EMPIRICAL INVESTIGATION OF SUPPLY CHAIN RESILIENCE AND SUPPLY CHAIN PERFORMANCE IN THE BISCUIT INDUSTRY OF PAKISTAN

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The thesis submitted in partial fulfillment of the degree of

Master of Science in Supply Chain Management, University of Management & Technology, Lahore.

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Department of Operations & Supply Chain Management

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DECLARATION

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By

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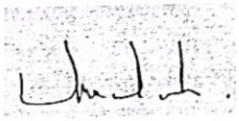

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Supervisor: Dr. Asher Ramish

Co-Supervisor: Dr. Mubbasher Munir

ABSTRACT

Purpose- The biscuit industry in Pakistan operates in a highly vulnerable and risky business environment, due to currency depreciation, continuous increases in energy prices, and tax burden. Current wars between countries and Red Sea issues at ports create a shortage of raw materials in Pakistan. The biscuit industry in Pakistan faces two major types of risk micro and macro. Both risks badly impact the resilience and performance of the biscuit industry. Micro risks are day-to-day and recurrent, and macro risks are rare adverse events. Supply chain visibility and supply chain flexibility are used as vulnerability mitigation strategies in this study. The study aims to investigate the impact of vulnerability mitigation strategies on supply chain resilience, supply chain performance, and supply chain risk. Supply chain resilience is used as a mediation between vulnerability mitigation strategy and supply chain performance. Supply chain risk acts as a mediator between vulnerability mitigation strategy and supply chain resilience. Supply chain information sharing is used as a moderator between supply chain flexibility and performance, and between supply chain flexibility and resilience. The comparison between Punjab and Sindh biscuit industry practices in the supply chain is evaluated.

Design/Methodology/Approach- A quantitative research strategy is used to collect primary data from the 330 employees working in the biscuit industry, in Sindh and Punjab Pakistan. A questionnaire survey is used to collect data and the collected data is analyzed by performing statistical tests in IBM AMOS and IBM SPSS software.

Finding- Supply chain visibility, and supply chain flexibility significantly and positively impact supply chain resilience, and supply chain performance, and negatively impact the supply chain risk**.** The mediation role of supply chain risk,

resilience, and moderation role of information sharing was found significant. Punjab and Sindh supply chain practices are the same

Practical implication- This research study is useful for the supply chain managers and management of the biscuit industry to identify risks and vulnerabilities in the supply chain and overcome them by applying vulnerability mitigation strategies. Supply chain information sharing is helpful for managers to make quick and rational decisions about supply chain activities to enhance supply chain performance and resilience.

Theoretical implication- This research study deepens the understanding of contingency theory: the contingency approach suggests that the management should use strategy as per changing situation not stuck up with a single best way and strategy. This study contributes to information processing theory which explains information sharing importance, and its relation with supply chain flexibility to enhance the performance and resilience of the biscuit industry supply chain. Another contribution is theoretically and empirically developing the relationship among the supply chain visibility, flexibility, risk, resilience, information sharing, and supply chain performance.

Keywords: vulnerability mitigation strategy, supply chain visibility, supply chain flexibility, supply chain resilience, supply chain risk, supply chain information sharing.

LIST OF ABBREVIATIONS

VMS (vulnerability mitigation strategy), SCV (supply chain visibility), SCF (supply chain flexibility), SCRE (supply chain resilience), SCR (supply chain risk), SCP (supply chain performance), SCIS (supply chain information sharing), SC (supply chain).

DEDICATION

I like to dedicate, this work to my (late) father who was, is, and will always be the source of light in the darkest and toughest days of my life. I am very grateful to learn the lessons of determination, honesty, and compassion he taught me, which helped me to grow.

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Chapter-I

Introduction

The Pakistan biscuit industry in the late 1970s shifted from local bakery-based products to packaged products. Pakistan's biscuit industry has grown at a 9.5 percent compound annual growth rate. Since 2009 international export of biscuits increased to 72.3 percent at an average yearly growth rate of 5.1 percent; this growth established a new global record of $37.5 billion in 2020. Pakistan stands ranked 68 among global exports with a market share of 0.1%. Pakistan in this Sector has a huge potential to get many shares in the international market of biscuit exports (Saleem et al., 2022).

The biggest humanitarian group in the world battling with a shortage of food is the Program of World Food (WFP), which feeds more than 1.42 billion of the world's poorest people by providing food products mainly high-energy biscuits which are manufactured in different countries and Pakistan is one of them (Peters et al., 2022). World Food procurement department procures biscuits through a competitive transparent bidding process Pakistan won the lowest number of tenders because its manufacturing cost is higher than other countries.

The biscuit industry of Pakistan is operating in highly vulnerable business conditions due to COVID-19 effects, the war between Ukraine and Russia, Israel and Palestine, and Red Sea issues in European ports (Saleem et al., 2022). The biscuit industry's most raw, packing, and technical materials and machinery are imported from European countries. From the second half of 2019-2024, the prices of major raw materials of biscuits: palm oil, wheat flour, sugar, milk powder, eggs, flavor, colors, cocoa powder, and packaging materials sharply increased in Pakistan. The currency depreciation continues increasing in energy prices, inflation, and global supply chain

disruption putting the biscuit industry at high supply chain risk in Pakistan (Saleem et al., 2022). Palm oil is the key ingredient of biscuits which is 94% imported from Malaysia, and Indonesia; the seasonality and volatile price of palm oil pose a potential risk, to the resilience and supply chain performance of this industry (Zaidi, 2014).

Vulnerability is a disturbance that causes the supply chain to deviate from normal activities and create a negative supply chain result, therefore it's critical to investigate the supply chain's risk and develop ways to mitigate it (Kurniawan et al., 2017). An inherent characteristic of the SCR is vulnerability, which is the incapacity to respond to an existing SCR. (DuHadway et al., 2019). Supply chain techniques like SCV and SCF reduce risk and increase SCRE in the biscuit sector (Ali et al., 2023; Can Saglam et al., 2021). The supply chain can reduce SCR by benefiting from information sharing among its participants (de Assis Santos & Marques, 2022). Supply chain vulnerability mitigation strategies can improve the organization's resilience and performance by reducing supply chain risks (Risonarta & Kamila, 2022).

Supply chain risk is an unanticipated event or condition that negatively affects the full part or any part of the supply chain. The risky events might come from micro-level supply chain activities that are operational and recurrent such as sudden shoot-up demand and supply and transport and logistics function failure (Colicchia & Strozzi, 2012; Gurtu & Johny, 2021). Natural catastrophes and pandemics are examples of unfavorable, non-recurring events that pose a risk to the supply chain at the macro level. These risks have a detrimental effect on the performance of the organization and confuse the way the firm operates (Mouloudi & Evrard Samuel, 2022). Mitigating the supply chain risk is very important for any organization. Strategies for mitigating vulnerabilities dramatically lower risk and exposure while enhancing performance in biscuit firms (Ali et al., 2023; Kurniawan et al., 2017).

Supply chain visibility clarifies both supply and demand visibility and emphasizes how each visibility affects the biscuit industry's performance (Kurniawan et al., 2017). Because of the supply chain's flexibility, businesses can quickly adapt to changes in the business environment, demand variations, and vulnerabilities (Ali et al., 2023). The organization's resources can easily recombine due to supply chain flexibility. It is also helpful to get a competitive advantage. The organization can achieve long-term success by sensing and agility if the Supply chain is flexible (Bag & Rahman, 2023). SCRE refers to an organization's capacity to bounce back from disruptive events and resume normal operations. Biscuit companies in the supply chain can develop resilience by assessing and reducing risk and vulnerability (Ozdemir et al., 2022).

1.1 Research Gap

The influence of risk and SC vulnerability on SCRE and SCP is a current popular issue. A risky business environment badly impacts the profitability and continuity of business operations therefore there is a need to identify severe and adverse events and mitigate them by applying different mitigation strategies and enhancing information flow in the business (Avcı, 2022). Experts have worked on SCR and vulnerability reduction strategies to raise SCP and SCRE. This investigation is predicated on the findings of past studies and a thorough examination of the gaps (Table 1.1). This research project aims to close the gap in knowledge about risk and vulnerability, Identify and develop strategies to mitigate vulnerability and risk, and increase SCP and SCRE in the biscuit industry.

Strategies like SCV and SCF were employed in this study. These tactics hurt supply chain risk but have a favorable impact on SCP and SCRE (Ali et al., 2023). This research study also explains the mediating role of SCR and SCRE and the moderating role of SCIS.

Table 1.1 Research Gap

Supply Chain Visibility (SCV)	The consequences of greater visibility brought about by advancements in big data analytics, in particular, is another intriguing area for future research, in our opinion. This area can provide more precise estimates of changes in demand and the frequency and duration of disruptions, as well as early problem detection and supplier disruption detection/sensors (Cagri Gurbuz et al., 2023)
	About data management, data analytics, and data integration, the organization anticipated that the outcomes would serve as the cornerstone for the next testing and visibility system installation (Kalaiarasan et al., 2023).

	we concentrate on the visibilities resulting from a focal firm's induction of supply and demand, distinct from those resulting from supplier and customer integration. Thus, future studies can investigate whether supply chain visibility enhances innovation performance more effectively (M. Hu et al., 2024).
Supply Chain Flexibility (SCF)	Future studies look into how strategic planning affects the success of flexible supply chains. Additionally, it can look more closely at how particular flexibility components interact with particular sustainable supply chain techniques (Edwin Cheng et al., 2022)
	Several difficulties that could be addressed in future studies have been missed in our setting. We concentrate on a single supplier and store. It would be fascinating to see how supplier production flexibility influences revenue-sharing contract design in the context of competition in the downstream or upstream markets (Koussis & Silaghi, 2023).
Supply Chain Resilience (SCRE)	We highlight topics that have often been overlooked in studies, SCR, and SCRE across business sizes and industries when talk about potential avenues for future research (Safari et al., 2024).
	Organizations are being forced by the pandemic to create a robust supply chain. that incorporates e-commerce to ensure that it can withstand any emergency or unforeseen circumstance in the future (Sharma et al., 2021).
	The model used in this work might provide the basis for further research of a similar nature. It is also necessary to investigate the obstacles or difficulties associated with supply chain resilience since most currently available literature on its facilitators concentrates on positive drivers. For instance, more research must be done on the internal and external elements that could compromise a company's resilience and long-term existence (Salam & Bajaba, 2023).

	Future studies can examine how mitigation tactics relate to organizations' competitive strategies and market-winning criteria. Finally, the study did not include external risk elements like social, environmental, or economic hazards when examining efficient solutions from an operations perspective (Um & Han, 2021).
Supply Chain Risk (SCR)	Future research might also look at the costs and benefits of implementing SCRM procedures over a variety of time horizons to understand how decisions might alter if the environment or suppliers' dependability changes over time (Kamalahmadi et al., 2022).
	Subsequent research endeavors may concentrate on SCR factors and incorporate infrequent and severe adverse occurrences into the suggested framework. (Avcı, 2022).
	By utilizing the result and analysis of supply chain vulnerability, researchers should be able to assess the effects of different hazards on certain supply chain entities and direct future investigations into the efficacy and selection of supply chain risk mitigation techniques (Deshpande et al., 2023).
	Multiple elements are also crucial to supply chain risks. Examples include the knowledge, and abilities of employees, the culture of the company, and the traits of senior management. Future studies could look into how individuals and organizational skills and experiences impact the application of supply chain risk techniques (Deshpande et al., 2023).
	Future studies should aim to identify supply chain risks, rank them, and choose appropriate risk management techniques for post-epidemic scenarios (Dohale et al., 2023).
	The study lays the groundwork for additional research at determining and assessing supply chain tactics to lessen specific risk factors (Chukwuka et al., 2023).

Supply Chain Information Sharing (SCIS)	Future research focuses on different types of supply- and demand-side risks. Mitigation risks using vulnerability mitigation strategies, for enhancing company performance will be more beneficial for small and medium enterprises. Lastly, future research might include mediators (such as supply chain resilience and disruption) and moderators (like information sharing) in the current study model. These are worthwhile directions to pursue (Ali et al., 2023).
	This study examines the information-sharing approach used by an online retailer using demand data. Future studies can examine the supplier's two-way information exchange plan, including private information (Liu et al., 2021).
	Future research must collect data over time to improve accurate assessment and comprehension of the enduring consequences of information sharing on SC, particularly considering the continuous evolution of information technology platforms (Baah et al., 2022).

The above table highlights the importance and gap of each construct used in this study. Some common gaps are mentioned below extracted from the table (1.1) on which this study is based and specifically focused.

1) Additional types of SCR, such as supply- and demand-side risks, are anticipated in future research. The performance and resilience of a company's supply chain can be increased by using vulnerability mitigation strategies; future research could focus on mediators of SC disruption and resilience as well as moderators of information sharing (Ali et al., 2023).

2) The study lays the groundwork for more research aimed at locating and utilizing pertinent supply chain techniques that may be applied to reduce SCR factors, such as micro and macro issues, and improve the SCRE and SCP (Chukwuka et al.,

2023).

3) Given that supply chains are predicted to become increasingly complex systems shortly, further study on preventing or lessening susceptibility disruptions is necessary (Browning et al., 2023).

1.2 Research Objectives

1) To study the supply chain vulnerability mitigation strategies (VMS) SCV, and SCF impact on the SCP of the biscuit industry.

2) To Study the supply chain vulnerability mitigation strategies SCV and SCF impact on the biscuit industry SCRE. which mediates the impact on the SCP of the biscuit industry (Ali et al., 2023; de Assis Santos & Marques, 2022).

3) To Study the supply chain vulnerability mitigation strategies SCV and SCF impact on SCR which mediates the impact on SCRE of the biscuit industry (Ali et al., 2023).

4) To study the SCF in the presence of SCIS impact on the SCP of the biscuit industry (Browning et al., 2023).

5) To study SCF in the presence of SCIS impact on the SCRE of the biscuit industry (Browning et al., 2023).

6) Comparison of the biscuit industry Sindh and Punjab practices of SCV, SCF, SCR, SCIS, SCRE, and SCP.

1.3 Research Question

1) Do the SC vulnerability mitigation strategies SCV and SCF impact on the SCP of the biscuit industry?

2) Do the SC vulnerability mitigation strategies SCV and SCF impact the biscuit industry SCRE which mediates the impact on SCP of the biscuit industry (Ali et al., 2023; Browning et al., 2023; de Assis Santos & Marques, 2022)?

3) Do the SC vulnerability mitigation strategies supply SCV and SCF impact on SCR which mediate the impact on SCRE of the biscuit industry (Ali et al., 2023)?

4) Do the SCF in the presence of SCIS impact the SCP of the biscuit industry (Browning et al., 2023)?

5) Do the SCF in the presence of SCIS impact the SCRE of the biscuit industry (Browning et al., 2023)?

6) Do a comparison of the biscuit industry in Sindh and Punjab, practices are different in SCV, SCF, SCR, SCIS, and SCP?

Chapter-II

Literature Review

The literature review critically examines construct used in research. vulnerability mitigation strategies SCV and SCF are constructs. SC risk, SC resilience, SC performance, and SCIS were also used as constructs in this research study. Hypotheses are derived from the below diagram.

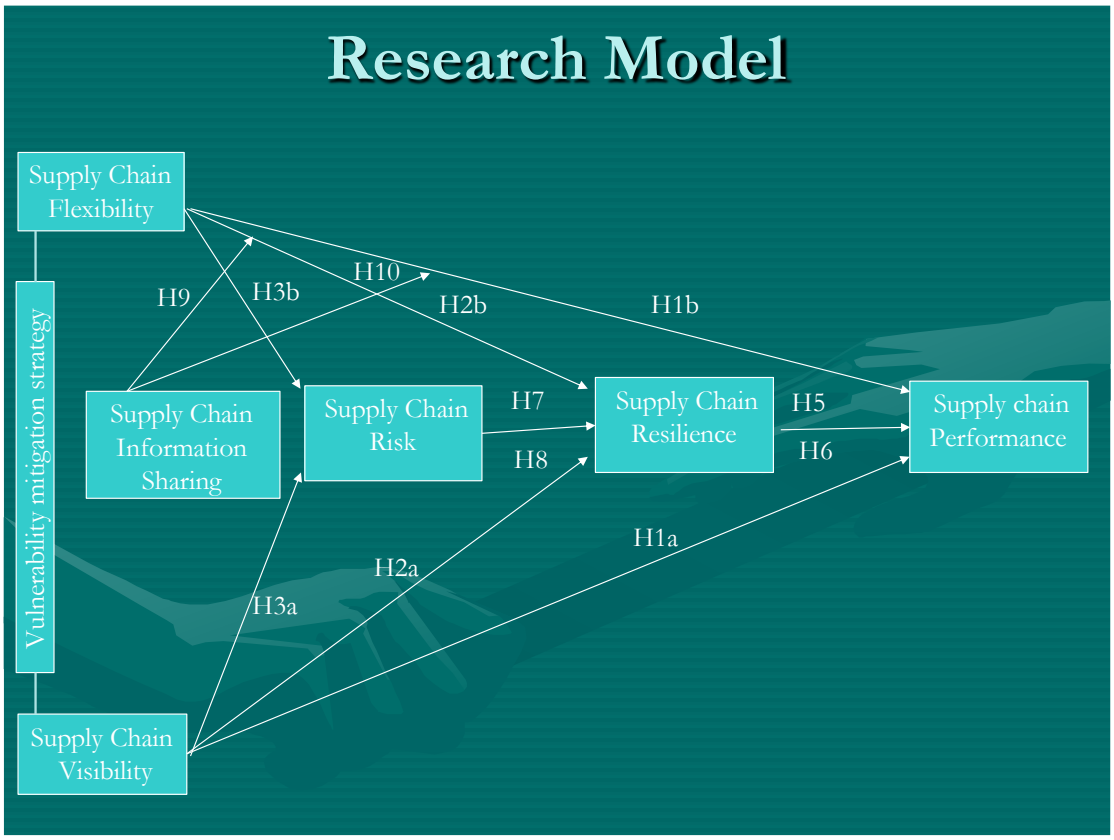

Figure 2.1: Conceptual Model

2.1 Research Hypotheses

H1a: SCV impact on SCP.

H1b: SCF impact on SCP.

H2a: SCV impact on SCRE.

H2b: SCF impact on SCRE.

H3a: SCV impact on SCR.

H3b: SCF impact on SCR.

H4: SCV, SCF, SCR, SCRE, and SCIS impact SCP.

H5: SCRE mediates the relationship between SCV and SCP.

H6: SCRE mediates the relationship between SCF and SCP.

H7: SCR mediates the relationship between SCV and SCRE.

H8: SCR mediates the relationship between SCF and SCRE.

H9: SCIS moderate relationship between SCF and SCRE.

H10: SCIS moderate relationship between SCF and SCP.

H11: Punjab and Sindh biscuit industry comparison of SCV, SCF, SCR, SCRE, SCIS, and SCP

2.2 Meta-Analysis of Supply Chain Risk and Vulnerability

The analysis of risk and vulnerability mitigation strategies is shown in Table 2.1 The analysis highlighted risk and vulnerability mitigation strategies, sample size, constructs, models, and analysis software used by earlier researchers.

Table 2.1: Meta-Analysis of Supply Chain Risk and Vulnerability

Author	Software	Sample size/ Techniques	Types of Models	Industry and country	Risk and Vulnerability Part	Supply Chain Risk and Vulnerability Mitigation Strategies
(Ramos et al., 2023)	PLS	98 Convenience	5variables Mediation Model	Agri-food sector (South Africa)	Supply chain disruptions never before seen as a result of the COVID-19 pandemic.	Dynamic capacity, integration, and adaptable organizational structures.
(Edwin Cheng et al., 2022)	partial least square structural equation model (SmartPLS)	101	4 variables Mediation Model	Automotive manufacturing companies (United States)	Analyze the connections between supply chain, sustainability, and adaptability.	Flexibility practices, Sustainability practices, Sustainability of both operational and overall performance metrics
(Oetomo et al., 2023)	partial least square (PLS)	100	6 Variables Moderated Mediation Model	Fashion industry (Indonesia)	The issue in product innovation flexibility of suppliers and integration.	Flexibility of inbound vendors outbound logistics providers, lead suppliers, and narrative integration
(Darmawan et al., 2023)	hierarchical regression linear regression	125 Convenience non-probability sampling	3 variables Mediation Model	Small and medium industry (Indonesia)	Performance vulnerability of small and medium organizations	Supply chain flexibility, Supply chain agility
(Rojo Gallego Burin et al., 2020)	structural equation model (SmartPLS3)	43 Census Method	3 Variables Mediation Model	National gas (Iran)	Supply chain ambidexterity (exploration, exploitation)	Supply chain ambidexterity, flexibility, information technology capabilities

(Al-Awlaqi & Aamer, 2022)	data envelopment analysis (DEA) regression model	1989 to 2019 Annual Financial Data	3 Variables Mediation Model	Goods and service-producing sector (US)	Firm efficiency during global supply chain pressure	Financial flexibility, firm efficiency
(Bag & Rahman, 2023)	covariance-based structural equation modeling Path analysis	760	6 Variables Moderation Mediation Model	Indian firms	Unique challenges in circular economy principal supply Chain partner relationship	Engagement, alliance, data analysis capabilities, Industry dynamics, sustainable supply chain flexibility, circular economy performance
(Baah et al., 2022)	(PLS-SEM)	119 Random Sampling	5 variables Mediation moderation Model	Manufacturing sector (Ghanaian)	Firm supply chain performance	Collaboration, visibility, agility
(Saqib & Zhang, 2021)	AMOSS-23 and SPSS-25	355 Random Sampling	9 variables moderation Model	Manufacturing firms (Pakistan)	Sustainability failure. Environment, performance of society, and economy.	learning, sensing, coordinating visibility, procurement, manufacturing, distribution sustainability
(J. Yang et al., 2021)	conformity factor Analysis and Path Analysis	1050 Convenience Sampling	6variablesa Mediation Model	Manufacturer (Hong Kong-Macao)	Supply chain disruption	Supply chain visibility, resilience, and capabilities
(M. Hu et al., 2024)	structural equation modeling	200 Random Sampling	7 variables Mediation Model	Manufacturer (China)	Supply, demand, and product innovation	Demand and supply visibility, customer internal supplier integration, Exploration, exploitation innovation
(Al-Khatib, 2023)	covariance-based structural equation modeling using Amos 25 software	225 Snowball Sampling	4 variables Mediation Model	Pharmaceutical sector (Jordanian)	Performance of the SC and operations.	Supply chain visibility, IOT, BDA

(Alghababsheh, 2023)	(PLS-SEM)	217 Random Sampling	4 Variables Mediation Modal	Time (Jordan)	Supply chain risk business and political tie	Business Tie, political tie, Integrative capability, Supply chain resilience
(Salam & Bajaba, 2023)	SPSS 27 hierarchal multiple regression PROCESS macro	133	4Variables Moderation Mediation Model	FMCG (Saudia Arab)	Missing Link between marketing and supply chain	Absorptive capacity, marketing, and SC alignment, resilience.
(Liu et al., 2021)	SPSS 22 AMOS 22	312	6 variables Moderation Mediation Model	Manufacturing industry (China)	local regional conflict, disaster, Environmental uncertainty,	Supply chain information sharing, Analysis, resilience supply chain rational and contractual governess,
(Gani et al., 2023)	SEM PLS	310	10 variables Mediation Model	Time (Bangladesh)	Sustainable supply chain, environment	IT, leadership, collaboration, firm supply chain capabilities, Self-confidence and management, Behavioral flexibility, Interpersonal understanding,
(El Baz & Ruel, 2021)	SEM using SmartPLS	470	7variables Mediation Model	Firms (French)	Supply chain disruption, uncertainty	Risk identification, assessment, mitigation, control, supply chain resilience, robustness
(Todo et al., 2023)	SEM Multiple Regression	282	8variables Mediation Model	Perishable goods (UK)	Challenges, crisis, disruption,	Supply chain robustness, risk Management, empowerment, innovation, velocity, proactivity, reactivity

2.2.1 Analysis Construct and Items

Table 2.2 explains the key items used by earlier researchers for measuring the constructs: SCV, SCF, SCRE, SCIS, and SCP. Items are taken from the previous work for measuring the constructs. Table 2.2 helps this study to develop items of constructs.

Table 2.2: Analysis Construct and items

Author	Construct	Items
(Um & Han, 2021)	Sourcing risk	Sourcing flexibility risk.
		Material quality risk.
		Supplier relationships supplier selection.
	Manufacturing risk	Operation breakdown.
		Product process design.
		Production capacity disruption.
	Delivery risk	Demand variation.
		Forecast error.
		Transporter and logistics reliability
		Service quality.
	Logistics risk	Logistics cost transportation and inventory
		outsourcing integration ownership.
(Todo et al., 2023)	Supply chain risk	Less probability of Supplier Failure.
		Less probability of transportation failure.
		Low probability of delivery chain disruption.
		Low probability of quality failure.
	Customer risk	Customer preferences change frequently.
	Supply chain risk	Key supplier fails to supply.
		Shipment delay affects production.
		Transportation interruption affecting deliveries.
(Mubarik et al., 2021)	Demand visibility	Customers share actual sales information
		Customer's sales information in a prompt, precise, helpful, and comprehensive manner.
		The customer shares information on the inventory level in a timely, Accurate, and complete useful format.

		Customers share promotional plan information. Customers share demand forecast information.
(Mubarik et al., 2021)	Supply visibility	Supplier shares inventory level information timely, accurate, complete, and useful format. The supplier provides advance shipment notice timely, accurate, complete, and useful format. The supplier provides lead time and delivery dates. Finished goods are located in the distribution network.
	Market visibility	Collect market information from various sources in a useful format.
(Brusset, 2016)	Visibility capabilities	Develop a web collaborative platform. Develop reporting tools IT. Track and trace IT tools. Integrate ERP with SCM Tool.
(Qader et al., 2022)	Supply chain visibility	Supplier shares inventory record. Advance shipment notice.
		Get market supply information from various. Get market demand in a useful format. Partner provides finished goods useful information in the distribution network. Partner provides information on finished goods timely in the distribution network.
		Obtain from several sources overall degree of the market Provide information in a fast, accurate, comprehensive, and practical manner.
(Huo et al., 2021)	Flexibility performance	Variety of product Customize products with different features. Meet different customer volume demands. Accommodate demand variation.
	Product development flexibility	Introduce many new products. Introduce new products efficiently. Implement different product modifications efficiently.

(Enrique et al., 2022; Jin et al., 2014)	Flexibility in production	Operate high and low-volume production.
		Change production volume efficiently.
		Accommodate many different product mixes efficiently.
	flexibility in Logistics	Can fill many different inbound and outbound shipment requests efficiently.
	Supplier flexibility	Meet need high and low order quantities.
		Efficiently respond to changes in firm order quantity.
		Efficient response on a changed variety.
	Flexibility of the supply base	Quickly identify new suppliers when needed.
		Easily make adjustments in the relationship.
		Switch to an alternate supplier efficiently
(Blome et al., 2014; Enrique et al., 2022)	Supply chain flexibility	adjusting supplier orders on change demand.
		Adjust customer orders on request.
		Decrease manufacturing lead time.
		Decrease the development cycle.
		Adjusting manufacturing process.
		Increase production volume.
		Increase the frequency of new launches.
(Delic & Eyers, 2020)	Sourcing flexibility	Quickly identify a new supplier.
		Easily add and remove suppliers.
		Easily contractual adjustment with the supplier.
		Modification decisions of product process design are made together with the supplier.
(Enrique et al., 2022)	Delivery flexibility	Easily add or remove carrier and distribution.
		Change product delivery schedule with ease.
		Flexible delivery strategy.
		Can change production volume easily.
		Ability to change a mix of products.
(Zhao et al., 2023)	Capacity to absorb	Redundancy resources placed before disruption.
		High-level awareness of the situation prediction crisis.
	Reaction time	Correct risk management plan when risk arises.

	Ability to recover	Efficiently return to normal operation after disruption. Business continuity by restructuring resources.
(Qader et al., 2022)	Supply chain resilience	Before disruption eliminate the source of disruption. Before improving the SC process to prevent disruption. Rapidly respond to disruption.
		Quick recovery from disruption. Response to disruption quickly reconfigures resources. After disturbance immediate recognize resources to respond.
(Chunsheng et al., 2020)	Readiness of the supply chain	Select firms easy to work. Choose reliable firms. Provide forecast, and sales data plans. Build reward structure for supply chain partners. Develop a contingency plan to increase supply chain stability.
	Alertness in the supply chain	Identify technology that increases visibility. Track structural changes in the market caused by political, social, and demographic structural changes. Detect threats to the supply chain. Update process for in-time delivery. Streamline process removes nonvalue-added activities. Adapt process to reduce new product development cycle time.
(Ojha et al., 2019; Wan et al., 2020)	Information-sharing at danger	Accurate risk-related information. Share real-time information on demand. Share information about events and changes. Partner informs issue that affects business. Integrate information systems with key suppliers and service providers. Operational and strategic information.

	Types of information	Inventory and demand information. Market sale information. Customer demand information. Strategic information marketing logistics etc.
(Glenn Richey et al., 2010)	Operational performance Financial performance Supply chain performance	Improved delivery reliability over the past two years. Improve lead time for customer delivery. Reduce customer lead time. Sales growth last 5 year. Save operating costs production transportation inventory holding costs and so on. Better return on investment. Sorter led time to meet demand. Meet customer-diversified demand.
(Qader et al., 2022)	Operational performance	Brand excellence recognition. Strong reputation for quality. Long-term relationship with partners. Product differentiation by customer.
(Foli et al., 2022)	Financial performance	High market share. High sales growth rate. High profit margin on products. High return on sale.
(Saqib & Zhang, 2021)	Supply chain performance Reliability performance Efficiency performance	Cost efficiency higher sale volume. Increase profitability. Improve the current process and create a new process. Supplier products and quality is reliable. Help each other related to the quality of the product. Reduce inbound and outbound transportation costs. Reduce warehousing and inventory holding costs. Meets on-time delivery requirements.

	Delivery performance	Delivery speed and reliability.
	Agility performance	Flexibility, design delivery performance.

2.3 Vulnerability Mitigation Strategies

There can be no vulnerability (from the perspective of potential harm or loss) in the supply chain without a hazard, and we can only define the susceptibility of an SC in the context of a group of hazards (de Farias et al., 2022). The term "hazard" refers to risk sources that have potential negative impacts on Supply chain functions, hazard is exposure due to an exposure event (Deshpande et al., 2023). Supply chain vulnerability presents more challenges for businesses to manage (Deshpande et al., 2023).

There are differences between risk and vulnerability in the supply chain. Firstly, risk refers to additional uncertainty, whereas vulnerability is the firm's incapacity to manage the risk. Secondly, vulnerability is a result of the risk source (Deshpande et al., 2023). Risk and vulnerability in the supply chain are tightly related and always discussed together, supply chain vulnerability is increased by supply chain internal and external risk and it reduces supply chain efficiency (Peck, 2006). According to a growing number of academics risk and vulnerability have different directions (Deshpande et al., 2023). A high-vulnerability is more prone to risk in contrast, a low-vulnerability supply chain is more resilient to hazards. SCR considers external and internal factors, while supply chain vulnerability should concentrate more on the status and characteristics of the supply chain itself (Deshpande et al., 2023). Assessing supply chain vulnerability is the first step in reducing risk, it’s critical to comprehend the degree of vulnerability of certain operations before generating tactics to counteract their flaws (Jomthanachai et al., 2022). Supply chain vulnerability types are mentioned below.

Table 2.3 Supply Chain Vulnerability Type

Categories	Vulnerability	Reference
Supply-demand vulnerability	Shortage of raw materials, labor, capacity, and low-quality cause low sales, and a weak flow of information in the overall supply chain.	(Alfaqiri et al., 2019)
Financial vulnerability	Inflation rises when currencies depreciate. dollar cost and raises each function's supply chain expenses.	(Iqbal et al., 2020)
Social and political vulnerability	Government instability, corruption, poor infrastructure, and natural disasters destroy the supply chain's regular and planned functionality.	(Mhalla, 2020)
Operational vulnerability	Unexpected variation in customer demand, shortage of stock, lack of innovation, poor implementation of information technology, logistic risk inbound outbound	(Akrofi & Antwi, 2020)

It is crucial to identify supply chain vulnerabilities to create solutions for mitigating those vulnerabilities.

2.3.1 Supply Chain Visibility (SCV)

Supply chain visibility is the ability of a company's supply chains to exchange information that they deem essential and beneficial for partners in the supply chain (Barratt & Oke, 2007). Demand and supply visibility are clarified along with the effects of each on SCRE, SCR, SCP, and profitability (Juan et al., 2022). The visibility of demand and supply always improves the firm performance (Ramanathan, 2014). In a previous study, several researchers showed how to examine the impact of information flows between suppliers and customers within a single visibility model. This model indicates that information transparency and clarity lower supply chain risk (Sharma et al., 2022). SCV clarifies middlemen's roles, enables businesses to operate fairly and transparently for buying and selling activities, and removes the associated risks (Olsson et al., 2013).

SCV is now understood to be essential for improving supply chain resilience, performance, and risk reduction for building analytical skills. Visibility has become a crucial element in supply chain performance, resilience, and risk in recent (Somapa et al., 2018). Information availability, accuracy, timeliness, completeness, and applicability to enhance tactical and strategic operations are the fundamental components of visibility (Somapa et al., 2018). If SCV is poor, SC players are forced to make decisions based on incomplete information which may result in incorrect forecasts, bullwhip effects, incorrect-sized stocks, and supply chain disruptions (Nooraie & Parast, 2015). These unforeseen occurrences can cause delivery delays and decreased materials, productivity, and income for manufacturing businesses worldwide (Agrawal et al., 2024).

Upstream, downstream, and internal (inside business processes) management operations are necessary for supply chain visibility to identify the blockage area and implement the right strategies to remove vulnerability and risk for the flawless function of demand and supply (Sodhi & Tang, 2019). The gathering, organizing, and sharing of data

within a business's processes is referred to as internal visibility, it consists of all the tools, methods, and components required for data collection and sharing throughout the internal supply chain and handling associate risk (Juan et al., 2022). Internal tracking occurs when goods and raw materials are supplied, kept in stock, and processed internally over several steps before being sent to a customer and an inventory location in the distribution chain (Agrawal et al., 2024). The term "external visibility" describes products and activities that are a part of the supply chain, both upstream and downstream, but are not produced by a corporate entity. It includes forecasting supply network status among supply chain partners across different geographic areas, and dynamic status information (Agrawal et al., 2024). SCV amongst partners improves the capacity to control and minimize risk and promptly respond to disturbances (de Farias et al., 2022). Based on the SCV literature review hypotheses are developed which are also mentioned in section (2.1) research hypotheses.

- (H1a).
- (H2a).
- (H3a).

2.3.2 Supply Chain Flexibility (SCF)

SCF refers to withstanding numerous modifications in the SC without significant disruption (Shekarian et al., 2020). Flexibility is the capacity of an organization to change with the market and satisfy client needs without taking unnecessary risks (Shekarian et al., 2020). The SCF of the company demonstrates its ability to effectively and economically respond to internal and external variables to manage supply chain risk (Huo et al., 2018). SCF promptly adjusts production volumes and product offering in response to fluctuations in client demand (Benzidia & Makaoui, 2020). The ability to produce goods in small and large batches to fulfill client demands,

such as make-to-order facilities is provided by manufacturing flexibility (Pellegrino et al., 2019). The capacity to swiftly and effectively reorganize internal resources in response to shifting demand and supply in the market is known as operational flexibility (Srinivasan & Swink, 2018). Establish internal-intensive competencies where flexibility is most heavily focused in enterprises (Aldhaheri & Ahmad, 2023).

The potential for suppliers to modify output levels on a period-by-period basis in response to erratic demand, a supplier may rationalize the selection of products offered, focusing on those that bring better profit, and reduce the volume of quantities produced in response to increasing energy prices (Koussis & Silaghi, 2023). Supply chain integration, forward, backward, horizontal, and vertical is necessary to boost SCF (Shukor et al., 2021). Implementing flexibility is essential to improving production performance (Kamalahmadi et al., 2022).

Customer satisfaction, quality, and productivity depend on supply chain flexibility (Delic & Eyers, 2020). Flexibility in the company's supply chain can enhance supply chain performance and resilience (Kamalahmadi et al., 2022). Businesses that integrate their supply chain and promote sales growth might benefit from SCF and business enhancement (Siagian et al., 2021). The two types of external SCF are inbound and outbound supplier flexibility. Inbound supplier flexibility refers to how ready and willing a company's suppliers are to provide inputs on demand (Fayezi & Zomorrodi, 2015). The term "inbound supplier flexibility" describes the ability to manage unique requirements, respond quickly to unique orders, and regularly fulfill unique requests (Das, 2011). The term "outbound logistics flexibility" describes how ready and able a company's logistics service providers are to manage special and unusual demands to move production between warehouses in various locations and deliver to clients (Chaudhuri et al., 2018).

Good relationships between the business and logistics service providers result in excellent distribution manufacturing output, namely finished goods examples of this flexibility include providing for unusual or exceptional requests managing unforeseen circumstances, and acting promptly with unforeseen requests (Jafari, 2015).

2.3.3 Level of Flexibility

The below explains the level of SCF.

Table 2.4 Flexibility Level

Supply Chain Domain	Range Flexibility	Response Flexibility
Demand management	Given a wide range of product demands, and the sudden increase in demand in market demand with diversity, and rapidly.	The ability of organizations to quickly meet demand, and respond to client needs, as and when they arise.
Sourcing	Ability to successfully deliver a variety of goods and services, materials in small and large numbers to customers, and have multiple Suppliers and strong relationships with suppliers so easily make changes in order quantity, range, and specifications of subsidiary parts used in the product.	Suppliers' capability to react immediately to changes in order quantity, range, and requirements within the requested timeframe. long-term good business relationships with suppliers so they immediately respond to change.
Manufacturing	Being able to work at both large and low production volumes and accommodating changes in production volume demand, easy changeover, and flexible labor.	Rapid production line setup for different products (change over time relatively low as per industry standards.

Logistics	Capability to support a variety of ranges and a sufficient number of vehicles have various modes of transportation air, sear, road rail. Variety of products or to accommodate a variety of loading capacities to satisfy client requirements.	the ability to supply goods quickly unplanned on demand and with the appropriate quality to every consumer when and where they need it.

The SCF literature assessment presented above serves as the foundation for the hypotheses, also discussed in section (2.1) research hypothesis.

- (H1b).
- (H2b).
- (H3b).

2.4 Supply Chain Risk (SCR)

A SCR arises from an activity or occurrence inside the supply chain that deviates from the expected outcomes and instead produces a loss or harm to the supply chain (Waqas et al., 2023). Supply chain risk brings about unwanted repercussions for the organization's supply chain performance increases the cost of the organization, and risks causing a bad performance and resilience of the organization (Kamalahmadi et al., 2022).

SCR can be classified into two categories: operational risk is a constant threat to an organization's routine operations, and disruption risk is associated with infrequent but significant harm to supply chain activities caused by acts of God (Kinra et al., 2020). SCF and SCV reduce operational risks demand fluctuations and lengthy lead times for deliveries (Avcı, 2022). Events like pandemics and natural disasters are uncommon but

have a significant influence on the supply chain is lessened by SCF and SCV (Hosseini et al., 2019; Kinra et al., 2020).

Two forms of SCR are also highlighted by the researchers inbound and outbound. Inbound risk which is delivery delays, comes from the upstream supplier side and is related to supplies and delivery. Outbound risk is related to customers' dissatisfaction due to controlled and uncontrolled risk, and these risks are mitigated by enhancing visibility and flexibility (Svensson, 2002). SCR literature expresses that researchers have divided risk into two broad categories micro-level recurrent nature, and macro-level rare disruption risks the impact of magnitude is very high such as natural disasters, and acts of God, the mitigation of risk enhances resilience and performance (El Baz & Ruel, 2021).

Because of the unpredictable environment in which current technology exists, manufacturers are exposed to the latest supply chain, the intense competition and the firm's struggle for cost reduction and innovation in the face of this unpredictability creates a huge level of micro-risk (Munir et al., 2020). Unpredictability in the supply can create forecasting errors, due to this firms are unable to produce goods without risk as uncertainty reduces the resilience (Tang & Musa, 2011). The classification of micro-level and macro-supply chain risks are mentioned in Table 2.5.

2.4.1 Micro-level Supply Chain Risk

Table 2.5 explains the micro-level SCR which are operational and recurrent natures.

Table 2.5 Supply Chain Micro Risk Classification

Demand Risk	Manufacturing Risk	Supply Risk	Logistics and Transportation Risk
Sudden increase and decrease customer demand	Labor dispute/strike	Supplier unable to handle volume requirement	Lack of outbound effectiveness, lack of inbound Effectiveness
Competitors offering discount high-quality	The high price of capacity	Bankruptcy of partner	Delay delivery
Incorrect Forecast	Capacity reconfiguring issue	Supplier monopoly	Damages of material on the way
Demand uncertainty	Early expire product	Supplier bed quality	Loss of product in transit
sudden fluctuation	Production distortion	Less number of middlemen supplier	Lack of transporter provide integration, packaging risk, material handling risk
Short Lead time required by customer	Warehousing storage risk	Lack supplier visibility	In transit theft
information distortion	Employee accident	Delivery late cost increases sudden	Supply chain unpredictability
High-level services required by customer	Unplanned breaks	Quality issues, flexibility issue, Confidence issue	Difficult on-time delivery, storage risk, warehouse-related risk
Increase competition in the organization	loss of motivation	Supplier biases	Seaport hurdles
Order fulfillment inaccuracy	Lack of experience and training	Default business partner selection	Port demurrages delay and congestion

2.4.2 Macro Risk Classification

Table 2.6 explains the macro-level SCR.

Table 2.6 Supply Chain Macro Risk Classification

➢ Natural calamity.
➢ External legal concerns.
➢ Grievances relating to social and cultural aspects.
➢ Terrorism and warfare.
➢ The risk posed by sovereignty
➢ Fire mishap
➢ Unrest in the area
➢ Unrest in politics

The supply chain visibility and flexibility mitigate micro and macro risks that subsequently impact supply chain resilience and performance, hypotheses of SCR developed are also mentioned in section (2.1) research hypotheses.

- SCR mediates the relationship between SCV and SCRE (H7).
- SCR mediates the relationship between SCF and SCRE (H8).

2.5 Supply Chain Resilience (SCRE)

Resilience word, which derives from the Latin word for bounce back has its central idea that a system may recover from a disruption and return to its initial planned performance (Jüttner & Ziegenbein, 2009). A resilient supply chain can better anticipate, react to, and recover from disturbances (Tukamuhabwa et al., 2015). Supply chains that are connected and have control over their structure and operation are better equipped to withstand unfavorable events, reduce risk, and

enhance their capacity to quickly recover from the risk (Scholten & Schilder, 2015). Supply chain resilience, by improving flexibility, rapidity, and visibility, establishes a framework to reduce different kinds of supply chain micro risks, including manufacturing, logistics, demand, and supply risk and vulnerability, to prevent and absorb changes and quickly reach the intended level of performance (Belhadi et al., 2022).

It's commonly believed that SCF and SCV improve resilience, which is the ability to bounce back and recover from unfavorable supply chain events to a targeted SCP level. In the organization, this indicates the firm's existing capacity to manage recurring risk and positively influence the SCP (Aslam et al., 2020). A company that implements a resilient strategy and manages its supply chain well will be able to identify, acquire, and apply strategic information to address SCR for competitive SCP (Safari et al., 2024). The operational risk could be quickly recovered from the disruption and maintain their performance level as the firm planned initially by applying supply chain visibility and flexibility strategies (Mandal et al., 2016).

The resilience idea is prevalent across many disciplines since it aids in managing or coping with any changes or disturbances in a system (Jomthanachai et al., 2022). When a disturbance occurs, resilient supply chain systems can return the supply chain to its initial conditions and performance level as the increase in resilience increases the supply chain performance (Jüttner & Ziegenbein, 2009). Subsequent studies concentrate on the empirical extension of the roles of environmental factors, which lower resilience, and human and physical capital, which boost it, throughout the supply chain (Dubey et al., 2021).

Repetitive barriers increased the importance of supply chain resilience since they allowed organizations to firmly withstand disruption. If a disruptive event had already occurred, a resilient system quickly restored to its pre-disturbance state (Wieland & Durach, 2021). The supply chain may withstand a great deal of disruption and become more robust with the aid of the SCV and SCF before modifying its organizational structure and management (Richey et al., 2022). The SCRE strategy is essential to enhance the SCP, some resilient strategies are mentioned below.

Table 2.7 Supply Chain Resilience

SCRE	Definition
Collaboration	At various levels, all supply chain stakeholders collaborate to accomplish common goals and objectives and avoid potential risks that are hurdles in achieving goals in the supply chain.
Technologies for Collaboration	Digital ecosystems and technology-driven networks offer SC visibility, disruption detection, and real-time monitoring.
Cyclical economy	Offer resources made from waste products, recycled materials, or products with longer life cycles.
Diversified multisource	Multisource proposals that are widely used to lower disruption.
Reshoring	Reduces transportation costs back shooting or nearshoring and makes it possible to maintain supplies in the event of global disruption.
Building redundancy (Gu et al., 2021)	Reserve buffer to reduce stock-outs while still satisfying consumer demand.

From the SCRE literature review, the hypotheses derived are also mentioned in section (2.1).

- (H5).
- (H6).

2.6 Supply Chain Information Sharing (SCIS)

To lower SCR and raise the organization's SCRE and SCP, information sharing on SCF is crucial (Y. Yang et al., 2022). Three elements make up SCR information sharing: risk information, risk information analysis and assessment, and risk-sharing mechanisms (Fan et al., 2017). Information exchange is essential to the supply chain because it influences its performance, resilience, and adaptability (Baah et al., 2022). The proactive and reactive flexibility that increases SCRE and SCP is facilitated by information integration and sharing within the supply chain; when SCIS is coupled with SCF positive outcomes are produced in terms of SCRE and SCP (Lu et al., 2024).

As information technology develops around the caliber of the data and information exchange. Information is crucial to inter-organizational buyer-supplier partnerships and is strategically important. Decision-making processes are significantly impacted by information exchange in buyer-supplier partnerships (Marinagi et al., 2015). Currently, SCF information exchange systems are utilized to support industrial companies in their information technology (Marinagi et al., 2015). SCIS is thought to be an essential phase in the supply chain's integration and transparency (Sundram et al., 2020). By sharing information, managers can plan their SCF strategies and adapt to the changing environment (Koçoğlu et al., 2011). The integration of financial resources, information and material movement, and both is necessary to establish an improved and efficient SCP (Kembro & Selviaridis, 2015). Managers can make judgments fast and

precisely using information technology (Mukhsin & Suryanto, 2021). Information technology (IT) advancements make it possible to swiftly and efficiently convey information of higher quality, which benefits the coordination of business processes (Koçoğlu et al., 2011).

Information sharing is becoming more crucial as advances in information technology such as EDI and POS (Apte & Viswanathan, 2002). Mature previous research has acknowledged the importance of SCIS (Colicchia et al., 2019).

Big data information sharing is a discipline of information science that describes how to gather and capture data, save it, organize it, process it, analyze it, disseminate it, and manage it in a huge volume and transfer it at a fast speed when necessary (Sanders et al., 2016). Data analytics and SCIS improve transparency and facilitate strong reactions to disruptive events (Zamani et al., 2023).

Table 2.8 Types of Information Sharing in Supply Chain

Types of Supply Chain Information (Ojha et al., 2019; Wan et al., 2020)
➢ Operations strategy, such as each supply chain process and function of firms.
➢ Demand information shared with supply chain partner current demand and future demand fluctuation in demand.
➢ Inventory information good and bad inventory number of days in hand inventory in transit and in-hand inventory.
➢ Marketplace sales data growth, downfall in sales with reasons to avoid risk.
➢ Customer demand information is the variation in demand due to price or competitor moves.

- Information about strategy (marketing, logistics, and other business tactics).

Research hypotheses are developed from the SCIS literature review and mentioned in section (2.1).

- (H9).
- (H10).

2.7 Contingency Theory

The theory of contingency is connected to this research study and hypothesis because contingency theory suggests there isn't a single optimal technique or best strategy to address any issue. The manager should change strategy with changes in the business environment, and choose a strategy that best fits the business environment (Caniato et al., 2016). The business should keep backup plans to make wise decisions and manage risk efficiently and effectively. SCV and SCF impact on SCP, SCR, and SCRE is examined through contingency theory as it does not bind the managers to stick up with a single strategy. if the demand increases the company matches the demand in a flexible way that fully satisfies the customer and does not adopt a rigid way that annoys the customer (Merminod et al., 2022). Contingency analysis reveals that correlations exist among strategies (Benítez Franco, 2023). Contingency theory could also use to explain how information sharing modifies supply chain integration techniques and new product flexibility (Hussain et al., 2023). Numerous authors encouraged studying and comprehending the conditions that define the boundaries between synergistic practices and results, including the variables that might help or worsen the integration of results as the changing in condition pushes to change the practices that the contingency theory emphasizes (Danese & Bortolotti, 2014).

2.8 Information Processing Theory

In this study, SCIS is used as moderation between SCF and SCRE, and between SCF and SCP. The hypotheses of moderation are connected with the information processing theory. It describes the organization's capacity to gather, process, and apply information to lower supply chain risk and vulnerability and increase performance and resilience (Engelen et al., 2010; Galbraith, 1974). The three primary pillars of the information processing theory: are information processing ability, information processing need, and information fit between ability and need to reduce SCR and improve SCP (Napier & Smith, 1987). The information related to SCF is discussed in this study, including flexibility of sourcing, logistics and transportation, operation, and production (Lu et al., 2024; Y. Yang et al., 2022). The information processing about flexibility helps managers to be prepared and alert about risky events in the biscuit industry (Fan et al., 2017). Information sharing concerning SCF, such as fulfilling customers' needs promptly, led to a rise in the SCRE and SCP (Huo et al., 2021). Building strong relationships with business partners and connected entities, as well as creating customer and vendor portals, can improve the information processing capacity. These actions have an impact on the supply chain's business performance both directly and indirectly (Ojha et al., 2019).

Chapter-III

Methodology

3.1 Introduction

In the subject of research, the methodology is considered extremely important. to choose the best research approach, the researcher must assess the nature of the subject under study. The research approach is covered in this section, with particular attention paid to the study design, research orientation, and philosophy.

3.2 Research Methodology

Table 3.1: Research Methodology

Ontology	There are different perspectives to judging reality, realism is a philosophy that deals with things and events that are real and live (Grubic & Fan, 2010; Sulaeman & Harsono, 2021).
Epistemology	Epistemology is the study of knowledge, and the knowledge consists of belief. In this study approach objectivism is applied, it deals with truth and truth can be attained through scientific and empirical studies (Borgström, 2012)
Theoretical perspective	Positivism describes knowledge as precise and can be empirically justified (Chicksand et al., 2012).
Method	Survey research.
Target Population	The target population is biscuit companies and suppliers of biscuit companies in Punjab and Sindh Pakistan. population size is 1900 employees equally divided between Sind and Punjab.
Sampling	Random sampling technique is used because in this technique the population members have an equal chance

Techniques	of selection and there is no bias in this method. The sample is drawn from the targeted population. Once the sample is drawn, it is convenient to collect data if the respondents live in a distant area through email, WhatsApp, Google Forms, and online meetings. It helps in time and cost saving, and speeds up the data collection in a limited period.
Sample Size	The sample size is 330 employees from the biscuit and biscuit suppliers' organization to make a sample representative we use yamens finding. n= N/1+N(e)^2=1900/1+1900(0.05) ^2 (Hendricks, 1936) n=Sample size=330 N=Population Size=2000 e= level of Precision 0.05 Sample size 330 is divided equally into Sind and Punjab Pakistan.
Sampling Frame	Sampling frame: Procurement department, logistics department, store and warehouse department, Sales and Marketing department, Accounting and Finance department, Operational and Production department, Quality and Research and development department.
Unit of Analysis	The managers and above-level employees with experience of > 5 years are selected for this research project. Personnel as an individual is the unit of analysis.
Data Collection Source	The primary and organizational level source is used for data collection from the managers and above employees related to the biscuits industry and suppliers of the biscuit industry. The organization has revenue of > 300 million annually from companies operating in Punjab and Sindh Pakistan. These two provisions are selected because most of the Biscuit industry operates in the Punjab and Sindh

	provisions. The data is related to supply chain visibility, flexibility, resilience, risk, SCIS, and SCP.
Data Collection Tools/Instruments	To gather participants' perspectives, a 5-point rating system ranging from strongly disagree to agree is utilized. It is easy to understand rating scale questions and answers to questions quickly. This helps to reach respondents in distant areas easily and cost-effectively through online questionnaires. The rating scale helps to collect primary data in a shorter period. It offers a comparative analysis of quantitative data within the target sample as all respondents are asked the same question.
Data Processing	Data screening, data classification, and data management. data will be edited and recollected to remove inconsistency, duplication, illegible, missing, and ambiguous responses.
Data Analysis and Interpretation	Demographic Statistics. IBM SPSS, IBM AMOS Factor analysis, including exploratory and confirmatory. Correlation, and regression. Using Andrew Hays technique for path analysis Models 1 and 4 are utilized for moderation and mediation analysis, respectively.
Reliability	The reliability and internal consistency of data are estimated via Cronbach's alpha and composite reliability. Test of multicollinearity (Hair et al., 2013)
Validity	The model fitness suggested by confirmatory factor analysis is validated (Black & Babin, 2019; L. Hu & Bentler, 1999). Items loaded, average variance extracted (AVE), composite reliability, and the square root of AVE are used to achieve convergent validity and discriminant validity (Hair et al., 2013; Voorhees et al., 2016).

3.3 Research Design

A careful analysis of the literature and the development of hypotheses have defined in study's aims. To collect data, the target demographic is randomly contacted using both physical and remote techniques.

3.4 Research Approach and Strategy

The research constructs are efficiently selected that combine actual results in addition to the underlying theory, a deductive research method is used. To fully understand the extracted theory, a survey questionnaire is designed and employed to collect quantitative data in a cross-sectional fashion from the selected respondents (Mohajan, 2020). In the deductive method, research starts with a theory and then refines the theory which can be tested using a hypothesis. The positivist philosophy remains the foundation of this research since the outcomes are better understood in light of this positivism. The deductive approach is a sort of top-down research methodology. The benefits of the deductive method include its scientific, objective, and targeted nature. The current study is deductive and adheres to positivism as it must test hypotheses and have specified aims, the deductive approach is appropriate.

There are two types of research strategies qualitative research, which is based on qualitative data and is concerned with opinions and sentiments, and quantitative research, which is based on facts and statistics and deals with quantifiable items (Basias & Pollalis, 2018). Since objectivism is the foundation of the current study's design and deductive reasoning is the method of choice, it is obvious that quantitative research is involved.

3.5 Design of Questionnaire

Based on applicability, the questionnaire is adopted from previous studies to finish the research. The data collection using questions has been thoughtfully designed to align with all relevant structures and provide comprehensive information to the intended audience, enabling them to fully comprehend the question's theme and provide an effective response. To guarantee scales and face validity and reliability, the construct and items for the questions are drawn from the prior study. The supply chain visibility construct is taken from the study of (Srivastava et al., 2015), This scale included six items and a Cronbach alpha score of 0.91. The construct of supply chain flexibility is taken from the analysis of (Ali et al., 2023; Braunscheidel & Suresh, 2009), Seven items were used to measure this construct, and the alpha value was 0.89. SCR is taken from the study of (Jüttner & Ziegenbein, 2009), Seven items were used to measure this scale, and the alpha value was 0.86. The supply chain performance construct is taken from the study of (Humphreys et al., 2004), Six items with an alpha value of 0.92 were used to measure this scale. The construct supply chain information sharing is taken from the study of (Wan et al., 2020), this scale was measured with 6 items with an alpha value of 0.88. The supply chain resilience construct is taken from the study of

the scale was measured with 5 items with an alpha value of 0.91. All selected items from the previous studies have good reliability and validity which confirms our questions are valid and reliable to collect data from the respondents.

3.6 Research Construct

Table 3.2 indicates the construct and items used for data collection in this study. The constructs and items are adopted from the previous research work

Table 3.2: Research Construct

Construct	Items	Reference
Supply Chain Visibility (SCV)	You get market supply information from various sources in a useful format. You get market demand information from various sources in a useful format. The supplier shares inventory-level information in a timely, accurate, complete, and useful format with you. The supplier provides advance shipment notice in a timely, accurate, complete, and useful format. The supplier provides lead time and delivery dates in a timely, accurate, complete, and useful format. Customers share actual sales information in a timely, accurate, complete, and useful format. Customers share demand forecast information in a timely, accurate, complete, and useful format. Logistics partners provide useful finished goods information in the distribution network.	(Mubarik et al., 2021; Qader et al., 2022; Srivastava et al., 2015)
Supply Chain Flexibility (SCF)	Can you modify the quantity of a supplier's order at any time?	(Ali et al., 2023; Braunscheidel & Suresh, 2009)
	Can your organization shift to an alternate supplier quickly when needed?	
	Do you have numerous transportation options for delivering goods to customers' organizations?	

	Can your organization easily change warehouse space and storage capacity? Your organization can operate in high and low volume efficiently to meet different customers' different volume demands.	
	Can your organization adjust customer orders at customer requests efficiently? Can your organization easily adjust the manufacturing process?	
Supply Chain Resilience (SCRE)	Do your supply chain partners adapt to the changes brought on by the disturbance to the supply chain? After disruption, your organization immediately recognizes resources to respond to disruption. Can you and your main supply chain partner recover to normal operations speedily after the supply chain disruption? Your Company before disruption monitors the supply chain process in advance to prevent form disruption Does your organization provide equal access to forecast sale data and plans to all your suppliers and customers?	(Alghababsheh, 2023; El Baz & Ruel, 2021)
	Does your organization develop a contingency plan to increase supply chain stability?	

Supply chain Risk (SCR)	Does your organization have a low probability of key supplier failure to supply key raw materials? Do you have multiple sources of suppliers for key materials? Is your supply chain well prepared for natural disasters (earthquakes, heavy rain)? Your manufacturing operations are interrupted due to your shipment's delays. Is your supply chain well prepared for major disruption (war terrorism, pandemic)? Does your organization have a low probability of logistics and transportation failure?	(Ali et al., 2023; Jüttner & Ziegenbein, 2009
Supply chain information sharing (SCIS)	Do you regularly share information with all supply chain partners about sales trends? Do you Share information about events and changes with partners?	(Ojha et al., 2019; Wan et al., 2020; Y. Yang et al., 2022)
	Do you provide excess to your database and ERP to your supply chain partners? your organization shares confidential information with your supply chain partner.	
	Do you share with partner day-to-day risk-related information regarding their pending orders?	
	Are you willing to share information on demands with your suppliers about inventory levels and production plans?	

	You and your supply chain partner have an excess of information on logistics-related functions. Do you share operational and strategic information with partners?	
Supply chain Performance	Your company provides the appropriate amount and quality at the appropriate time. Your organization has a long-term. relationships with the partners. Your organization meets customer-diversified demand. Your organization has a high market share.	(Ali et al., 2023; Humphreys et al., 2004)

Chapter-IV

Data Analysis

This chapter is about the analysis and results of the research data. The data is collected from 330 employees from the biscuit and biscuit suppliers' organization. The sample size is 330. The data is collected from face-to-face and online discussions, personal links, and emails. The 350 responses were collected out of which 330 were finalized for analysis. The data is entered in the IBM SPSS to check missing values and outliers, and in the study, no missing data and potential outliers are found for further analysis.

4.1 Descriptive Statistics

4.1.1 Gender and Province

In this data collection process, we had two types of gender. The collected data results are shown in the table below 88.5% of respondents are male and 11.5% of females participated in this survey. Male managers are easy to reach and communicate with, and in the biscuit industries there is a low number of female supply chain senior management designation therefore the response from females is less.

Two provinces Sindh and Punjab are selected for the research because biscuit manufacturers and suppliers of biscuit manufacturers operating in these two provinces in a large number. The response rate is equal to 50% from both provinces as described in the below table.

Table 4.1 Gender and Provision

Gender				Province			
	F	Percent	C.P		F	Percent	C.P
Male	292	88.5	88.5	Sindh	165	50	50
Female	38	11.5	100	Punjab	165	50	100
Total	330	100		Total	330	100	

4.1.2 Designation and Age Group

For this research, the contribution is made by 4 levels of supply chain management. The manager's response is 56.4%, the general manager's is 19.5%, the director's response is 15.8% and the chief executive's response rate is low 8.5%. The manager's access is easy therefore their response rate is high and due to the busy schedule of the CEO, getting responses from CEOs is much more difficult. The managers' perspectives are valuable to this research study since they are closely involved in the daily operations of the supply chain.

Data were gathered for this study from five distinct age groups. Table 4.2 shows that 59 respondents are from the age group of 20-30 which is about 17.9%. There are 132 responders, or 40% of the total, who are in the 31–40 age range. 10.4% of the respondents, or 99 out of 100, are between the ages of 41 and 50. The forty responders, or 12.1% of the total, are beyond 50 years of age.

Table 4.2 Designation and Age Group

Designation				Age Group			
	F	Percent	C.P		F	Percent	C.P
Manager	186	56.4	56.4	20-30 years	59	17.9	17.9
General manager	64	19.4	75.8	31-40 years	132	40	57.9
Director	52	15.8	91.5	41-50 years	99	30	87.9
CEO	28	8.5	100	Above 50 years	40	12.1	100
Total	330	100		Total	330	100	

4.1.3 Experience and Degree

The data analysis of the experienced persons is categorized into three groups. The 107 respondents have 6-10 years of experience about 32.4%. The 78 respondents have experience of 11-15 years which is about 23.6%. The 145 respondents have experience above 16 years which is about 43.9%. The percentage of collected data from the experienced person is healthy for the research.

The respondents with bachelor's degrees are 103 with a percentage of 31.1% out of the total. The master's degree holder respondents are 204 which is 61.8%, and only professional Certificate holders are 23 with a percentage of 7%. The participants are qualified to give valuable opinions

Table 4.3 Experience and Degree

Experience				Degree			
	F	Percent	C.P		F	Percent	C.P
6-10 years	107	32.4	32.4	Bachelors	103	31.2	31.2
11-15 years	78	23.6	56.1	Masters	204	61.8	93
Above 16 years	145	43.9	100	Professional certification	23	7	100
Total	330	100		Total	330	100	

4.1.4 Annual Sale and Number of Employees

The respondents are categorized into 5 groups according to their annual revenue. The 66 respondents related to the organization have yearly revenue of Rs.300-400 million the percentage is 20% out of the total. The Rs. 401-500 million annual revenue organizations respondents are 89 which is 27%. The respondents 99 with a percentage of 30% related to Rs. 401-500 million per year revenues organizations, and above 600 million revenue respondents 76 which is 30%.

The respondents are also categorized into 5 groups according to the number of employees in the biscuit industry. Respondents are 83 related to 0-100 the percentage is 25.2% out of the total. The 101-200 respondents are 98 which is 29.7%. The 77 respondents 23.3% related to 201-300, and above 400 respondents are 72 and a percentage is 21.8%.

Table 4.4 Annual Salary and Number of Employees

*Annual sale				No. of employees			
	F	Percent	C.P		F	Percent	C.P
300-400	66	20	20	0-100	83	25.2	25.2
401-500	89	27	47	101-200	98	29.7	54.8
501-600	99	30	77	201-300	77	23.3	78.2
Above 600	76	23	100	above 400	72	21.8	100
Total	330	100		Total	330	100	

*Million rupees

4.2 Factor Analysis

4.2.1 KMO AND Bartlet Test

The significant variable association also serves as the basis for testing different hypotheses and factor analysis (Dziuban & Shirkey, 1974).

Since the off-identity values differ from zero and correlate with one another, it suggests that the correlation matrix of the variables under study is not an identity matrix, supporting the suitability of factor analysis.

Table 4.5 KMO and Bartlett's Test

KMO Bartlett’s test		.921
Bartlett's Test of Sphericity	Approx. Chi-Square	10499.033
	Df	465
	Sig.	.000

4.2.2 Exploratory Factor Analysis

EFA is performed when exploring a new work. This research deals with new populations sample sizes, and industry. It is conducted to identify latent factors that explain the correlation pattern among measurement instruments or items and variables. It identifies groups of items that are correlated with each other and converts them into a smaller number of factors. An item score above 0.7 is considered suitable for factor measurement. in this study, EFA developed 6 factors and each item falls into the relevant factor having a value above 0.7. EFA explained 78.73% variability in data. Six factors: SCV, SCF, SCRE, SCR, SCP, and SCIS were created in this study. Eigenvalues greater than 1 are considered significant all six factors have eigenvalues greater than 1.

Table 4.6 Exploratory Factor Analysis

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.502	40.330	40.330	12.502	40.330	40.330
2	3.574	11.528	51.858	3.574	11.528	51.858
3	3.324	10.724	62.582	3.324	10.724	62.582
4	2.287	7.377	69.959	2.287	7.377	69.959
5	1.653	5.333	75.293	1.653	5.333	75.293
6	1.068	3.446	78.739	1.068	3.446	78.739

4.2.3 Confirmatory Factor Analysis

Confirmatory factor analysis is performed in Amos software to know the portion of variables that can be retained and that can be excluded in further testing. As pe (Salisbury et al., 2002), to verify that the items are correctly loaded on the underlying concept and that the observed items adequately describe the relevant construct, confirmatory factor analysis is performed. For this study, six constructs are established:

SCV item eight, SCF item seven, SCRE item six, SCIS item eight, SCP item four, and SCR item six.

As per the below diagram, all factors are loaded on the relevant latent variables SCV loading value ranges from 0.70 to 0.92, the SCF loading value is 0.77 to 0.89, the SCRE loading value range is 0.72 to 0.96, the SCIS loading value is 0.82 to 0.97, SCP loading value is 0.85 to 0.95 the SCR loading value is 0.83 to 0.98. The threshold value for factor loading is 0.7 items removed from the further analysis whose score is less than 0.7, items scored less than 0.7 are SCV1, SCRE5, and SCIS2 to SCIS5, SCR4, and SCR5. The below figure indicates the confirmatory factor analysis results.

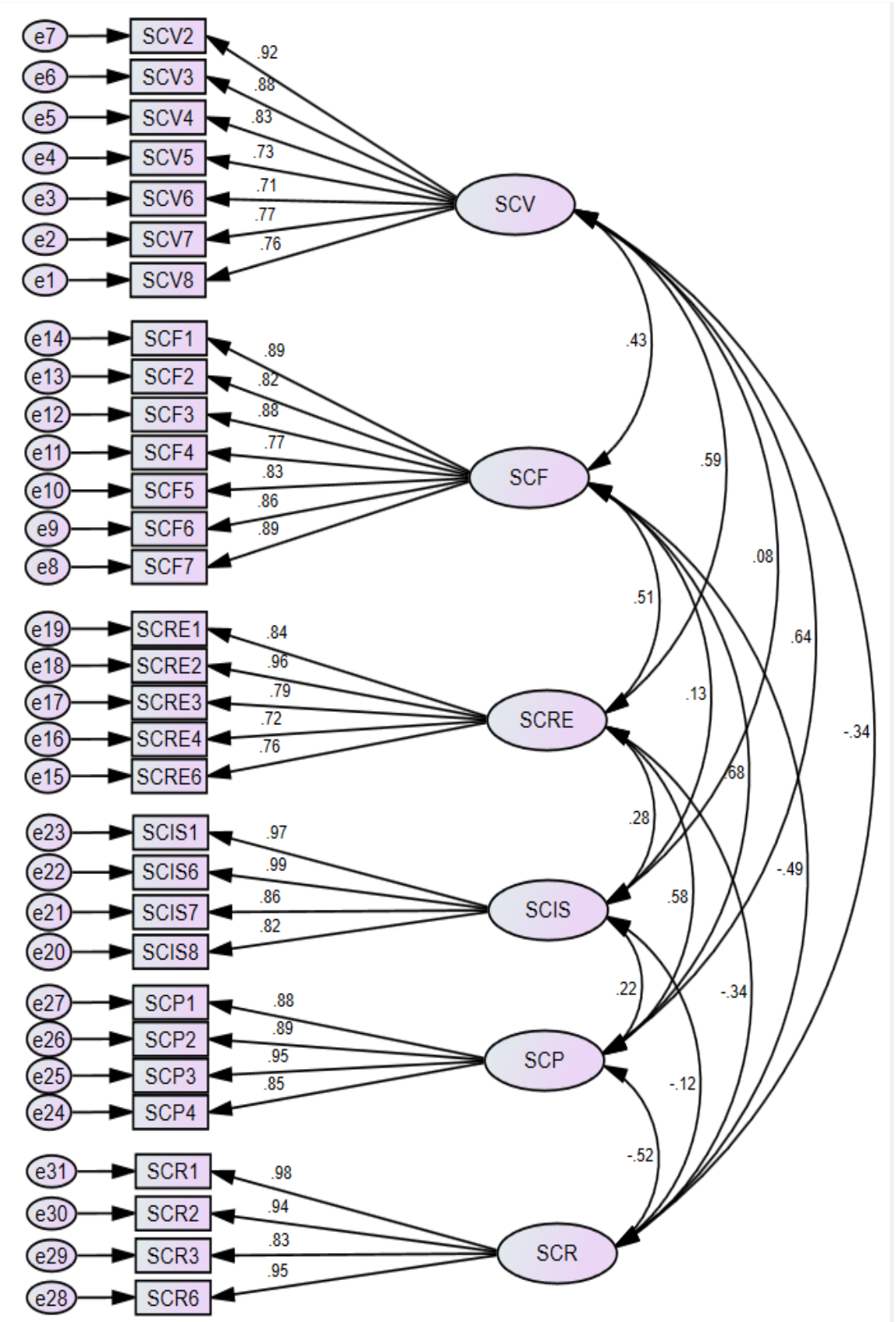

Figure 4.1: Confirmatory Factor Analysis Factor Loading

4.3 Non-Response Biases

4.3.1 Harman's single factor

The common method bias (CBM) is tested through Harman's single factor. there isn't any compelling evidence of common method bias in research data. According to this approach, the first factor in exploratory factor analysis should explain variances for non-response biases which should be less than 50% as guided by (Aguirre-Urreta & Hu, 2019). Using data from the exploratory factor analysis (Table 4.6) There is no response bias in this study, as the first factor accounts for 40.33% of the variance.

4.4 Model Fit Measure

The research model is evaluated using the standards provided by (Hair et al., 2013; L. Hu & Bentler, 1999) for model fitness. Less than the cut-off value of 3, the chi-square statistic's ratio to the degrees of freedom (CMIN/DF=964.72/419) is 2.302. This suggests a suitable match. It appears that the model fit is satisfactory because the Comparative Fit Index (CFI) score is 0.948, which is close to the 0.95 cut-off figure. The best fit for the model data is shown by a Uniform Root Mean Square Residual (SRMR) value of 0.034, which is much less than the 0.06 cut-off value. Given that the root mean square error of approximation (RMSEA) is 0.063 and below the 0.08 cutoff, the data and model fit appear to be very well matched. The Index of Incremental Fit (IFI) rating of 0.948 is rather close to the cut-off value of 0.95, indicating a fit that is passable but not quite ideal. Although it is somewhat above the 0.90 cut-off point, the Tucker-Lewis Index (TLI) of 0.942 is still an acceptable level. Strong evidence suggests that this measure model is a good fit for additional study, as advised by, based on the computed values of the indices (Hair et al., 2013; L. Hu & Bentler, 1999).

Table 4.7 Model fit measure

Model indices	Measurement Model	Cut-off values
Chi-square (CMIN/DF)	2.302	<3
CFI	0.948	>0.95
SRMR	0.034	<0.06
RMSEA	0.063	<0.08
IFI	0.948	>0.95
TLI	0.942	>0.90

4.5 Composite Reliability and Convergent Validity

The dependability and internal consistency of the components inside a construct are evaluated using Cronbach's Alpha. Values greater than 0.70 are often regarded as appropriate and advised by (Black & Babin, 2019; Hair et al., 2013), with values above 0.80 being preferable. Excellent internal consistency is indicated by Cronbach's Alpha values above 0.90 for all variables (SCV, SCF, SCR, SCIS, SCP, and SCR). Internal consistency is measured by composite reliability (CR), which is similar to Cronbach's Alpha. Values above 0.70 are regarded as satisfactory, and values above 0.80 are preferred, as advised by (Fornell & Larcker, 1981; Hair et al., 2013). With composite reliability scores exceeding 0.90 for each of the six constructs, outstanding dependability is shown. It is verified that the study model data has strong internal consistency based on the results of Cronbach's alpha and composite reliability.

The amount of variance that the construct concerning the amount of variance owing to measurement error captures is measured by the average variances extracted (AVE). According to average variances retrieved values greater than 0.50, the construct accounts for more than half of the variation of its elements (Fornell & Larcker, 1981; Hair et al., 2013; Voorhees et al., 2016). Every construct has average variance extract values greater than 0.50, a sign of strong convergent validity.

Table 4.8 Composite Reliability Convergent validity

Construct	Items	Loading	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
SCV	SCV8	0.76	0.924	0.927	0.645
	SCV7	0.775			
	SCV6	0.71			
	SCV5	0.73			
	SCV4	0.827			
	SCV3	0.884			
	SCV2	0.915			
SCF	SCF7	0.895	0.948	0.948	0.723
	SCF6	0.858			
	SCF5	0.83			
	SCF4	0.767			
	SCF3	0.883			
	SCF2	0.825			
	SCF1	0.889			
SCRE	SCRE6	0.761	0.907	0.91	0.67
	SCRE4	0.723			
	SCRE3	0.791			
	SCRE2	0.961			
	SCRE1	0.837			
SCIS	SCIS8	0.820	0.952	0.952	0.832
	SCIS7	0.857			
	SCIS6	0.994			
	SCIS1	0.966			
SCP	SCP4	0.846	0.939	0.94	0.796
	SCP3	0.950			
	SCP2	0.891			
	SCP1	0.878			
SCR	SCR6	0.947	0.957	0.96	0.857
	SCR3	0.825			
	SCR2	0.938			
	SCR1	0.984			

4.5.1 Discriminant Validity

The correlations between constructs are shown along with their significance levels. Table 4.9 describes discriminant validity (Black & Babin, 2019; Fornell & Larcker, 1981) for evaluating relationships between constructs. Significant correlations suggest meaningful relationships between constructs. Significant correlations have been shown between SCV and supply SCR as well as SCF, SCRE, SCP, and SCIS. Significant correlations have been found between SCF and SCV, SCR, SCP, and SCRE. Significantly, SCRE has a negative correlation with SCR and a positive correlation with SCF, SCP, and SCV. SCIS has negative associations with SCR and lesser but statistically significant connections with SCF, SCRE, SCP, and SCV. SCP correlates negatively with SCR and positively with SCV, SCF, SCRE, and SCIS. There is a negative association between the SCR and the SCP, SCIS, SCV, SCF, and SCRE.

According to the Fornell-Larcker criterion, a construct should share more variance with its indicators than with other constructs (Fornell & Larcker, 1981), Accordingly, the square root of the Average Variance Extract (AVE) for each construct ought to be greater than the correlations it has with other constructs. The table below shows good discriminant validity because the average variances of the construct values are higher than the intercorrelation values of the constructs.

Table 4.9 Discriminant Validity

	SCV	SCF	SCRE	SCIS	SCP	SCR
SCV	**0.833**					
SCF	0.431***	**0.851**				
SCRE	0.586***	0.511***	**0.819**			
SCIS	0.110*	0.125*	0.281***	**0.912**		
SCP	0.645***	0.678***	0.576***	0.219***	**0.892**	
SCR	-0.337***	-0.487***	-0.345***	-0.115*	-0.521***	**0.926**

*** Correlation P 0.001, ** Correlation P 0.01 *Correlation P 0.05. Bold text indicates the square root of AVE.

4.5.2 Kurtosis and Skewness

Kurtosis and skewness analysis are performed to verify that the data is normal. The normal distribution's components are skewness and kurtosis. Skewness is a metric used to quantify data symmetry. A negative skewness number implies left-skewed data, whereas a positive value shows right-skewed data. Kurtosis's positive value denotes a heavier tail in the data with more outliers, while its negative value shows lighter tails with fewer outliers.

The purpose of kurtosis and skewness is to verify the normalcy of research data using different values. The literature provided the kurtosis and skewness coefficient values, which ranged from -2 to +2 (Field, 2013; Gravetter & Wallnau, 2014). The value -1.5 to +1.5 is guided by (Tabachnick, B.G., & Fidell, 2010). The value -1 to +1 is guided by (Bulmer, 1979). Additionally, the coefficient values of kurtosis and skewness must fall between -7 and +7 to satisfy the normality assumption of the data (Black & Babin, 2019; Hair et al., 2013). Table 4.10 shows that the SCER, SCIS, SCP, and SCR are closer to 0 and positively skewed, indicating that the data is normally distributed. The skewness coefficient values of SCV and

SCF are negatively skewed and closer to zero. All variables have negative kurtosis coefficient values, which fall between -0 and -1, suggesting that the data is somewhat regularly distributed. The sample size for each construct in the analysis is 330, and there are no missing values.

Table 4.10 Skewness and kurtosis

				Valid		Missing	
	Mean	Skewness	Kurtosis	N	Percent	N	Percent
SCV	2.941	-0.017	-0.110	330	100.0%	0	0.0%
SCF	2.845	-0.024	-0.143	330	100.0%	0	0.0%
SCRE	2.740	0.032	-0.459	330	100.0%	0	0.0%
SCIS	2.634	0.052	-0.951	330	100.0%	0	0.0%
SCP	2.940	0.059	-0.117	330	100.0%	0	0.0%
SCR	2.850	0.013	-0.122	330	100.0%	0	0.0%

4.6 Collinearity Statistics

All the tolerance values are well above 0.2, and all the VIF values are below 5. This indicates that multicollinearity is not a concern in the research. The predictors are sufficiently independent of one another, and the multicollinearity is minimal, ensuring reliable and stable estimates of the regression coefficients. The model does not suffer from multicollinearity issues based on the Tolerance and VIF values. This indicates that the predictors are independent and the regression analysis provides reliable results.

Table 4.11 Multicollinearity Statistics

	Collinearity Statistics	
	Tolerance	VIF
SCV	.657	1.523
SCF	.647	1.547
SCRE	.580	1.724
SCIS	.909	1.101
SCR	.759	1.318

Dependent variable SCP

4.7 Relationship of Variables

The multiple regression model is run to check and test the hypothesis developed based on our conceptual model. The positive and negative direct relation is checked by running the multiple regression analysis.

4.7.1 Direct Positive Relation of Hypothesis

H1a:

H1b:

H2a:

H2b:

4.7.1.1 SCV and SCF Impact on SCP (H1a & H1b)

The multiple correlation coefficient (R) in the table below reveals a strong positive link (R-value of 0.747) between the predictor's SCV, SCF, and the outcome variable SCP. The coefficient of determination, or R-square, measures how much of the variance in the dependent variable the SCF and SCV can be accounted for by the independent variables.

The regression model fitness is explained in the ANOVA portion of the table below. The unexplained sum of the square variance value, 243.455, is smaller than the regression sums of the square explained variance value, 308.176, in the table below. The F value is 206.965, which is a significant ($p<0.05$) value. shows that the independent variables SCF and SCV in this model account for variations in the dependent variable SCP.

This ANOVA table shows that the regression model is suitable for examination. The coefficient section in the table below explains the change of the dependent variable due to changes in each independent variable separately. The dependent SCP changes by 0.404 units when the independent variable SCV changes by one unit, according to the independent variable's standardized beta score is 0.404 and significance score ($p<0.05$). Assuming acceptance of Hypothesis H1a, SCV directly and significantly improves the SCP. Similarly, a 1-unit change in SCF results in a 0.484-unit change in the dependent variable SCP, according to the independent variable SCF, which has a standardized beta coefficient value of 0.484 and a significance value ($p<0.05$). Hypothesis H1b is also accepted as the SCF has a significant positive direct impact on the SCP.

Table 4.12: Direct Positive Relation H1a & H1b

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
.747	0.559	0.556	0.862		
ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Regression	308.176	2	154.088	206.965	0.000
Residual	243.455	327	0.745		
Total	551.63	329			
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients		
	Beta	Std. Error	Beta	T	Sig.
(Constant)	0.09	0.15		0.6	0.549
SCV	0.479	0.048	0.404	10.031	0.000
SCF	0.506	0.042	0.484	12.016	0.000
Dependent Variable: SCP					
Predictors: SCV, SCF					

4.7.1.2 SCV and SCF Impact on SCRE (H2a & H2b)

There is a fairly significant positive link between the predictor's SCV, SCF, and the dependent variable SCRE in this study, according to the multiple correlation coefficient in the table below (R-value 0.609). According to the coefficient of determination R-square, the independent variables SCV and SCF account for 37.1% of the variation in the dependent variable SCRE. Finding possible correlations and testing the hypotheses are the goals of this study, which uses a novel population and sample size. The R-square value of 37.1% is adequate to offer significant understanding.

Regression model fitness is explained in the ANOVA portion of the table below. The value of the regression sums of square explained variances in the table below is 152.17, and the F value of 206.965 is significant ($p<0.05$), indicating that the independent variables SCF and SCV in this model account for variations in the dependent variable SCRE. The model appears to be fit for regression analysis based on this ANOVA table.

The following table's coefficient section describes how changes in each independent variable independently affect the dependent variable. With a significance level p-value less than 0.05 and a standardized beta score is 0.419 for the independent variable SCV, it can be seen that a change of one unit in SCV affects the dependent variable SCRE by 0.419 units. Acceptance of Hypothesis H2a results from the SCV's substantial positive direct influence on the SCRE; when the SCV rises, the SCRE rises as well. Similarly, the independent variable SCF has a standardized beta score is 0.302 and significance score p-values less than 0.05 which indicates the 1-unit change in SCF caused a 0.302-unit change in the dependent variable SCRE. Hypothesis H2b also accepted as SCF has a significant positive direct impact on SCRE. The research data proved that SCV and SCF positively impact the SCRE of the biscuit industry.

Table 4.13 Direct positive relation H2a & H2b

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.609	.371	.367	.889

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	152.710	2	76.355	96.424	0.000
Residual	258.942	327	.792		
Total	411.652	329			

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	Beta	Std. Error	Beta	T	Sig.
(Constant)	.701	.155		4.530	.000
SCV	.429	.049	.419	8.705	.000
SCF	.273	.043	.302	6.288	.000

Dependent Variable: SCRE

Predictors: SCF, SCV

4.7.2 Direct Negative Relation of Hypotheses

H3a:

H3b:

4.7.2.1 SCV and SCF negatively impact SCR (H3a & H3b)

The multiple correlation coefficient in the table below R is 0.486. The results of this study point to a moderately strong correlation between the dependent variable SCR and the predictor's SCV, SCF. The independent variables SCV and SCF can account for 23.6% of the variance in the dependent variable SCR, according to the R-square coefficient of determination. Finding possible correlations and testing the hypotheses

are the goals of this study, which uses a novel population and sample size. The study's R-square score of 23.6% is adequate to offer significant understanding.

The regression model fitness is explained in the ANOVA section. The regression sums of square explained variances in the table below are 133.64 and the F value is 50.517; both values are significant p-values less than 0.05 and show that the independent variables in this model, SCF, and SCV account for variations in the dependent variable, supply chain risk (SCR). This ANOVA table shows that the model is suitable for regression analysis.

The following table's coefficient section describes how changes in each independent variable independently affect the dependent variable. The dependent variable SCR changed by -0.143 units when all other independent variables were held constant, according to the independent variable SCV, which has a standardized beta coefficient value of -0.143 and a significance p-value less than 0.05. It is accepted that Hypothesis H3a is true since SCV directly and significantly lowers the SCR of the biscuit industry as it rises. Likewise, the independent variable SCF has a significance value ($p<0.05$) and a standardized beta score is -0.410. This shows that a 1-unit change in SCF resulted in a -0.410-unit change in the dependent variable SCR while all other independent variables remained constant. Given that the SCF directly and significantly negatively affects the SCR, hypothesis H3b is also accepted. The results of the multiple regression analysis demonstrated that SCF and SCV have a negative effect on the biscuit industry's SCR.

Table 4.14 Direct Negative Relation H3a & H3b

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.486	.236	.231	1.15013

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	133.646	2	66.823	50.517	.000
Residual	432.554	327	1.323		
Total	566.200	329			

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	Beta	Std. Error	Beta	T	Sig.
(Constant)	4.588	.200		22.934	.000
SCV	-.171	.064	-.143	-2.689	.008
SCF	-.434	.056	-.410	-7.725	.000

Dependent Variable: SCR

Predictors: SCF, SCV

4.7.3 SCV, SCF, SCR, SCR, SCIS Impact on SCP

H4:

The multiple correlation coefficient, or R, indicates how strongly the values of the dependent variable are expected to match those of the observed variable. The outcome variable and the predictors have a strong association, as indicated by the R-value of 0.782. The coefficient of determination, or R-square, indicates how much of the variance in the dependent variable can be predicted based on the independent factors. A 61.2% variance in the dependent variable explained by the predictors is indicated by the R-square value of 0.612. This implies a good fit between the model and the analysis. The overall influence of five constructs on the SCP is explained by

hypothesis H4, and this effect is statistically significant. SCP benefits from the SCV, SCF, SCRE, and SCIS. SCR is detrimental to SCP, therefore the model as a whole is important.

Table 4.15 SCV, SCF, SCR, SCRE, and SCIS impact on SCP

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.782	.612	.606	.813

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	337.468	5	67.494	102.109	.000
Residual	214.162	324	.661		
Total	551.630	329			

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	Beta	Std. Error	Beta	T	Sig.
(Constant)	.688	.247		2.783	.006
SCV	.399	.051	.337	7.888	.000
SCF	.380	.045	.363	8.441	.000
SCRE	.107	.053	.092	2.028	.043
SCIS	.100	.036	.099	2.734	.007
SCR	-.196	.039	-.199	-4.997	.000

Dependent Variable: SCP

Predictors: SCV, SCF, SCRE, SCIS, SCR

4.7.4 Mediation Relationship of Variables

H5:

H6:

H7:

H8:

4.7.4.1 SCRE mediate SCV and SCP (H5)

Summary model 1: With a coefficient of 0.5561, p-values less than 0.05, and an R-square of 29.49%, the table below shows that SCV significantly predicts SCRE. Finding possible links and testing the hypothesis are the goals of this study, which uses a novel population and sample size. The R-square value of 29.49% is adequate to offer insightful information. A moderate association between supply chain resilience and visibility is indicated by the R 0.5431.

Model 2 summary: SCP is significantly predicted by both SCV and SCRE. The SCRE is 0.345 and the SCV is 0.5231. 42.64% of the variation in SCP of the biscuit business that can be accounted for by SCV and SCRE is described by the R-Square. The mediator variable SCRE, the outcome variable SCP, and the predictors of SCV have a moderate multiple correlation, as indicated by the R-value of 0.653.

The direct effect shows that an increase in SCV of one unit led to an increase in SCP. The direct effect of 0.5321 units is statistically significant p-value less than 0.05. The indirect effect of 0.1918 suggests that SCV affects SCRE, which in turn affects SCP. In particular, through its impact on SCRE, a one-unit rise in SCV is linked to a 0.1918-unit increase in SCP. The bootstrapped confidence intervals (BootLLCI = 0.115, BootULCI = 0.2678), which do not include zero, and the p-value from the Sobel test both show that this indirect impact is statistically significant.

The total of the direct and indirect impacts of SCV on SCP can be interpreted as the overall effect. This would make the formula 0.5231 + 0.1918 = 0.7149. Given the significance of the direct and indirect effects, it can be said that SCRE both positively and partially mediates the link between SCV and SCP.

Table 4.16 Mediation Analysis H5

Andrew Hays Model: 4 Sample Size: 330

Dependent variable: SCP

Independent variable: SCV

Mediation variable: SCRE

SCV impact on SCRE:

Summary Model 1:

R	R-sq	MSE	F	df1	df2	P
0.5431	0.2949	0.8849	137.1909	1	328	0.000
	Coeff	Se	T	P	LLCI	ULCI
Constant	1.1045	0.1489	7.4167	0.000	0.8116	1.3975
SCV	0.5561	0.0475	11.7129	0.000	0.4627	0.6495

SCV and SCRE impact on SCP:

Summary Model 2:

R	R-sq	MSE	F	df1	df2	P
0.653	0.4264	0.9676	121.548	2	327	0.000
	Coeff	Se	T	P	LLCI	ULCI
Constant	0.4564	0.1683	2.7121	0.007	0.1253	0.7874
SCV	0.5231	0.0591	8.848	0.000	0.4068	0.6394
SCRE	0.345	0.0577	5.9748	0.000	0.2314	0.458

The direct effect of SCV on SCP:

Effect	Se	T	P	LLCI	ULCI
0.5231	0.0591	8.848	0.000	0.4068	0.6394

Mediation/Indirect effect of SCV on SCP through SCRE:

	Effect	BootSE	BootLLCI	BootULCI
SCRE	0.1918	0.039	0.115	0.2678

Sobel test (Mediation significant test):

	Statistics	Se	P
	5.3249	0.0360	0.000

4.7.4.2 SCRE mediate SCF and SCP (H6)

In brief Model 1: With an R-square of 22.52% and a coefficient of 0.4288, p-value less than 0.05, and SCF significantly predicting SCRE, as the table below illustrates. Finding possible correlations and testing the hypotheses are the goals of this study, which uses a novel population and sample size. The R-square value of 22.52% is adequate to offer insightful information. There is a strong association between resilience and supply chain flexibility, as indicated by the R 0.4746.

SCF and SCRE both strongly predict SCP, according to Summary Model 2. The effect of SCRE is 0.3422 and that of SCF is 0.5334. According to the R-square, SCF and SCRE were explained by 49.06% of the variation in SCP of the biscuit industry. A significant multiple correlation between the predictors of SCF, the mediation variable SCRE, and the outcome variable SCP is indicated by the R-value of 0.7004.

A one-unit rise in SCF is shown to have a direct effect of 0.5334 on an increase in SCP. The direct effect of 0.5334 units is statistically significant p-values less than 0.05. The 0.1467 indirect effect suggests that SCF affects SCRE, which in turn affects SCP. In particular, through its impact on SCRE, a rise of one unit in SCF is linked to an increase of 0.1467 units in SCP. The bootstrapped confidence intervals (BootLLCI = 0.098, BootULCI = 0.2072), which do not include zero, and the p-value from the Sobel test both show that this indirect impact is statistically significant.

The overall impact of SCF on SCP is the whole of its direct and indirect impacts. In this instance, the overall effect would be 0.5334 + 0.1467 = 0.6801. Positive and noteworthy effects are produced both directly and indirectly. The link between SCF and SCP is found to be partially positively mediated by SCRE, leading to the acceptance of hypothesis H6.

Table 4.17 Mediation Analysis (H6)

Andrew Hays Model: 4 Sample Size: 330

Dependent variable: SCP

Independent variable: SCF

Mediation variable: SCRE

SCF Impact on SCRE:

Summary Model 1:

R	R-sq	MSE	F	df1	df2	P
0.4746	0.2252	0.9724	95.3423	1	328	0.000

	Coeff	Se	T	P	LLCI	ULCI
Constant	1.52	0.1362	11.1575	0.000	1.252	1.788
SCF	0.4288	0.0439	9.7643	0.000	0.3424	0.5151

SCF and SCRE Impact on SCP:

Summary Model 2:

R	R-sq	MSE	F	df1	df2	P
0.7004	0.4906	0.8593	157.4621	2	327	0.000

	Coeff	Se	T	P	LLCI	ULCI
Constant	0.4847	0.1504	3.2224	0.0014	0.1888	0.7806
SCF	0.5334	0.0469	11.3733	0.000	0.4411	0.6256
SCRE	0.3422	0.0519	6.5934	0.000	0.2401	0.4444

The direct effect of SCF on SCP:

Effect	Se	T	P	LLCI	ULCI
0.5334	0.0469	11.3733	0.000	0.4411	0.6256

Mediation/Indirect effect of SCF on SCP through SCRE:

	Effect	BootSE	BootLLCI	BootULCI
SCRE	0.1467	0.028	0.098	0.2072

Sobel test (Mediation significant test):

	Statistics	Se	P
	5.4648	0.0268	0.000

4.7.4.3 SCR mediate SCV and SCRE (H7)

In brief Model 1: The table below shows that, with an R-square of 9.6% and a coefficient of -0.3733, p-values less than 0.05, and SCV adversely and substantially predicts SCR. The aim of this study is to uncover potential correlations and test the hypothesis that the R-square value of 9.6% is sufficient to provide useful insight. The study deals with a new population and sample size. A weak but substantial association between SCV and SCR is seen by the R-value of 0.3108.

Summary Model 2: There is a substantial correlation between SCR and SCV. SCV has a favorable impact on supply chain visibility, while SCR hurts SCRE. The impact of SCR is -0.1391 and the impact of SCV is 0.5041. Model R-square in this section indicates that SCR and SCV account for 49.06% of the variance in SCR of the biscuit business. The supply chain performance dependent variable, supply chain risk mediator, and predictor variable have a moderate multiple correlation, as indicated by the R-value of 0.5648.

An increase in SCV of one unit is shown to have a direct influence on SCRE of 0.5041 units. This direct effect is statistically significant ($p < 0.05$). The indirect impact of the 0.0519 unit shows that by affecting SCR, SCV also affects SCRE. A one-unit rise in SCV is linked, via its impact on SCR, to a 0.0519-unit rise in SCRE. The bootstrapped confidence intervals (BootLLCI = 0.0176, BootULCI = 0.0911) are not zero, indicating that this indirect effect is statistically significant. Additionally, the Sobel test p-value is less than 0.05.

Total SCV on SCRE = 0.5041 + 0.0519 = 0.556 is the sum of direct and indirect effects. Given that the relationship between SCV and SCRE is found to be somewhat

mediated by SCR and the significance of both the direct and indirect effects, hypothesis H7 is accepted.

Table 4.18 Mediation Analysis (H7)

Andrew Hays Model: 4 Sample Size: 330
Dependent variable: SCRE
Independent variable: SCV
Mediation variable: SCR

SCV impact on SCR:

Summary Model 1:

R	R-sq	MSE	F	df1	df2	P
0.3108	0.0966	1.5594	35.0822	1	328	0.000
	Coeff	Se	T	P	LLCI	ULCI
Constant	3.9479	0.1977	19.9695	0.000	3.559	4.3368
SCV	-0.3733	0.063	-5.923	0.000	-0.4973	-0.2493

SCV and SCR impact SCRE:

Summary Model 2:

R	R-sq	MSE	F	df1	df2	P
0.5648	0.319	0.8573	76.5781	2	327	0.000
	Coeff	Se	T	P	LLCI	ULCI
Constant	1.6539	0.2182	7.5796	0.000	1.2246	2.0831
SCV	0.5041	0.0492	10.2538	0.000	0.4074	0.6008
SCR	-0.1391	0.0409	-3.3988	0.0008	-0.2197	-0.0586

The direct effect of SCV on SCRE:

Effect	Se	T	P	LLCI	ULCI
0.5041	0.0492	10.2538	0	0.4074	0.6008

Mediation/Indirect effect of SCV on SCER through SCR:

	Effect	BootSE	BootLLCI	BootULCI
	0.0519	0.019	0.0176	0.0911

Sobel test (mediation significant test):

	Statistics	Se	p.value
	2.4324	0.0167	0.015

4.7.4.4 SCR mediates SCF and SCRE (H8)

In brief Model 1: The table below shows that, with an R-square of 21.9% and a coefficient of -0.496, p-values less than 0.05, and SCF negatively and substantially predicts SCR. Finding possible correlations and testing the hypotheses are the goals of this study, which uses a novel population and sample size. The R-square value of 21.9% is adequate to offer insightful information. A moderate connection between SCF and SCR is indicated by the R 0.4681.

SCF and SCR both significantly predict SCRE, according to Summary Model 2. SCRE is impacted by SCR adversely and SCF favorably. The effects of SCR are -0.1027 and SCF are 0.3773. According to this section model, SCR and SCF account for 23.65% of the variation in the biscuit industry's SCRE. The goal of this study is to find possible relationships and test the hypotheses; it uses a novel population and sample size, and its R-square value of 23.65% is adequate to offer insightful information. The dependent variable SCP, mediator variable SCR, and predictor variable SCF have a moderate multiple correlation, as indicated by the R 0.4864.

According to the direct effect, there was a 0.3778 unit rise in SCRE for every unit increase in SCF. There is a statistically significant direct influence ($p < 0.05$). The indirect effect of 0.0510 suggests that SCF affects SCR, which in turn affects SCRE. Through its impact on SCR, a one-unit rise in SCF translates into a 0.0510-unit increase in SCRE. The bootstrapped confidence intervals (BootLLCI = 0.0059, BootULCI = 0.1000), which exclude zero, and the p-value from the Sobel test both indicate that this indirect impact is statistically significant. The total effect of SCF on SCRE is equal to the sum of the direct and indirect effects (0.3773+0.0510=0.4283). Since there is evidence that SCR partially mediates the link between SCF and SCR and because both the direct and indirect effects are significant, hypothesis H8 is accepted.

Table 4.19 Mediation Analysis (H8)

Andrew Hays Model: 4 Sample Size: 330						
Dependent variable: SCRE						
Independent variable: SCF						
Mediation variable: SCR						
SCF impact on SCR:						
Summary Model 1:						
R	R-sq	MSE	F	df1	df2	P
0.4681	0.2191	1.3479	92.0548	1	328	0.000
	Coeff	Se	T	P	LLCI	ULCI
Constant	4.2614	0.1604	26.5689	0.000	3.9459	4.577
SCF	-0.496	0.0517	-9.5945	0.000	-0.5977	-0.3943
SCF and SCR impact on SCRE:						
Summary Model 2:						
R	R-sq	MSE	F	df1	df2	P
0.4864	0.2365	0.9611	50.6583	2	327	0.000
	Coeff	Se	T	P	LLCI	ULCI
Constant	1.9577	0.2405	8.1417	0.000	1.4847	2.4308
SCF	0.3778	0.0494	7.6475	0.000	0.2806	0.475
SCR	-0.1027	0.0466	-2.2032	0.0283	-0.1944	-0.011
The direct effect of SCF on SCRE:						
Effect	Se	T	P	LLCI	ULCI	
0.3778	0.0494	7.6475	0.000	0.2806	0.475	
Mediation/Indirect effect of SCF on SCRE through SCR:						
	Effect	BootSE	BootLLCI	BootULCI		
SCR	0.051	0.0241	0.0059	0.1000		
Sobel test (Mediation significant test):						
	Statistics	Se	p.value			
	2.1404	0.0237	0.0323			

4.7.5 Moderation Analysis of Variables

H9:

H10:

4.7.5.1 SCIS moderate SCF and SRES (H9)

SCF, the moderation variable, SCIS, and the dependent variable, SCRE, have moderate multiple correlations, as indicated by R 0.5431 in the table below. SCF and SCIS, together with their interaction, account for 29.5% of the variance in SCRE, according to the R-squared of 0.295. To test the hypothesis that an R-square value of 29.5% is adequate to yield meaningful insight, this study will uncover potential relationships and work with a fresh population and sample size.

Because it is used to evaluate the moderating effect, the interaction term needs to be large. The supply chain resilience SCRE is significantly impacted by the interaction between SCF and SCIS, as seen by the interaction effect value (SCF x SCIS) of 0.1016 with t = 3.1436, p = 0.0018, LLCI = 0.0380, and ULCI 0.1651 not including zero. SCF and SCIS do not significantly impact supply chain performance. SCIS interacts with SCF and produces significant results.

The variation is 29.5% in the absence of interaction terms. The interaction term accounts for an extra 2.14% of the variance in SCRE, according to the highest order unconditional interaction R-squared change of 0.0214. We accept hypothesis H9 because the interaction term is significant (p = 0.0018), suggesting that the impact of SCF on SCRE is dependent on the degree of SCIS.

As the amount of information sharing rises from 1.25 to 4, the effect size likewise rises from 0.2612 to 0.5405, according to the conditional effects analysis in the table below. At every level of SCIS that has been studied, the impact of SCF on SCP is positive and significant, and the effect size grows as SCIS rising. Thus, the beneficial

effects of SCF on supply chain resilience SCRE are strengthened and higher levels of SCIS are supported.

Table 4.20 Moderation Analysis H9

Andrew Hays Model: 1 Sample Size: 330

Dependent variable: SCRE

Independent variable: SCF

Moderation variable: SCIS

SCIS moderates the relationship between SCF and SCRE:

Summary Model 1:

R	R-sq	MSE	F	df1	df2	P
0.5431	0.295	0.8902	45.471	3	326	0.000

	Coeff	Se	T	P	LLCI	ULCI
Constant	1.873	0.2982	6.2814	0.000	1.2864	2.4596
SCF	0.1343	0.096	1.3994	0.1626	-0.0545	0.3231
SCIS	-0.1122	0.1049	-1.0699	0.2854	-0.3186	0.0941
Int_1	0.1016	0.0323	3.1436	0.0018	0.03800	0.1651

Product terms key: Int_1: SCF x SCIS

Test interaction:

	R2-chng	F	df1	df2	P
X*W	0.0214	9.8821	1	326	0.0018

Focal predictor: SCF, Moderation var: SCIS, Dependent var: SCRE

Predictor (SCF) at values of the moderator (SCIS)

SCIS	Effect	Se	T	P	LLCI	ULCI
1.25	0.2612	0.0623	4.1921	0	0.1386	0.3838
2.25	0.3628	0.0444	8.1717	0	0.2755	0.4501
4	0.5405	0.0604	8.9504	0	0.4217	0.6593

4.7.5.2 SCIS moderate SCF and SCP (H10)

The dependent variable SCP, moderation variable SCIS, and independent variable SCF have a moderate multiple correlation, as indicated by R 0.6728 in the table below. The interaction between SCF and SCIS accounts for 45.26 percent of the variance in SCP, according to the R-squared of 0.4526. The moderator's role is demonstrated by the significant interaction term, which is utilized to assess the moderating effect. A substantial interaction impact between SCF and SCIS on SCP is shown by the interaction SCF and supply SCIS effect value (SCF x SCIS) of 0.0896 with t = 2.7181, p = 0.0069, LLCI = 0.0247, and ULCI 0.1544 not including zero.

The SCP is positively increasing with an increase in SCF, according to the SCF effect value of 0.424 t = 4.3406, p = 0.000, LLCI 0.2323, and ULCI 0.6175 not including zero. SCIS has little effect on SCP. Significant outcomes are produced by the interaction between SCIS and SCF.

In the absence of interaction terms, 45.26% is the variation. The interaction term accounts for an extra 1.24% of the variance in SCP, according to the highest order unconditional interaction R-squared change of 0.0124. We accept hypothesis 10 because the interaction term is significant (p = 0.0069), suggesting that the impact of SCF on SCP relies on the degree of SCIS.

The following table's conditional effects analysis illustrates how the effect size rises from 0.5368 to 0.7832 supply as the level of information sharing grows from 1.25 to 4. At every SCIS level that has been studied, there is a favorable and significant impact of SCF on SCP. With an increase in SCIS, the effect size grows. This reinforces the beneficial effects of SCF on (SCP) and encourages greater SCIS levels.

Table 4.21 Moderation Analysis H10

Andrew Hays Model: 1 Sample Size: 330

Dependent variable: SCP

Independent variable: SCF

Moderation variable: SCIS

SCIS Moderate the relationship between SCF and SCP:

Summary Model 1:

R	R-sq	MSE	F	df1	df2	P
0.6728	0.4526	0.9262	89.8606	3	326	0.000

	Coeff	Se	T	P	LLCI	ULCI
Constant	1.399	0.3042	4.5997	0.000	0.8006	1.9973
SCF_M	0.4249	0.0979	4.3406	0.000	0.2323	0.6175
SCIS_M	-0.1352	0.107	-1.2637	0.2073	-0.3457	0.0753
Int_1	0.0896	0.033	2.7181	0.0069	0.0247	0.1544

Product terms key: Int_1: SCF x SCIS

Test interaction:

	R2-chng	F	df1	df2	P
X*W	0.0124	7.3879	1	326	0.0069

Focal predictor: SCF, Moderation var: SCIS, Dependent var: SCP

Predictor at values of the moderator:

SCIS	Effect	Se	T	P	LLCI	ULCI
1.25	0.5368	0.0636	8.4456	0.000	0.4118	0.6619
2.25	0.6264	0.0453	13.8325	0.000	0.5373	0.7155
4	0.7832	0.0616	12.7137	0.000	0.662	0.9043

4.7.5.3 Model shifts

The direct relationship between the hypothesis and data is measured using multiple regression analysis. It clarifies how variations in the independent variables affect the dependent variable. By adjusting for the effects of other independent factors, it enables researchers to quantify the individual contributions of each independent variable and comprehend how numerous independent variables contribute to the dependent variable. The objectives of this research study are perfectly answered by

multiple regression since each independent variable has a considerable impact on the dependent variable. Supply chain performance and resilience are positively impacted by research predictors of supply chain flexibility and visibility, whereas supply chain risk is adversely affected.

A mediation analysis was used in place of multiple regression analysis in this study to address complex linkages. The influence of the mediator variable on the dependent variable and the influence of the independent variable on the mediator variable are explained. Should the indirect effect be considerable, the mediation variable comes into play. The study examines the mediation functions of supply chain risk and resilience. Research demonstrates that supply chain risk and resilience have a major mediating effect. Mediation analysis is used because multiple regression analysis is unable to conduct indirect analysis.

Complicating correlations that are beyond the scope of multiple regression and mediation analysis is resolved by the moderation analysis. In cases where a moderation variable is present, moderation analysis describes the strength of the link between the dependent and independent variables. A new variable called the interaction is created when independent factors in the moderation analysis interact with the moderation variable. Analysis switches to moderation analysis since the mediation analysis is unable to provide an interaction term. If the interaction term is significant, then moderation comes into play. The study aims to investigate whether supply chain information sharing influences the relationship between resilience and flexibility in the supply chain as well as the relationship between performance and flexibility in the supply chain. The moderation analysis responds by stating that moderation is effective and that the interaction term is substantial.

4.7.6 Result Summary of Hypothesis

4.7.6.1 Direct Relation Hypothesis Result

Table 4.22 Direct Relation Hypothesis Result

Hypothesis Number	Hypothesis Relation	Beta Value	T-Statistics	P-Value	Hypothesis Decision
H1a	**SCV → SCP**	0.404	10.031	0.000	Supported
H1b	**SCF → SCP**	0.484	12.016	0.000	Supported
H2a	**SCV → SCRE**	0.419	8.705	0.000	Supported
H2b	**SCF → SCRE**	0.302	6.288	0.000	Supported
H3a	**SCV → SCR**	-0.143	-2.689	0.008	Supported
H3b	**SCF → SCR**	-0.410	-7.725	0.000	Supported

4.7.6.2 Mediation Relation Hypothesis Result

Table 4.23 Mediation Relation Hypothesis Result

	Mediation Relation	Indirect effect	SE	LLCI	ULLCI	Sobel test	P-value	Hypothesis Decision
H5	**SCV → SCRE→SCP**	0.1918	0.039	0.115	0.2678	5.3249	0.000	Supported
H6	**SCF → SCRE→SCP**	0.1467	0.028	0.098	0.2072	5.4648	0.000	Supported
H7	**SCV → SCR→SCRE**	0.0519	0.019	0.0176	0.0911	2.4324	0.015	Supported
H8	**SCF → SCR→SCRE**	0.0510	0.021	0.0059	0.1000	2.1404	0.0323	Supported

4.7.6.3 Moderation Relation Hypothesis Result

Table 4.24 Moderation Relation Hypothesis Result

	Moderation Relation	Int_1 Coeff	SE	LLCI	ULLCI	P-value	Hypothesis Decision
H9	**SCF→ SCIS→SCP**	0.0896	0.0330	0.0247	0.1544	0.0069	Supported

H10	**SCF →SCIS→SCRE**	0.1016	0.0323	0.038	0.1651	0.0018	Supported

4.7.7 Comparison of Sindh and Punjab Provision

H11: Punjab and Sindh biscuit industry comparison of supply chain visibility, flexibility, risk, resilience, information sharing, and performance.

Punjab and Sindh regions have the same mean and standard deviation values. The SCF similar in Sindh and Punjab. The mean value is slightly higher in Punjab comparing Sindh indicating marginally better SCRE the standard deviation is also higher in Punjab, suggesting more variability in resilience levels. Punjab has a higher mean, indicating better SCV than Sindh. The standard deviation is slightly lower in Punjab, indicating less variability in supply chain visibility. Sindh has a higher mean, suggesting marginally better SCIS, and Punjab shows more variability with a higher standard deviation. Punjab has a higher mean, indicating better SCP. Both regions show the same levels of variability in practices. Both provinces have very similar means and standard deviations, suggesting similar levels of SCR.

The practices of supply chain flexibility, risk resilience, visibility, information sharing, and performance are not significantly different between the two regions. The t-test of SCV and SCP significant alpha value of 0.10 but not significant at an alpha value of 0.05 which is recommended for the significance. The collected data is from the biscuit industry using the same standard rules and regulations “F&D Act 2012, FSSC 2200” (Maietta et al., 2017; Purwanto et al., 2023) and affects the same form of the external environment due to the same business nature. The participant's response is in the same direction therefore this research has not found a significant difference in the Sindh and Punjab biscuit industry practice.

Table 4.25 Comparison of Sindh and Punjab

	Mean Province		Std. Deviation Province		T-test of equality of mean	
	Punjab (n=165	Sindh (n=165)	Punjab (n=165)	Sindh (n=165)	T	Sig
SCF	2.886	2.805	1.243	1.235	0.59	0.556
SCRE	2.695	2.786	1.036	1.197	-0.738	0.461
SCV	2.849	3.033	1.133	1.045	-1.65	0.090
Sscis	2.683	2.586	1.258	1.327	0.681	0.496
SCP	2.842	3.038	1.285	1.301	-1.56	0.098
SCR	2.862	2.838	1.300	1.327	0.168	0.867

Chapter-V

Research Findings and Recommendations

5.1 Discussion on Research Finding

The biscuit industry is one of the major industries of Pakistan unfortunately, this industry faces issues in the supply chain due to vulnerabilities and risks which are found in this study to fill gaps in the literature, such as demand and supply vulnerability and risk as explained by (Alfaqiri et al., 2019) poor quality of finished products not meeting international standards, skilled labor and management staff shortages, capacity issues due to variation in demand, raw material shortages (palm olein oil, milk powder, cocoa powder), poor information flow throughout the entire supply chain poor connectivity with partners (Iqbal et al., 2020). Currency depreciation is a major issue in Pakistan and directly affects the performance of all industries including the biscuit industry, rise in dollar prices, and elevated inflation. The operational vulnerability and risk found in this study are explained by (Akrofi & Antwi, 2020) unexpected changes in customer requests for unique and customized products such as chocolate-coated biscuits, cream filling, and different colors in biscuits and packaging that cause frequent changeover of process machines and molds. Supply shortages by the supplier due to strikes and long public holidays, low availability of temperature-controlled containers, and in-plant storage challenges exist especially before and after Eid and long public holidays. temperature-controlled containers are a major need of the biscuit industry for transporting and storing perishable natural raw materials and finished goods such as liquid eggs, fresh cream, pure butter, chocolate biscuits, etc. The temperature-sensitive material buffer stock before holidays increases the inventory and additional costs such as electricity and maintenance staff costs, and also increases the risk of material spoilage in the absence of top management supervision, low stock causes the production to shut down after long

holidays if the material is not arrived as per plan because the shortages of container exist in the market, such vulnerability creates disbalance and uncertainty in the supply chain and break the connectivity in the supply chain.

The above highlighted the inability of the biscuits industry's supply chain, resulting in an increase in supply chain risk and weakening the ability of the firm to sustain and bonus back during uncertain events. The vulnerability and risk also cause poor performance of the overall supply chain therefore our research applies the vulnerability mitigation strategies such as SCV and SCF and empirically proves that SCV and SCF mitigate SCR and enhance SCRE and SCP of the biscuit industry (Ali et al., 2023; de Assis Santos & Marques, 2022).

vulnerability mitigation strategies SCF, and SCV were used in this study to overcome the vulnerability in the supply chain of the biscuit industry (Kurniawan et al., 2017). The supply chain information-sharing moderating role, supply chain risk, and resilience mediation role are also found in this study which enhance the overall performance of the SC of the biscuit industry. According to contingency theory, businesses shouldn't be restricted to using a single strategy and instead should adapt their approach when the business evolves (Neilsen, 1974; Werlin, 1989). Tested 11 hypotheses in this research and all were supported. This complete study is based on 6 constructs and 12 hypotheses developed from the literature review.

Hypothesis (H1a): SCV has a beneficial effect on SCP. The H1a findings agree with the earlier research (Brusset, 2016) which shows that by satisfying the customer's diverse demand, delivering goods at the appropriate time and location, improving service quality, building a solid reputation for quality, improving fill rate accuracy, and cutting costs across the board, SCV has a positive and significant impact on the SCP (Strijkers et

al., 2011) the study also supports our findings that SCV provides transparent complete timely information about the supply and demand in the market, the inventory level of upstream and downstream partners, production, logistics activities, and each activity of the supply chain which is key and useful to making an action plan rational decision controlling cost and meeting customer expectations. The findings of this investigation are corroborated by the work of (Agrawal et al., 2024; Kalaiarasan et al., 2023) Sensor-based technologies such as RFID with different ranges, Tracker, web-chem, dash-chem, drive camp Google Map, and Google Earth enhance the visibility of material and logistics and transportation in real-time which helps to get better control and helps to get timely rational decisions to avoid disruption and improve SCP. The initial investment is significantly high on sensory devices but the benefits outweigh the investment in the medium to long run.

The Hypothesis (H1b) is SCF positively affects the SCP the results of this study are in line with the findings of (Benzidia & Makaoui, 2020; Rojo Gallego Burin et al., 2020) this suggests that SCF assists businesses in creating a range of biscuit goods with various attributes to satisfy high- and low-consumer demands, satisfy various needs for inbound and outbound logistics Maintain inventory levels, and quickly add and remove suppliers. The biscuit industry must adopt a SCF strategy as it is directly and positively related to the performance of the biscuit industry. SCF assists the company in partnering with outside organizations that manage labor, materials for temperature control, and inbound and outbound logistics. The results of this study align with the findings (Swafford et al., 2008) He discovered that SCF offers product diversity while meeting customer requests, ensures manufacturing capacity, and shortens waiting times in the supply chain.

The Hypothesis (H2a) is that SCV positively impacts SCRE. This research is consistent with the work of (Anwar, 2022; Tigga et al., 2021) who emphasized that SCV means monitoring and tracking each process and action in a supply chain in real time. During disturbances, supply chain visibility supports better decision-making by providing timely and accurate information. The biscuit industry can change suppliers and shipments reroute, using real data. SCV assesses the effects of various interruption scenarios and guides efficient backup plans using scenario analysis. When there is clear visibility the biscuit industry managers can create diversification plans to increase resilience, such as procuring from multiple suppliers, keeping buffer stock, and pre-arrangements of resources to cope with disruption. This finding agrees with the outcome of the research results of (Ekanayake et al., 2022) which indicates that SCV increases the SCRE.

The Hypothesis (H2b) is that SCF positively impacts SCRE. The results of this study suggest that by fostering flexibility across the whole supply chain, the biscuit industry can become more resilient to unforeseen events, maintain company continuity, and recover quickly from setbacks. The outcomes of H2b align with the findings of

(Brusset & Teller, 2017; Mandal et al., 2016) It clarified that resilience is the ability of the business to adjust to changing circumstances. Flexible and adaptable supply chain plans for every function can increase resilience. SCF increases productivity and competitiveness while reducing adverse effects in the biscuit industry's supply chain. Flexibility in workforce management allows companies to reallocate labor resources quickly in response to production needs, ensuring that human resources are optimized during disruptions. Scaling operations up or down in response to demand makes it easier for businesses to manage resources and maintain responsiveness and efficiency (Rajesh, 2021).

The hypothesis (H3a) supply chain visibility reduces supply chain risk. This study empirically proves that the biscuit industry anticipates and manages possible risks by having a clear and complete supply chain picture. In this research, H3a is supported by work of early research (Kaufmann et al., 2012; Khan et al., 2008) said that the ability to see the supply chain businesses extend their supplier and customer base, target new segments and opportunities, and lower risk by identifying dependency on particular suppliers and geographic areas. Supply chain visibility reduces delivery failure, production failure, transportation, process failure, forecast error, and logistics failure with ease by offering precise data in real time and a snapshot of the whole supply chain (Khan et al., 2008). The fact that supply chain risk is effectively controlled before occurrence and that observable, transparent, and real-time information is shared between SC partners has greatly decreased the risk associated with SC activities.

The hypothesis (H3b) SCF mitigates SCR. The finding is consistent with the work of (Fawcett et al., 2000; Hatani et al., 2013) explained that SCF also reduces the SCR related to sudden shoot-up and shoot-down demand high and low volume demand, and sensitive product logistics management. To avoid production shutdown flexibility allows different delivery options by air, sea, and rail transportation, and provides different production, procurement, and storage options. The biscuit industry can use adaptable order fulfillment techniques drop shipping and shipping from stores to satisfy customers. This research finding matches the outcome of the work (Hatani et al., 2013) as proven in research results SCF is a key strategy for managing and mitigating risk. Flexible sourcing strategies like dual sourcing or multiple sourcing regional sourcing control risks associated with geopolitical unrest, natural disasters, and other regional disruptions.

The hypothesis (H4) explains the overall SCV, SCF, SCR, SCRE, and SCIS impact on supply chain performance. The overall results are found significant.

The hypothesis (H5) and hypothesis (H6) are related to mediation analysis. SCRE mediates the relationship between SCV and SCP and between SCF and SCP. Since SCRE partially mediates the relationship, the Sobel test also demonstrated that the effect of mediation is statistically significant, supporting Hypotheses H5 and H6. There is a favorable correlation between SCF and SCV as well as SCRE. The results of the H5 investigation are in line with those of (Huang et al., 2023; Kalaiarasan et al., 2023) show that SCV positively impacts SCRE and consequently, SCRE enhances the SCP of the biscuit industry. The SCV provides accurate information about market demand and supply, collaborative planning, production, inbound and outbound transportation, procurement, warehousing, and inventory levels. The real-time data enable the organization to develop resilience by identifying the potential risk, changing production plans, sourcing, and distribution plans, and allocating raw materials, labor, and transportation where most needed to enhance the performance. The H6 findings align with the investigation of (Chunsheng et al., 2020) indicated supply chain flexibility allows the biscuit firms to keep flexible resources, and multiple sourcing builds redundancy of resources to deal with any situation, the flexibility makes the SC resilient and the SCRE enhances the SCP of the firms.

The mediation relationship is connected to hypotheses (H7) and (H8). The link between SCF and SCRE as well as between SCV and SCRE is mediated by SCR. H7 and H8 are about the mediation role of the SCR the hypotheses are accepted as both hypotheses' results are statistically significant and it is empirically proven and backed by the previous study (Um & Han, 2021) It suggests that SCR mediates the link between SCF and SCRE and between SCV and SCRE to some extent. SCRE and SCR have an

inverse relationship: as SCR rises, SCRE falls. Because of the lower SCR and higher SCRE, statistical analysis confirmed that the SCF and SCV lower the SCR. The empirical analysis shows that SCV and SCF reduce SCR and reduce risk, which raises the biscuit industry's SCRE.

Hypothesis (H9) Between SCF and the biscuit industry's SCRE, SCIS acts as a moderator. This study's findings align with those of the investigation into (Huo et al., 2021; Rajesh, 2021) who made the case that SCIS combines labor and makes resources and processes flexible to meet supply chain demands. While SCIS alone does not significantly alter the SCRE, the combined effect of SCF and SCIS increases the resilience of the biscuit business. More precisely, higher levels of information exchange within the supply chain enhance the positive benefits of SCF on SCRE. The advance shipment notice by the supplier helps the customer organization plan production accordingly. The information sharing by the customer to the supplier of daily production activity reports, and frozen and unfrozen production plans helps the supplier to maintain the inventory level (Huo et al., 2021). The present study underscores the criticality of implementing adaptable supply chain protocols and fostering information exchange among stakeholders to optimize resilience. This study provides empirical evidence for the increasing effect of SCF on SCRE with increasing information-sharing levels. The hypothesis (H9) is accepted since the impact of the interaction between SCIS and SCF is considerable.

The hypothesis (H10) The link between the biscuit industry's SCF and SCP is moderated by SCIS. The main, statistically significant effect of SCF on SCP is positive; the effect of SCF on SCP is dependent on the level of SCIS; and there is a positive interaction term between SCF and SCIS. The results of this analysis concur with those of (Colicchia et al., 2019) demonstrating that the benefits of information

sharing among supply chain participants exceed the costs involved and that in the present competitive SCIS serves as a tool for improving SCP. The findings supported by the research work of (Jimenez-Jimenez et al., 2019) show that SCIS interacts with SCF and enhances the performance of the biscuit industry. Increased flexibility comes at a cost, but if the activities are managed well, there are long-term and short-term benefits. Based on the analysis, SCIS is involved in moderating the relationship between SCF and SCP. More precisely, higher degrees of supply chain information sharing magnify the positive impacts of SCF on SCP. This study highlights how important it is to encourage SCIS among partners and have flexible supply chain protocols to maximize performance.

The comparison of supply chain practices in Sindh and Punjab provinces is the subject of the hypothesis (H11), the findings of which are inconsequential according to the t-test; SCV and SCP are significant at an alpha score of 0.10, but not at the suggested alpha score of 0. 05. The collected data is from the biscuit industry which uses the same standard rules and regulations F&D Act 2012, FSSC 2200 (Maietta et al., 2017; Purwanto et al., 2023) and affects the same from external environment due to the same business nature.

5.2 Practical Implication

This study highlights the significance of SCV, which can be helpful for supply chain managers in the biscuit business. The management of the biscuit industry can get transparent, real-time, correct, and on-time information on logistics, inventory, demand, and supply so that issues like bullwhip, stock-out, delays supply risk are avoided. The visibility promptly raises flags for the supply chain risk to be resolved on priority. The biscuit industry manager looks beyond the boundaries of their firm supply chain, the manager must share daily information on opening stock of key raw materials of biscuits

such as sugar, fat, milk powder, palm oil, and packaging material with our suppliers so they ensure the on-time delivery of materials This study aids managers in raising SCF and SCV. The supply chain managers collect and transfer advance shipment notice of deliveries to the relevant departments so the logistics, production, and quality teams can align their activities accordingly and adjust their activities plans according to sharing information. The information is not shared internally about delivery arrivals the risk of short and excess inventory exists which ultimately impacts the performance of firms. The demand, forecast, sales, and operational plan information must be shared with suppliers so the supplier can arrange deliveries. The research suggests that enhanced visibility helps to develop collaborations in different sections and product categories and develop vendor management inventory which will be very successful in the presence of visibility and flexibility. The supply chain manager should focus on enhancing visibility in the supply chain by applying strong communication network integration and sensory devices such as RFID and tracking devices which provide control over inventory level supply and demand management and operational activities.

SCF helps the management to get orders in high and low volume, the flexibility gives confidence to the supply chain managers to negotiate better prices quality, and mode of logistics which benefits the biscuit industry supply chain. In the absence of flexibility, the bargaining power of the manager is weakened. When SCF and SCIS are integrated, the supply chain gains resilience. The information sharing pushes the manager to add capacity if market demand is upward or move to another market if the current market is non-profitable. The flexibility is always discussed with the cost, the manager should do a cost and benefit analysis and engage supply chain partners to combine investment on equipment which creates flexibility in the supply chain to gain mutual benefit. The biscuit industry in Pakistan has two types of ordering systems

make-to-stock and make-to-order and both systems work smoothly in the presence of visibility and flexibility so the managers must apply flexibility and visibility strategies with another business strategy and invest in these two strategies out of monthly profit to gain long term sustainable growth, customer satisfaction, and profit.

Building SCR is crucial given the erratic and unpredictable business environment in Pakistan. The greatest approach to increase SCRE is to determine a close partnership with upstream-downstream and collaborative partners competitors and government policymakers as the close relationship enhances the connectivity and information flow. The sharing of correct and real-time information builds trust among partners, and they can be prepared, alert, and fight in unity with uncertain and distributive events in the supply chain, the biscuit firms utilize the resources to keep the supply chain activities as planned during disruptive events.

The proposed model in this research practically and perfectly fits the current business scenario in Pakistan as the finance bill 2023-2024 brings a lot of cost increase for the industry in the form of taxes, and energy costs. The Pakistan government imposed a federal excise duty of Rs 15 per kg on sugar a key raw material of biscuits. The Rs 15 per kg directly hit the biscuit industry cost of products. The SCV of sugar helps the SC managers to assess how much total stock is available in the country at sugar mills, distributors, and retailers and how much the consumption of the season in the country before a new crop if the sugar stock in the country is larger than the consumption of the country then the manager can proceed for bulk buying for 5 to 6 months to avoid the effect of the 15 per kg cost of tax, there is involved the carrying and storage cost that will be a minimal 1% to 2% per kg. if the decision of sugar buying is taken then flexibility in the supply chain is ensured in the execution. The budget was announced in mid-June and is effective from the 1st of July the organization has only

15 days to lift 6 times more stock of monthly consumption from the suppliers' warehouse so the flexibility in the storage capacity, labor, logistics, ensures the sugar delivery, and in the absence of the flexibility cause a 15% per kg loss. The flexibility and visibility help the supply chain managers to keep the operation as planned, and for such a supply chain risk of price, delivery, and storage the organization resists and keeps the business resilient. SCIS is important in the sugar case as it creates a channel for the coordination among the outbound logistics team of suppliers and transporters and the warehousing team of customers, management and concerned stakeholders have access to information about the supply chain of the sugar deal. This is the example of only a single material this study suggests that the supply chain manager uses this model in all materials and products to make the supply chain of the biscuit industry profitable.

5.3 Theoretical Implication

First off, this research backs up the idea that there is no one ideal way to operate an organization; instead, strategies should adapt to changes in both the internal and external environments (Lawrence & Lorsch, 1967). This study is a contingency-based view and deepens the understanding of the contingency view contingency theory also known as the situational or adaptable theory (Hamann, 2017; Stonebraker & Afifi, 2004). As per the systematic view, there is a universal principle for managing activity and operation in the supply chain, contingency theory highlights that each organization is different in size, production volume, capacities, etc. Contingency theory helps to understand how well firms can match their performance and operational and strategic measures to the demands and supply and shifting external environments.

Most of the raw materials and machinery of the biscuit industry are imported from the European region, due to the ongoing Red Sea and geopolitical conflicts that are causing unavoidable supply chain disruptions in the European region, there is a war

between Ukraine and Russia the major ports are experiencing severe congestion and a shortage of vessels and containers that has led to a substantial risk of delays in shipping schedules. Keeping this situation in mind the management which is currently using just in time system and keeps a lean inventory changed its strategy with this changing situation as a contingency theory recommends so the company should maintain high safety and buffer stock and shift sourcing from the European region to the Asian region to avoid shortages of materials, production shut down and satisfy customer demand on time. The contingency theory emphasizes the fit-and-match approach. The discussed strategies in this research SCV and SCF are the best fit in the different situations. If the demand increases the flexibility allows for an increase in production. If the worst situation in any region exists supply chain visibility provides timely information to shift to alternate. Centralized and decentralized warehousing options depend on the changing situation if the demand is stable and certain then the firm adopts the centralization option if the product demand is uncertain customers want a quick response so the company should adopt decentralization. The tactics included in this research support other supply chain strategies in many scenarios to improve SCP and SCRE, including vendor management inventory, supplier development, supplier integration and collaboration, inventory and transportation management, and supplier development.

Secondly, the information processing theory benefits greatly from this research. Information processing need, information processing ability, and information fix—the relationship between processing ability and information needs that reduce risk and improve the SCP—are its three main pillars. The lovers' relationship grows as a result of information exchange. This study examined an association between SCF and SCIS that emerged in the biscuit industry literature. The empirical analysis of this study indicates that the interaction between flexibility and information sharing positively

impacts the resilience and performance of the biscuit industry. Since information processing theory places a strong emphasis on the need for and processing power of information, the moderating effect of information sharing deepens understanding of the theory. This study reveals when supply chain information sharing interacts with supply chain flexibility it creates a synergy effect on the resilience and the performance of the supply chain in the biscuit industry. The information sharing about the process and strategy of the firms, current demand future and fluctuation in demand, good and bed inventory, in-hand and in-transit inventory, demand variation, and competitive move (Ojha et al., 2019). The information-sharing role is vital for flexible planning as when the organization is fully informed about customers it can meet sudden shoot demand with a wide range of products, source material in small and large batched from multiple sources as per customer demand, and fulfill demand using various modes of transportation air, sea, rail, road. The accurate information of demand helps the supplier to manage a full truckload of bulk items for a single customer. Suppliers can save cost by making 1 single full truckload of different customers who belong to the same route, and market with route planning and truck scheduling. This work adds to the body of research showing that combining SCIS and SCF proactively and significantly raises the SCP.

The relationship between performance, resilience, risk, and vulnerability reduction techniques that have been demonstrated both conceptually and empirically constitutes the third contribution made by this study. To the best of my knowledge, no other researcher had examined the effects of vulnerability mitigation strategies on SCP and SCRE using SCR and SCRE as mediators and SCIS as a moderator in a single model before this study. Therefore, it represents a significant contribution to the literature on vulnerability mitigation strategies. Supply chain information of demand

forecast, sales of customers, and promotion plans help to enhance supply visibility by providing delivery information lead time, and delivery dates. The supply chain's total performance is impacted by visibility into supply and demand, which results in lower transportation costs, less inventory investment, and higher levels of quality and services (Mubarik et al., 2021). Utilized as vulnerability mitigation techniques, SCF and SCV statistically demonstrate their influence on the SCRE, supply SCPR, and SCR of the biscuit industry both techniques help identify potential SCR during disruptions and in formulating plans to recover from them without impairing supply chain performance (Saqib & Zhang, 2021).

5.3 Research Limitation and Future Research Direction

We recommend that further research be done by altering the sample size and adding more provinces to the current study model to find the statistical difference in the working of the different provinces. This study used a 330-sample size for research analysis and made a comparison using an independent t-test, but the results were in the same direction and did not find any statistically significant difference between the participants of Sindh and Punjab.

This study achieved the purpose of the research as the all-established hypothesis supported but we conducted the research in the biscuit industry of Sindh and Punjab, therefore, this study has limited generalizability so we recommended that further research should be done on the other sectors such as textile, milk and fat industry and other cities of Pakistan and other country like Indian, Bangladesh for the better generalizability. We have done a cross-sectional study we recommend the longitudinal study of the same research model as we did non-response bias and there was no such issue found but the data collection in the different periods in the long run better avoid the non-response bias issue. We have interpreted the moderator in the current study model as information

exchange; however, we suggest that moderators for big data analytics and the Internet of Things be included in future research. We used two vulnerability techniques in this analysis, and we suggest adding more in future research, such as supplier integration and Islamic financing.

5.4 Conclusion

According to this study's theoretical and empirical findings, vulnerability mitigation strategies like SCF and SCV have a positive effect on the SCRE and SCP of the biscuit business while having a negative effect on SCR. When creating organizational long-term and short-term goals, businesses in the biscuit industry that are dealing with SCR, SCRE, and SCP issues must also take into account the moderation role of SCIS and the mediation role of SCR and SCRE. Additionally, they must incorporate vulnerability mitigation strategies SCV and SCF.

The biscuit industry's SCP is heightened as a result of the SCV and SCF's influence on the industry's SCRE. The empirical research of this study validates the role that SCRE performs as a mediator between the biscuit industry's SCP, SCF, and SCV. The firms' SCRE and SCP rise when the SCR is mitigated, whereas the SCR is decreased by SCV and SCF. The biscuit industry's SCRE and SCP are improved by the interaction of SCIS and SCF, as well as by the existence of SCIS. The involvement of SCIS in moderation was validated by this investigation. At a higher level of SCIS, the effect of SCF is greater in SCRE and SCP; the impact of lower information sharing is lower and the impact of higher information sharing is larger.

There is little difference in the means when comparing the supply chain procedures used by the biscuit industries in Sindh and Punjab. The performance and visibility of the supply chain are significant at an alpha score of 0.10, but not at the

suggested significance alpha score of 0.05. The outcome is the same because both provinces adhere to the same set of guidelines and policies and experience identical effects from shifts in the outside world, including pandemics, war, shortages of raw materials, prohibitions on the export of biscuits, and imports of essential raw materials.

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Appendices

Appendix-1

The construct and items are used for the research data collection and analysis

Construct	Items	Reference
Supply Chain visibility (SCV)	You get market supply information from various sources in a useful format.	(Mubarik et al., 2021; Qader et al., 2022; Srivastava et al., 2015)
	You get market demand information from various sources in a useful format.	
	The supplier shares inventory-level information timely, accurate, complete, and useful format to you.	
	The supplier provides advance shipment notice timely, accurate, complete, and useful format.	
	The supplier provides lead time and delivery dates timely, accurate, complete, and useful format.	
	Customers share actual sales information timely, accurate, complete, and useful format.	
	Customers share demand forecast information timely, accurate, complete, and useful format.	
	Logistics partners provide useful finished goods information in the distribution network.	
Supply Chain Flexibility (SCFL)	Can you modify the quantity of a supplier's order at any time?	(Ali et al., 2023; Braunscheidel & Suresh, 2009)
	Can your organization shift to an alternate supplier quickly when needed?	
	Do you have numerous transportation options for delivering goods to customers' organizations?	
	Can your organization easily change warehouse space and storage capacity?	
	Can Your organization operate in high and low volume efficiently to meet different customers' different volume demands?	
	Can your organization adjust customer orders on customer requests efficiently?	

	Can your organization easily adjust the manufacturing process?	
Supply Chain Resilience (SCRE)	Are you and your main supply chain partners can adapt to the changes brought on by the disturbance to the supply chain?	(Alghababsheh, 2023; El Baz & Ruel, 2021)
	After disruption, your organization immediately recognizes resources to respond to disruption.	
	Can you and your main supply chain partner recover to normal operations speedily after the supply chain disruption?	
	Your company before disruption monitors the supply chain process in advance to prevent from disruption.	
	Does your organization provide equal access to forecast sale data and plans to all your suppliers and customers?	
	Does your organization develop a contingency plan to increase supply chain stability?	
Supply chain Risk (SCR)	Does your organization have a low probability of key supplier failure to supply key raw materials?	(Ali et al., 2023; Jüttner & Ziegenbein, 2009)
	Do you have multiple sources of suppliers for key materials?	
	Is your supply chain well prepared for natural disasters (earthquakes, heavy rain)?	
	Your manufacturing operations are interrupted due to your shipment's delays.	
	Is your supply chain well prepared for major disruption (war terrorism, pandemic)?	
	Does your organization have a low probability of logistics and transportation failure?	
Supply chain information sharing (SCIS)	Do you regularly share information with all supply chain partners about sales trends?	(Ojha et al., 2019; Wan et al., 2020; Y. Yang et al., 2022)
	Do you share information about events and changes with partners?	
	Do you provide excess to your database and ERP to your supply chain partners?	
	your organization shares confidential information with your supply chain partner.	

	Do you share with partner day-to-day risk-related information regarding their pending orders?	
	Are you willing to share information on demands with your suppliers about inventory levels and production plans?	
	You and your supply chain partner have an excess of information on logistics-related functions.	
	Do you share operational and strategic information with partners?	
Supply chain Performance	Your organization delivers the right quantity and quality at the right time	(Ali et al., 2023; Humphreys et al., 2004)
	Your organization has a long-term relationship with your partner	
	Your organization meets customer-diversified demand	
	Your organization has a high market share	

Appendix-2

Questionnaire

Below is a complete questionnaire used for the data collection and analysis

Questionnaire Form

Vulnerability Mitigation Strategies supply chain visibility and flexibility Impact on Supply Chain Risk and Resilience and Performance of Biscuit Industry the Role of Information Sharing (Empirical Comparison Sindh and Punjab of Pakistan)

I am a student of Master of Supply Chain Management. This Questionnaire is part of my Academic Research thesis and the purpose of this research is to find out how supply chain vulnerability strategies visibility and flexibility mitigate supply chain risk and enhance the resilience and performance of the biscuit industry and what the mediation role of supply chain resilience and supply chain risk and moderation role of information sharing to in supply chain modal

Confidentiality is a priority for me being a researcher. Your response will be anonymous and will never be linked to you personally. The provided information shall be kept fully confidential and will be used just to fulfill my research work. Your cooperation will be highly appreciated

Gender	☐ Male	☐ Female
Province	☐ Sind	☐ Punjab
Age Group (in years)	☐ 20-30 ☐ 41-50	☐ 31-40 ☐ Above 50

Designation	☐ Manager	☐ General manager
	☐ Director	☐ CEO
Degree	☐ Bachelor's	☐ Master's
	☐ Professional certificate	
Work Experience	☐ 6-10 years	☐ 11-15 years
	. ☐ above 16 years	
Annual sale (Million Rs)	☐ 300 to 400	☐ 401-500
	☐ 501-600	☐ Above 600
No of employees	☐0-100	☐ 101-200
	☐ 201-300	☐ Above 400

Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	**2**	**3**	**4**	**5**

Sr. #	**Statement/ items**	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	You get market supply information from various sources in a useful format	①	②	③	④	⑤

2	You get market Demand information from various sources in a useful format.	①	②	③	④	⑤
3	The Supplier shares inventory level information timely, accurate, complete, and useful format to you.	①	②	③	④	⑤
4	The supplier provides advance shipment notice timely, accurate, complete, and useful format	①	②	③	④	⑤
5	The supplier provides lead time and delivery dates timely, accurate, complete, and useful format	①	②	③	④	⑤
6	Customers share actual sales information timely, accurate, complete, and useful format	①	②	③	④	⑤

7	Customers share demand forecast information timely, accurate, complete, and useful format	①	②	③	④	⑤
8	Logistics Partners provides useful finished goods information in the distribution network	①	②	③	④	⑤
9	Can you modify the quantity of a supplier's order at any time?	①	②	③	④	⑤
10	Can your organization shift to an alternate supplier quickly when needed	①	②	③	④	⑤
11	Do you have numerous transportation options for delivering goods to customers' organizations?	①	②	③	④	⑤
12	Can your organization easily change warehouse	①	②	③	④	⑤

	space and storage capacity?					
13	Can Your organization operate in high and low volume efficiently to meet different customers' different volume demands?	①	②	③	④	⑤
14	Can your organization adjust customer orders on customer requests efficiently?	①	②	③	④	⑤
15	Can your organization easily adjust the manufacturing process?	①	②	③	④	⑤
16	Are you and your main supply chain partners can adapt to the changes brought on by the disturbance to the supply chain	①	②	③	④	⑤
17	After disruption, your organization immediately recognizes	①	②	③	④	⑤

	resources to respond to disruption.					
18	Can you and your main supply chain partner recover to normal operations speedily after the supply chain disruption?	①	②	③	④	⑤
19	Your Company before disruption monitors the supply chain process in advance to prevent form disruption	①	②	③	④	⑤
20	Does your organization provide equal access to forecast sale data and plans to all your suppliers and customers?	①	②	③	④	⑤
21	Does your organization develop a contingency plan to increase supply chain stability?	①	②	③	④	⑤

22	Does your organization have a low probability of key supplier failure to supply key raw materials?	①	②	③	④	⑤
23	Do you have multiple sources of suppliers for key materials?	①	②	③	④	⑤
24	Is your supply chain well prepared for natural disasters (earthquakes, heavy rain)	①	②	③	④	⑤
25	Your manufacturing operations are interrupted due to your shipment's delays	①	②	③	④	⑤
26	Is your supply chain well prepared for major disruption (war terrorism, pandemic)	①	②	③	④	⑤
27	Does your organization have a low probability of	①	②	③	④	

	logistics and transportation failure?					
28	Do you regularly share information with all supply chain partners about sales trends?	①	②	③	④	⑤
29	Do you Share information about events and changes with partners?	①	②	③	④	⑤
30	Do you provide excess to your database and ERP to your supply chain partners?	①	②	③	④	⑤
31	your organization shares confidential information with your supply chain partner	①	②	③	④	⑤
32	Do you share with partner day-to-day risk-related information regarding their pending orders?	①	②	③	④	⑤

33	Are you willing to share information on demands with your suppliers about inventory levels and production plans?	①	②	③	④	⑤
34	You and your supply chain partner have an excess of information on logistics-related functions.	①	②	③	④	⑤
35	Do you share operational and strategic information with partners?	①	②	③	④	⑤
36	Your organization delivers the right quantity and quality at the right time	①	②	③	④	⑤
37	Your organization has a long-term relationship with your partner	①	②	③	④	⑤

38	Your organization meets customer-diversified demand	①	②	③	④	⑤
39	Your organization has a high market share	①	②	③	④	⑤