$). TI, in turn, positively influences SCR with a path coefficient of ($\beta = 0.131$, $p = 0.002$), although the effect is small ($f^2 = 0.018$). The indirect effect of SCDC on SCR through TI is calculated at ($\beta = 0.088$, $p = 0.003$), underscoring the importance of leveraging technological innovation to further enhance SCR. Indicating that while SCDC directly enhances SCR, its impact is also partially channeled through improvements in TI, thereby bolstering SCR indirectly. The total effect of SCDC on SCR, combining both direct and indirect pathways, is (β =0.682), underscoring the significant role of TI in mediating the SCDC-SCR relationship. These findings suggest that Technological Innovation serves as an important mediator, amplifying the positive influence of Supply Chain Dynamic Capabilities on Supply Chain Resilience.

In light of the prior discussion, the analysis indicates that there is a significant positive effect of ***Supply Chain Dynamic Capabilities on Technological Innovation*** which corresponds with the results of (Li et al., 2024), (Hamidu etal., 2023), (Sabahi & Parast, 2020), (Parast et al., 2019), (Gružauskas and Vilkas, 2017), (Ju et 11 al.,2016), (Chatterjee et al., 2022), (Pham et al., 2023), (Bag et al., 2021), (Shin & Park, 2021), (Oeij et al., 2022), (Ndonye & Odiyo, 2022), (Mamula et al., 2019), (Le & Lei, 2018), (Demmer et al., 2011), (Rojo et al., 2018), (Dubey et al., 2018b), (Barrat & Oke, 2007), (Kaufmann & Gaeckler, 2015), (Vickery et al., 2015), (Kaipia, 2008), (Chiang et al., 2015), (Chopra & Sodhi, 2004), (Swafford et al., 2008), (Yu et al., 2019), (Ambulkar et al., 2015), (Bode et al., 2011), (Wieland & Wallenburg, 2013), (Hurley & Hult, 1998), (Tiwari et al., 2024), (Issa et al., 2024), (Can Saglam et al., 2021), (Siagian et al., 2021), (Juan et al., 2022), and (Feng, & Jalali, 2024). The authors revealed that SCDC measured by the various dimensions of leadership support, agility, SCDO, collaboration, flexibility, information sharing, and integration has a positive effect on TI. Furthermore, the analysis revealed that there is a strong and significant direct effect of ***Technological Innovation on SCR*** which aligns with the results of (Garrido-Moreno et al., 2024), (Forliano et al., 2023), (Irfan et al., 2022), (Do et al., 2022), (Dovbischuk, 2022), (Li et al.,2021), and (Gružauskas and Vilkas, 2017). The authors emphasized the role of TI in enhancing SC resilience.

In the Palestinian context, marked by persistent challenges SCDC emerges as a critical enabler in navigating disruption with TI serving as a force multiplier enhancing the operationalization of these dynamic capabilities. The adoption of technological innovation is impactful in Palestine since it assists industrial firms in navigating logistical, and infrastructural challenges. Therefore, integrating technological innovation with dynamic capabilities improves supply chain resilience in a complex operational setting. Nonetheless, this finding raises the question: "***Why does technological innovation serve as a partial mediator in the Palestinian industrial sector?***"

The partial mediation of Technological Innovation in the Palestinian context could be attributed to the foundational role of SCDC to SCR. For example, flexibility in dealing with multiple suppliers and agility enable industrial firms to respond effectively to borders closures. Another possible explanation for the partial mediating role of TI is the adoption of TI is constrained by economic limitations and infrastructure challenges. Furthermore, skill gaps of employees that hinder the effective utilization of advanced technological tools could be another reason. Furthermore, the uneven adoption of technological tools among industrial firms where some firms leverage advanced tools while others struggle to implement the basic ones. Another critical factor that might limit the extent to which TI mediates the SCDC- SCR relationship is the cultural factor and the resistance to change. In addition to the lack of the institutional framework required to integrate technological innovation fully. Thus, TI is vital for enhancing SCR but can't override or substitute the foundation role of well-established SCDC that industrial firms heavily depend on. Thereby, TI has a complementary/supportive enhancer rather than a dominant driver in mediating the nexus between SCDC-SCR in Palestine as a developing context.

Based on the preceding discussion and according to the author's best knowledge, no prior research has examined the study-specific constructs in combination. This leads to discussing the mediation function of TI in the relationship between SCDC and SCR through the lens of the underpinning theories of this study: Resource-Based, Dynamic Capabilities, and Contingency theories. According to RBV (Barney, 1991), in this study, SCDC dimensions serve as industrial firms' resources that could enhance SCR. Technological innovation serves as a complementary resource that enhances these capabilities, demonstrating the role of Palestinian firms in utilizing their resources to navigate SC disruption and maintain resilience. DCT (Teece et al., 1997) concentrates on the firm's ability to navigate disruption by building, integrating, and reconfiguring capabilities. The study findings have shown the direct impact of SCDC on enhancing SCR. However, the partial mediating function of TI reveals the dynamic nature of these capabilities where adopting TI tools amplifies their ability in dynamic settings. However, the disparity and limitations in the TI adoption limit its potential as a full mediator. According to the CT (Fiedler, 1997), industrial firms should tailor their strategies to align with the external environment in a challenging context like Palestine. The study findings revealed that while SCDC directly enhances SCR, the role of technological innovation as a mediator is contingent upon cultural, economic, infrastructure, and institutional readiness. Thus, emphasizing the need for context-specific strategies to enhance SC resilience.

Consequently, it is recommended that Palestinian industrial firms prioritize their investment in technological tools and processes to enhance SCDC effectiveness and utilize TI to enhance flexibility and agility to enable swift adaption to the volatile environment. Industrial firm leaders should foster a culture that values innovation by securing the required resources and training to ensure adoption and adaption. Additionally, industrial forms should balance their investment between SCDC enhancement and TI. Additionally, industrial sector policymakers should develop and promote strategies to enhance the integration of TI for building resilience and incentivize technology investment through tax benefits, grants, and subsidies.

To summarize the results of <u>Question Three</u>, from the previous discussion, it was found that the mediation analysis indicates that Technological Innovation partially mediates the relationship between Supply Chain Dynamic Capabilities and Supply Chain Resilience. While SCDC directly enhances SCR, its effect is intensified when mediated by TI, demonstrating the interrelationship among SC dynamic capabilities, technological innovation, and SC resilience. Every dimension of SCDC impacts SCR both directly and via the advancement of technological innovation, highlighting their dual pathways of influence. The findings affirm the essential role of technological advancements in maximizing the effectiveness of dynamic capabilities, reinforcing the importance of integrating technological innovation to build resilient supply chains.

As detailed in **Table 4.24.** The results indicate that SCDC has both direct and indirect effects on SCR, with TI acting as a partial mediator. The direct effect of SCDC on SCR is substantial, with a path coefficient of ($\beta = 0.594$, $p < .001$), and an effect size of ($f^2 = 0.369$), showing that SCDC strongly enhances SCR, direct pathway significantly contributes to the model, explaining 47.4% of the variance in SCR ($R^2 = 0.474$, Adjusted $R^2 = 0.472$).

SCDC also shows a positive indirect effect on SCR through TI, the path coefficient for SCDC on TI is ($\beta = 0.671$, $p < .001$), with a large effect size ($f^2 = 0.817$), accounting for

45% of the variance in TI ($R^2 = 0.450$, Adjusted $R^2 = 0.448$). TI, in turn, positively influences SCR with a path coefficient of ($\beta = 0.131$, $p = 0.002$), though the effect is small ($f^2 = 0.018$).

Consequently, TI does not fully mediate the relationship between SCDC and SCR because SCDCs possess a significant capacity to directly affect SCR. Nonetheless, the indirect effect through TI may augment the direct impact, thereby improving SCR within the Palestinian industrial sector. The function of TI servers as a resource and facilitator of dynamic capabilities under specific contextual contingencies.

D- The Fourth Question "How does technological innovation impact supply chain resilience?" represented in hypothesis **H4** and referring to **Table (4.34)** the results show a strong and significant direct effect of Technological Innovation on SCR ($\beta = 0.542$, $p < .001$), supporting H4. Additionally, a positive path coefficient indicates that higher levels of technological innovation are associated with greater supply chain resilience. The effect size ($f^2 = 0.416$) highlights the substantial contribution of TI to SC resilience outcomes. This result is consistent with the results of Garrido-Moreno et al. (2024) the authors found that innovation and resilience are essential dynamic capabilities for adjusting to a changing business environment and sustaining competitiveness. Additionally, Forliano et al. (2023) validate that the firm's technological orientation favorably impacts the maturity of its digital strategy, resulting in increased organizational resilience. Furthermore, Irfan et al. (2022) the authors indicated that companies, especially in developing nations, are leveraging technology to improve knowledge management (KM) capabilities to bolster resilience and achieve a competitive advantage. Likewise, Do et al. (2022) demonstrate that innovation management strategies improve organizational resilience, which in turn boosts innovation. Dovbischuk (2022) revealed that the presence of innovation-oriented competencies and organizational learning was found to have a positive association with increased levels of resilience during the epidemic. Similarly, Li et al. (2021) explained how some innovative initiatives improved business resilience during the pandemic. Furthermore, Gružauskas and Vilkas (2017) the authors contend that combining capabilities of collaboration, flexibility, redundancy, and integration with emerging Industry 4.0 technologies can lead to supply chain resilience.

In the Palestinian context marked by geopolitical and economic instability, logistical and infrastructural challenges, and a fragmented supply chain. Technological innovation involves the integration of digital technologies, advanced tools, and process technologies to help industrial firms anticipate risks, respond more effectively to prevailing challenges, and adapt to the volatile environment.

The strong and significant direct effect of Technological Innovation on SCR could be discussed through the lens of the underpinning theories of this study. According to resource-based theory, firms can achieve competitive advantages by cultivating VRIN resources (Barney, 1991). Technological innovation is a crucial resource that enables companies to improve supply chain resilience by increasing operational efficiency. For Palestinian firms with restricted resource access, technological innovation acts as a strategic catalyst that enhances supply chain resilience, thereby maintaining performance and competitive advantage.

The Dynamic Capabilities perspective emphasizes the firm’s ability to sense, seize, and reconfigure resources to withstand and adapt to constantly changing settings (Teece et al., 1997). TI is considered a capability that enables firms to anticipate SC risks (sense), implement advanced technological tools such as AI, ERP, and digital SC platforms (seize), and continually reconfigure processes to attain resilience (reconfigure). Thus, the Palestinian firms that enhance these capabilities will be better positioned to navigate the constantly changing environment.

Furthermore, this corresponds with contingency theory (Fiedler, 1993), which asserts that no one-size-fits-all strategy exists for sustaining a supply chain in a volatile environment. Rather, it depends on the contextual setting. In the Palestinian context, characterized by political instability and fragmented markets, technological innovation emerges as a contingent factor that aids firms’ supply chain resilience strategies in addressing disruptions and assists firms that leverage technological innovation in adapting their operations to environmental challenges, thus enhancing supply chain resilience.

According to the author's knowledge, no direct studies have investigated the impact of TI on SCR in Palestine. Nonetheless, there are related studies in the neighboring countries that provide useful insights, such as the one conducted in Jordan by Ali et al. (2024), the authors investigated the synergistic impact of AI technology, supply chain collaboration, and information sharing on supply chain resilience. The findings imply that practical information-sharing activities are crucial for attaining supply chain resilience amid unpredictability and disruptions. It illustrates the significance of technology adoption and supply chain collaboration for enhancing supply chain resilience. Information sharing is demonstrated to be a crucial mediator. Furthermore, Alshawabkeh et al. (2024) investigated the interconnections among digital collaboration, analytical capability, and supply chain resilience in Jordan's food processing sector. The research indicates that digital collaboration and analytical capabilities substantially improve supply chain resilience. Furthermore, analytical capability mediates the connection between digital collaboration and supply chain resilience.

Consequently, it is advised that Palestinian industrial enterprises implement technologies such as digital tracking systems, digital supply chain platforms, and Enterprise Resource Planning (ERP) systems (Ivanov & Dolgui, 2020), which enable firms to more effectively anticipate risks, optimize inventory, improve decision-making, and collaborate with supply chain partners. Industrial enterprises ought to encourage investment in technologies that leverage big data and artificial intelligence to improve their analytical and proactive capabilities in risk identification and operational efficiency enhancement. Policymakers must provide grants and subsidy incentives to promote technology adoption among firms. Furthermore, developing building capacity programs in digital skills to ensure employees' capability of implementing and managing technological advancements. These factors will assist industrial firms in improving SCR by promoting technological advancement amidst persistent disruptions.

To summarize the results of <u>Question Four</u>, from the previous discussion, the analysis revealed a significant and positive path coefficient indicating support for H4, demonstrating that increased levels of technological innovation positively enhance supply chain resilience. Furthermore, the correlation analysis shows a moderate positive association between Supply Chain Resilience (SCR) and Technological Innovation (TI), with an observed correlation coefficient of 0.542 **Table 4.33.** The results indicate that as technological innovation increases within the supply chain, SC resilience also tends to improve, suggesting that technological innovation supports the supply chain's ability to handle disruptions effectively.

Furthermore, the model demonstrates an explanatory power for SCR, with $R^2 = 0.294$, suggesting that TI explains 0.294 of the variances in SCR, highlighting the significance of TI in enhancing SCR. This suggests that various elements could influence SCR beyond just technological advancements. These elements could encompass strategies for managing risks that pinpoint, evaluate, and alleviate potential threats posed by political unrest, economic changes, and natural calamities. Improvements in logistics and infrastructure could be an additional element that influences SCR. Additionally, expertise and understanding of human resources play a role in the SC's perspective. Moreover, financial stability allows industrial firms to invest in strategies that enhance supply chain resilience, including the use of alternative suppliers. Additionally, the legal landscape and market dynamics could influence SCR significantly. Furthermore, technological tools adoption, like ERP systems could be another possible enabler of SCR. Factors within culture and organization that encourage proactive resilience planning and adaptation. Implementing sustainability practices that incorporate environmentally friendly methods could improve SCR through better resource optimization. All these factors could empower Palestinian industrial firms to improve their SCR.

E-The Fifth Question -Control Variables "Is there any controlling effect of firm size and age on supply chain resilience?" represented in hypothesis **H5** and referring to **Table (4.35)** results show that **firm age** has a positive but weak effect on SCR, with an unstandardized coefficient (β) of 0.050 and standardized coefficient of 0.071. However, the effect does not reach statistical significance ($p = 0.221$), suggesting that while older firms may have some enhanced SC resilience, their age alone does not substantially strengthen supply chain resilience; the effect size for firm age is minimal ($f^2 = 0.005$), reinforcing its limited contribution.

Conversely, **firm size** has a negative association with SCR, with an unstandardized coefficient (β) of -0.050 and a standardized coefficient of -0.099, approaching statistical significance ($p = 0.064$). However, a negative trend implies that larger firms may experience slight reductions in SC resilience. However, the effect size for Firm Size ($f^2 = 0.008$) also points to a minimal impact.

The model explains only 0.8% of the variance in SCR, with an R^2 of 0.008 and an Adjusted R^2 of 0.004, highlighting the limited explanatory power of Firm Age and Firm Size in predicting supply chain resilience within the model. The findings align with Sullivan & Wamba (2022), who demonstrated that AI positively influenced SCR, whereas the control variables of firm age and size did not significantly affect the outcomes. Nonetheless, although the direct impact of firm age and size on SCR is negligible in this study, it may assume a more significant role when considered as primary predictors or in different settings.

The old firms in Palestine could benefit from their accumulated experience and connections with supply chain partners; however, the challenging contextual environment may limit these firms' capacity to utilize their experience in improving supply chain resilience. This is consistent with the findings of Scholten and Schilder (2015), who highlighted that contextual challenges in developing countries can outweigh the advantages associated with larger firms.

The negative association between firm size and SCR may be attributed to the inefficiencies and complexities inherent in managing large enterprises in developing nations. Palestinian large enterprises struggle with slow decision-making, bureaucratic inertia, and challenges in adapting to unstable environments characterized by constrained resources, inadequate infrastructure, and continuous disruptions.

5.2 Summary of the Study Findings

Based on the prior analysis of the study's findings, the study results could be summarized as follows:

- Supply Chain Dynamic Capabilities dimensions (SCDC) positively impact Technological Innovation (TI). The direct effects of SCDC on TI reveal varying degrees of influence across dimensions with Supply Chain Leadership Support demonstrating the strongest positive effect. Supply Chain Agility follows closely. Supply Chain Disruption Orientation also has a moderate positive impact on TI. Both Supply Chain Flexibility and Supply Chain Collaboration show small positive relationships with TI. Supply Chain Information Sharing and Supply Chain Integration display weak negative effects on TI.

- Supply Chain Dynamic Capabilities dimensions positively impact supply chain resilience. The direct effects of SCDC on SCR indicate varying degrees of influence, with Supply Chain Disruption Orientation showing the strongest influence. Supply Chain Integration also exhibits a strong positive impact on SCR. Supply Chain Agility and Supply Chain Flexibility show moderate positive effects on SCR. Supply Chain Collaboration and Supply Chain Leadership Support show weaker positive effects. Unexpectedly, Supply Chain Information Sharing has a small negative effect on SCR.
- Technological Innovation mediates the nexus between SCDC and SCR. The findings affirm the essential role of technological advancements in maximizing the effectiveness of dynamic capabilities, reinforcing the importance of integrating technological innovation to build resilient supply chains.
- Technological innovation serves as a partial mediator in the relationship between SCDC and SCR.
- Every dimension of SCDC impacts SCR both directly and via the advancement of technological innovation, highlighting their dual pathways of influence. (Partial Mediation for all SCDC dimensions).
- Technological Innovation has a significant positive effect on supply chain resilience, indicating that technological advancements within the supply chain are crucial for fostering SC resilience.
- Neither firm age nor size significantly influences SCR within Palestinian industrial firms.

5.3 Study Recommendations

Based on the theoretical framework and the analysis of the study results, the researcher formulated the following recommendations for Palestinian industrial firms and policymakers:

5.3.1 Recommendations for Palestinian Industrial Firms

- Palestinian industrial firms should prioritize enhancing supply chain leadership support and agility, as these factors significantly contribute to the advancement of technological innovation. Leadership programs and agile practices are imperative. Moreover, improving SCDO and promoting collaboration and flexibility can facilitate technological innovation. Initiatives must target deficiencies in supply chain integration and information sharing to ensure that such information sharing and integration yield actionable insights instead of inefficiencies.
- Industrial firms should prioritize the enhancement of SCDO and integration, as these capabilities exert the most significant positive influence on SCR. They should formulate proactive risk management strategies and improve seamless integration throughout the supply chain. Moreover, industrial enterprises should invest in improving flexibility and agility to effectively adapt to and mitigate disruptions. Nonetheless, supply chain collaboration and leadership support must be augmented by additional robust practices, as these capabilities positively influence supply chain resilience, albeit with limited impact. Industrial enterprises must rectify inefficiencies in supply chain information sharing to mitigate their unforeseen adverse impact on supply chain resilience.
- Industrial firms ought to incorporate technological innovation into supply chain practices to optimize the influence of SCDC on SCR by utilizing digital tools, data analytics, and automation to improve efficiency, adaptability, and risk management. Industrial enterprises ought to augment their investment in employee training to leverage these technologies effectively.
- Industrial firms must prioritize the adoption of technological innovations to boost supply chain resilience. This encompasses the deployment of advanced technological tools, including real-time tracking systems, predictive analytics, digital platforms, and automation. They should prioritize the augmentation of employees' expertise to ensure the successful implementation of these technologies.

- Industrial firms ought to augment supply chain dynamic capabilities and technological innovation to bolster supply chain resilience, as these elements directly influence SCR. The study findings indicate that neither industrial firms' age nor size significantly improves supply chain resilience. Consequently, companies of all ages and sizes possess an equal opportunity to utilize SCR by embracing technological innovation, improving SCDC, and promoting proactive risk management to alleviate disruptions from volatile environments, irrespective of their age or size.

5.3.2 Recommendations for Palestinian Policymakers:

- Policymakers should formulate initiatives that bolster supply chain leadership support, agility, and the adoption of technological innovations by providing tax incentives, grants, and training programs. They should also establish innovation hubs and public-private partnerships to improve collaboration among industries, universities, and the government to develop technological solutions. Moreover, it is essential to establish standards for supply chain information sharing and provide disruption management training to assist industrial firms in adopting a proactive approach to mitigate disruptions and foster technological innovation.
- Policymakers ought to endorse SCDO development and supply chain integration via training programs, risk management strategies, and incentives for technological progress. They should promote agility and flexibility by providing incentives for technological innovations that guarantee adaptability. Policymakers must also tackle supply chain information sharing by establishing standardized protocols that guarantee secure and efficient dissemination of information. Facilitating leadership development and collaborative initiatives can significantly improve SCR across various industries.
- Policymakers ought to advocate for technological innovation as a crucial facilitator of SCR by offering incentives and grants to stimulate research, development, and technology adoption. They ought to cultivate innovation hubs and public-private partnerships to enhance collaboration and information

exchange. Therefore, ensure that the industrial sector possesses the necessary expertise and technological resources to utilize SCDC for enhanced supply chain resilience.

- Policymakers must establish and execute supportive frameworks that foster technological innovation and improve supply chain dynamic capabilities. This encompasses financial incentives and funding for technological innovations, adoption, and capacity-building programs to enhance the skills of supply chain participants. Priority must be placed on establishing an ecosystem that fosters innovation-driven resilience, enabling industrial firms of all ages and sizes to equally capitalize on these advancements to alleviate disruptions and improve supply chain resilience.
- Policymakers ought to facilitate the adoption of technological innovation across sectors by augmenting investment in infrastructure development, including digital platforms and reliable internet access. They should also establish training programs to equip employees with the requisite skills to utilize advanced technologies effectively. Alongside financial incentives, including grants and subsidies to facilitate technological advancements.

These factors will assist industrial firms in improving SCR by promoting technological advancement and enhancing SCDC amidst persistent disruptions.

5.4 Contribution of the Study: Theoretical Implications

This study will deepen our understanding of the primary SC dynamic capabilities that influence technological innovation and supply chain resilience. Furthermore, this research will make a significant theoretical contribution by developing a comprehensive framework that incorporates critical constructs such as supply chain dynamic capabilities, technological innovation, and supply chain resilience in the context of emerging countries where firms face frequent challenges.

This study enriches the DC perspective by confirming that SCDCs directly enhance SCR and indirectly through TI, highlighting the importance of integrating TI in SCDC and SCR frameworks.

The results support the role of TI as a mediator, providing a nuanced understanding of how firms can leverage technological innovation to bolster their supply chain resilience and adaptability. The findings positioned TI as a strategic source within RBV emphasizing its significance in translating SCDC into resilient supply chains. Furthermore, the insignificant observed role of firm age and size on SCR challenges the traditional assumption that large or old firms inherently possess more resilient supply chains. Thus, the findings of this study will broaden the theoretical boundaries of SCDC, TI, and SCR literature, thereby making a valuable contribution to the current body of knowledge in these fields.

5.5 Contribution of the Study: Practical Implications

Furthermore, it is crucial to consider various managerial implications. Firms are obligated to allocate resources toward bolstering their innovative capacities. Firms should foster their strategic focus on technological integration such as adopting advanced technological or predictive analytical tools. This practice facilitates their success in competitive environments and enhances their overall performance. It also equips them to effectively address potential disruptions and mitigate risks within volatile contexts. Industrial firms should train and enhance their employees' skills in utilizing dynamic capabilities, emphasizing innovation-driven strategies that ensure resilient SC.

Furthermore, policymakers should incentivize technology adoption through grants, taxes, and subsidies. Since SCR is not dependent on firm age and size, firms should develop tailored strategies focusing on operational efficiency rather than structural characteristics to enhance SCR across industrial firms.

Additionally, understanding the mediating role played by technological innovation in the connection between supply chain dynamic capabilities and supply chain resilience will provide decision-makers in industrial firms with valuable insights into the optimal strategies that can be implemented to improve supply chain resilience and technological innovation. Thus, this research will aid supply chain players in formulating supply chain resilience strategies, which in turn can boost operational efficiency, hence improving supply chain resilience and eventually resulting in enhanced firm performance and competitive edge (Cahyono et al., 2023).

Furthermore, the findings of this research will provide a unique perspective on supply chain resilience, which can assist decision-makers in expanding their strategies to mitigate the effects of disruptive occurrences. By doing so, organizations can prevent or mitigate potential negative consequences. Additionally, this investigation will assist decision-makers in connecting supply chain resilience strategies to technological innovation.

5.6 Study Limitations

This research endeavor encountered several limitations, as the data were exclusively acquired through the survey. While the questionnaire is a widely used data collection method, it encounters various limitations, such as misunderstanding or misinterpretation of the survey questions which can compromise the data collected validity (Saris & Gallhofer, 2014). This led the researcher to adopt a complementary method by disseminating the survey via WhatsApp using a designated application and engaging with respondents to clarify their queries while maintaining objectivity and ensuring their responses were unaffected. The researcher encountered challenges in collecting survey responses due to the substantial volume of surveys typically received by the firms.

Additionally, this investigation concentrated on a subset of companies operating within the industrial sector across the West Bank of Palestine. This will limit the generalizability of the findings to other sectors or nations. Moreover, owing to extraordinary political conditions, firms in the Gaza Strip were omitted from the research study. Significantly, the data were gathered during a state of war, necessitating extra efforts to persuade respondents to participate in a survey. Furthermore, the participation of supply chain executives and business owners in this survey was voluntary.

5.7 Future Research Directions

The results of this study offer a significant framework for improving supply chain resilience. Future research may expand upon these insights by investigating several key areas:

- **Contextual Examination:** Conduct comparative analyses across diverse regional contexts -political, economic, and cultural- to ascertain the consistency of these findings, concentrating on particular industries and regional challenges, thereby enhancing the understanding of how these regional factors may influence these relationships.
- **Sector-specific Insights**: Analyzing the variation in the influence of SCDC on SCR, with TI serving as a mediator, across specific key Palestinian industries. As well as investigate these relationships in other sectors including service, health, and tourism. This will reveal customized strategies and sector-specific dynamics.
- **Specific Cutting-edge Technological Tools**: Examining the impact of specific technological tools such as AI, IoT, and Blockchains on mediating the nexus between SCDC and SCR. This will provide actionable insights into leveraging technology to enhance SCR.
- **Broader Metrics**: Future research could expand the scope of metrics by exploring additional mediators such as organizational culture or organizational learning, as well as moderators like environmental uncertainty, corporate governance, and market complexity, which could influence the relationship between SCDC and SCR. This would offer a more comprehensive perspective on the involved dynamics.
- **Longitudinal Research Design**: A longitudinal approach would effectively capture the long-term effects of SCDC on SCR, mediated by TI. This method would improve understanding of the temporal dynamics and regional issues within the Palestinian industrial framework.
- **Utilizing the Qualitative Approach:** Supplement the quantitative method with qualitative methods such as focus groups, interviews with industrial firm executives, or case studies. This will facilitate a more profound understanding of the mechanism underlying the observed relationships.

By exploring these areas, future research can further refine the understanding of how SCDC could enhance SCR by integrating TI, particularly in developing economies. It can also provide actionable insights to guide future innovation and resilient supply chains in a frequent disruption context.

5.8 Conclusions

The escalating volatility in the global economy since the 2009 financial crisis, encompassing the USA–China trade war and the COVID-19 pandemic, has necessitated businesses to develop SC resilience to swiftly address unforeseen disruptions (Yu et al., 2022). However, as supply chains grow, businesses' operations become more vulnerable and intricate. Due to recent complexity, supply chains are now more vulnerable to hazards, instability, and disruptions. Approximately 65% of firms experience interruptions annually, with 13% reporting losses of over €1 million in 2019 (Ali et al., 2024). In light of the inherent volatility of the business environment, it is crucial to adopt a strategic approach that focuses on cultivating and enhancing dynamic capabilities within the supply chain, which is essential for bolstering supply chain resilience.

Furthermore, technological innovation is widely seen as a strategic approach to attaining and sustaining supply chain resilience while bolstering firms' profitability and competitiveness. Notably that firms operating in Palestine encounter several obstacles within a dynamic and competitive landscape, including economic and political instability, Israeli occupation, and total reliance on Israeli counterparts, inadequate legislative framework, dependence on international aid, management of multiple currencies, and limited access to financial resources (PMA, 2016).

Additionally, most studies in this area have been conducted in developed nations, with less attention paid to developing economies (Junaid et al., 2023), therefore, it is imperative to assist organizations in enhancing their supply chain management, mitigating supply chain risks, and enhancing their competitive advantage. Hence, this study investigates the interconnects among SCDS, TI, and SCR within the Palestinian industrial sector. Specifically, this study aims to empirically explore the mediating function of technological innovation on the nexus between supply chain dynamic capabilities and supply chain resilience. Structural Equation Modeling (SEM-Amos) validated the proposed model and examined the interconnections across the various constructs.

Findings from 448 executives in industrial enterprises in the West Bank of Palestine demonstrate that the study's measurement models were valid and reliable, affirming the robustness of the constructs involved. The results indicate that supply chain resilience exists at a moderate level. The analysis revealed that supply chain dynamic capabilities positively influence both technological innovation and supply chain resilience. Furthermore, technological innovation was identified as having a substantial positive effect on supply chain resilience. Additionally, technological innovation serves as a partial mediator in the relationship between supply chain dynamic capabilities and supply chain resilience. Highlighting those dynamic capabilities enhance SC resilience more effectively when coupled with technological innovation. Furthermore, the analysis demonstrated that neither firm age nor size significantly influences SCR.

The holistic perspective presented by the proposed model will make a valuable contribution to the existing literature on supply chain dynamic capabilities, technological innovation, and supply chain resilience. Furthermore, this research will aid decision-makers in formulating supply chain resilience strategies that might successfully boost supply chain resilience through the integration of technological innovation.

Thus, it is advised that Palestinian firms equilibrate their investments between SCDC and TI. Policymakers in the industrial sector should devise and advocate strategies to bolster the integration of technological innovation for enhancing resilience, incentivize technological investments, promote regulatory reforms, and establish policy support that enhances trade and logistical efficiency while alleviating resource accessibility challenges.

For future research, it is recommended to involve comparative studies across various regional contexts, invite the variation of SCDC's impact on SCR with TI as a mediating factor in key industrial sectors, employ a longitudinal research design to explore how the interplay among SCDC, TI, and SCR evolve, and consider additional potential mediators or moderators such as organizational culture, organizational learning, corporate governance, or market complexity in addition to supplement the quantitative method with qualitative approaches.

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Appendix #1: IRB Approval Letter

Arab American University

Institutional Review Board - Ramallah

الجامعة العربية الأمريكية

مجلس اخلاقيات البحث العلمي – رام الله

IRB Approval Letter

Study Title: "An Empirical Study on the Impact of Supply Chain Dynamic Capabilities on Supply Chain Resilience: The Mediating Role of Technological Innovation".

Submitted by: Huda Abedel Rahman Mahmoud Takrouri

Date received: 8th July 2024

Date reviewed: 10th July 2024

Date approved: 10th July 2024

Your Study titled **"An Empirical Study on the Impact of Supply Chain Dynamic Capabilities on Supply Chain Resilience: The Mediating Role of Technological Innovation"** with the code number **"R-2024/A/117/N"** was reviewed by the Arab American University Institutional Review Board - Ramallah and it was approved on the 10th of July 2024.

Sajed Ghawadra, PhD
IRB-R Chairman
Arab American University of Palestine

الجامعة العربية الأمريكية - فلسطين
مجلس اخلاقيات البحث العلمي - رام الله
IRB-R
ARAB AMERICAN UNIVERSITY-PALESTINE
INSTITUTIONAL REVIEW BOARD - RAMALLAH

General Conditions:

1. Valid for 6 months from the date of approval.
2. It is important to inform the IRB-R with any modification of the approved study protocol.
3. The Bord appreciates a copy of the research when accomplished.

رام الله – فلسطين

Tel: 02-294-1999 **E-Email:** IRB-R@aaup.edu **Website:** www.aaup.edu

Appendix #2: Distributed Survey

Construct	Items	Source	Scale
Section (1) Respondents and Firms Profiles		Belhadi et al. (2021). Can Saglam et al (2021).	
A. Respondents' Profile			
Gender	Male		
	Female		
Position	General Manager/CEO/Director		
	Logistics/Supply Chain Manager/ Executive		
	Operations/Production Manager/ Executive		
	Marketing/Purchasing /Sales Manager/ Executive		
	Senior Managers (Finance, HR, etc.)		
	Other		
Managerial Experience (#of Years)	5-10 10-15 15 and more		
B. Firm Profile		Hopkins (2021). Ali et al. (2017). Kamalahmadi &Parast (2016). Soltani et al. (2013). Lee et al. (2018).	
Firm Age (#of Years)	1-5		
	5-10		
	10-5		
	More than 15 Years		
Firm Size (#of Employees)	5-10 10-15 15-20 20 and more		
(Economic Activity)	Manufacturing Mining & Extraction Electricity, gas, steam, and air conditioning supply Water supply, sanitation management, and reclamation activities other	(PCBS,2019).	
Availability of Supply Chain Department	Do you have a supply chain department in your firm? Yes/No		

Section (2) Scale Items for Measuring Constructs

Constructs	Measurements	Items	Source
Supply Chain Dynamic Capabilities (SCDC)	**SC Agility (SCA)**	"SCA1. Stock levels are easily visible across the supply chain." "ASA2. Demand levels are visible throughout the supply chain." "SCA3. Our firm maintains constant and frequent contact with its partners." "SCA4. Our supply chain responds faster to SC decisions." "SCA5. Our SC can swiftly introduce new items to fulfill the needs of our clients." "SCA6. Our SC can provide items to the clients before the due date."	**Visibility** **SCA1-SCA3** are adopted from Dubey et al.(2018b). Barrat & Oke (2007). **Velocity** **SCA4-SCA6** are adopted from Kaufmann & Gaeckler (2015). Vickery et al. (2015). Kaipia (2008). Chiang et al. (2015).
	SC Information Sharing (SCIS)	"SCIS1. SC Partners are informed in advance of any changing needs." "SCIS2. Our partners share their knowledge of core business processes with us." "SCIS3. We and our partners exchange information that aids in developing business plans." "SCIS4. We and our partners keep each other informed about events or changes that may affect the other partners."	**SCIS1- SCIS4** are adopted from Lee et al. (2018). Ju et al. (2016)
	SC Flexibility (SCF)	"SCF1. Our firm has several available suppliers."	**SCF1-SCF4** are adopted from Rojo et al. (2018). Can Saglam et al (2021).

		SCF2.The supply chain can modify production facilities and processes. "SCF3. The information systems inside the supply chain can facilitate transportation, distribution, and inventory management." "SCF 4. The supply chain can alter distribution modes."	Juan et al. (2022). Moon et al. (2012).
	Supply Chain Disruption Orientation (SCDO)	"SCDO1. We maintain constant vigilance to anticipate any problems in the supply chain." "SCDO2. We anticipate Supply chain disruptions are constantly looming." "SCDO3. We consider how supply chain disruptions may have been prevented." "SCDO4. An in-depth analysis is performed when a disruption in the supply chain has occurred."	**SCDO1- SCDO4** are adopted from Bode et al. (2011). Yu et al. (2019). Stephens et al. (2022). Laguir et al. (2023).
	SC Collaboration (SCC)	"SCC1. Our Firm and SC partners work together to explore new markets and client responses." "SCC12. Our Firm and SC partners devised a communication plan for action. Especially during difficulties." "SCC13. Our Firm and its SC partners work together to design their products or processes." "SCC14. Our firm and SC partners collaborate in implementing their operational processes."	**SCC1-SCC4** are adopted from Juan et al. (2022). Ju et al. (2016). Cao & Zhang (2011). Simatupang & Sridharan (2008). Dubey et al. (2020). Yu et al. (2019). Srinivasan & Swink (2018).

	SC Leadership Support (SCLS)	“SCLS1. The leadership team consistently offers sufficient support as required.” “SCLS2. We assert that leadership support is crucial in developing resilient supply chain strategy(ies).” “SCLS3. We assert that the leadership team is crucial in decision-making during challenging circumstances.” “SCLS4. We assert that our firm possesses an experienced leadership team well-equipped to navigate challenging or volatile circumstances effectively.”	**SCLS1-SCLS4** are adopted from Chatterjee & Chaudhuri (2021). Smart et al. (2017). Zhang et al. (2018). Le and Lei (2018). Venkatraman (1989). Fiedler (1993). Donate & Guadamillas (2011).
	SC Integration (SCI)	“SCI1. The integration of many departments within a firm is a crucial capability.” “SCI2. A firm's integration capability is closely associated with collaboration.” “SCI3. We involve our main supply chain partners in goal-setting, planning, problem-solving, and demand forecasting in advance.” SCI4. Our main supply chain partners and we communicate about changing needs in advance.”	**SCI1-SCI4** are adopted from Muafi & Sulistio (2022). Eslami et al. (2021). Ju et al. (2016).
	Product Innovation (PDI)	“PDI1. Compared to our key rivals, "the use of latest technological innovations in new product development" is high.”	**PDI 1-PDI3** are adopted from Lee et al. (2018). Hamidu et al. (2023.)

Technological Innovation (TI)		"PDI 2. The speed of new product development" is fast in comparison to our key rivals." "PDI 3. Compared to our key rivals, the number of new products that are first-to-market (early market entrants) is high."	
	Process Innovation (POI)	"POI 1. The technological competitiveness" of our processes is high in comparison to our key rivals." "POI 2. Compared to our key rivals, the speed of adopting the latest technological innovations in our processes is high." "POI 3. The rate of change in processes, techniques, and technology is higher than that of our key competitors."	**POI 1-POI 3** are adopted from Lee et al. (2018). Hamidu et al. (2023).
Supply Chain Resilience (SCR)	-Resuming product flow. -Surpass initial functional state. -Overseeing financial ramifications. -Retain control. -Derive lessons.	"SCR1. Our firm can respond properly to disruptions by promptly resuming product flow." "SCR2. Our firm can efficiently recover and surpass its initial state of function." "SCR 3. Our firm can effectively manage the financial consequences of disruptions." "SCR 4. Our firm can retain the desired control over structure and operation." "SCR5. Our firm can derive valuable insights from interruptions."	**SCR1-SCR5** are adopted from Yu et al. (2019). Altay et al. (2018) Golgeci & Ponomarov, (2013). Can Saglam et al. (2021).

"دراسة تجريبية حول تأثير القدرات الديناميكية لسلسلة التوريد على مرونة سلسلة التوريد: الدور الوسيط للابتكار التكنولوجي"

اسم الطالبة: هدى عبد الرحمن محمود تكروري

لجنة الأطروحة:

د. أيمن عرموطي

د. براشانث بهاردوج

د. حسام الشمري

ملخص

الخلفية والأهداف: أصبحت العمليات التجارية أكثر تعقيدًا وعرضة للمخاطر. حيث يؤدي تغير المناخ، والإرهاب، وعدم الاستقرار السياسي، والأمراض المعدية إلى زيادة اضطرابات سلسلة التوريد. علاوةً على ذلك، بسبب المنافسة الشديدة، والنمو السريع في تكنولوجيا المعلومات، والتسارع الاقتصادي العالمي، وتنوع توقعات العملاء، تواجه المنظمات اضطرابات جديدة تهدد أدائها وقدرتها التنافسية. ونتيجة لذلك، فإن كل شركة في سلسلة التوريد معرضة للاضطراب؛ إذ يعاني أكثر من 70% من الشركات من اضطرابات سلسلة التوريد سنوياً (Ali et al., 2024; Scholten et al.,2019) إضافة إلى ذلك، فإن سلاسل التوريد التقليدية لا تستطيع التكيف مع بيئات الأعمال غير المتوقعة .في ضوء التقلبات الكامنة في بيئة الأعمال، من الضروري تبني نهج استراتيجي يركز على تطوير وتعزيز القدرات الديناميكية داخل سلسلة التوريد. كما يُنظر إلى الابتكار التكنولوجي على نطاق واسع كنهج استراتيجي لتحقيق واستدامة مرونة سلسلة التوريد، مع تعزيز ربحية الشركات وقدرتها التنافسية. استناداً إلى نظرية الموارد، ونظرية القدرات الديناميكية، ونظرية التوافق، تهدف هذه الدراسة إلى اختبار تأثير القدرات الديناميكية لسلسلة التوريد (SCDC) على مرونة سلسلة التوريد (SCR) مع التركيز بشكل خاص على الدور الوسيط المحتمل للابتكار التكنولوجي (TI) في هذه العلاقة.

المنهجية والنتائج: لتحقيق هذا الهدف، تم توزيع استبيان مُنظم على عينة ممثلة من المدراء التنفيذيين لسلاسل التوريد في الشركات الصناعية في الضفة الغربية بفلسطين. وتمت التحقق من صحة النموذج باستخدام SEM–Amos حيث كشفت النتائج من 448 مديراً تنفيذياً أن مرونة سلسلة التوريد موجودة بمستوى متوسط. تؤثر القدرات الديناميكية لسلسلة التوريد بشكل إيجابي على كل من الابتكار

التكنولوجي ومرونة سلسلة التوريد. ويعمل الابتكار التكنولوجي كوسيط جزئي في العلاقة بين القدرات الديناميكية لسلسة التوريد ومرونة سلسة التوريد. وعلاوةً على ذلك، فإن للابتكار التكنولوجي تأثير إيجابي كبير على مرونة سلسلة التوريد. بالإضافة إلى ذلك، لا يؤثر عمر الشركة أو حجمها بشكل كبير على مرونة سلاسل التوريد.

التوصيات، الأصالة، والتداعيات: لذلك، يُوصى بأن تُوازن الشركات الصناعية الفلسطينية استثماراتها بين القدرات الديناميكية والابتكار التكنولوجي ويجب على صانعي السياسات صياغة استراتيجيات لتعزيز دمج الابتكار التكنولوجي لتحسين المرونة، وتشجيع الاستثمارات التكنولوجية، وتعزيز الإصلاحات التنظيمية، ووضع سياسات تدعم كفاءة التجارة والخدمات اللوجستية، مع تخفيف تحديات الوصول إلى الموارد. سيساهم النهج الشامل للنموذج المقترح في إثراء الأدبيات الحالية حول القدرات الديناميكية لسلسلة التوريد، والابتكار التكنولوجي، ومرونة سلسلة التوريد. ستساعد هذه الدراسة صناع القرار في صياغة استراتيجيات لمرونة سلسلة التوريد من خلال دمج الابتكار التكنولوجي.

الكلمات المفتاحية: القدرات الديناميكية لسلسلة التوريد، مرونة سلسلة التوريد، الابتكار التكنولوجي، توجه مواجهة اضطرابات سلسلة التوريد، القطاع الصناعي.