

العنوان :

**دور إدارة العمليات في تحسين مرونة سلسلة التوريد في الشركة السعودية
للصناعات الأساسية (سابك)**

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Abstract

This study examines the impact of operations management—encompassing quality management, process optimization, and risk management—on supply chain resilience at Saudi Basic Industries Corporation (SABIC). Given the increasing complexity and volatility of global supply chains, organizations must adopt strategic approaches to mitigate risks, enhance efficiency, and ensure operational stability. A quantitative research approach was employed, utilizing survey data collected from SABIC’s supply chain professionals. Statistical analysis, including regression modeling, was conducted to assess the relationship between operations management practices and supply chain resilience. The findings reveal that quality management significantly contributes to supply chain stability by ensuring product consistency and minimizing defects. However, supplier quality control remains an area for improvement. Process optimization strategies, such as automation, workflow improvements, and digital transformation, enhance operational efficiency but require further integration for maximum impact. Risk management, particularly predictive analytics and contingency planning, plays a vital role in mitigating supply chain disruptions, yet variability in implementation across departments suggests a need for standardized risk assessment frameworks. The regression analysis confirms that operations management has a statistically significant effect on supply chain resilience, though the moderate R^2 value indicates that additional external factors—such as supplier collaboration, regulatory changes, and market dynamics—also influence resilience. Based on these findings, the study recommends enhanced supplier quality assurance, deeper digital transformation, improved risk management frameworks, and a balance between operational efficiency and flexibility. This research contributes to the growing body of knowledge on supply chain resilience by providing insights into how strategic operations management can strengthen supply chain stability. Future studies should explore the role of emerging technologies, sustainability initiatives, and workforce competencies in further enhancing supply chain resilience in a rapidly evolving industrial landscape.

Chapter 1: Introduction

1.1. Introduction

Global business operations require supply chain resilience as their base for sustainability and success in the constantly changing economic and environmental and geopolitical conditions. The COVID-19 pandemic together with trade wars and natural disasters and fast-moving technological changes caused organizations to analyze and transform their supply chain strategies because of the exposed weaknesses in global supply networks. Operations management functions as the essential foundation to strengthen supply chains through their ability to confront and evolve past unexpected incidents (Aljabhan,20223).

Operations management includes the entire process of strategic planning and program organization and directorate supervision applied to product and service production and delivery. Organizations can build resilient and agile supply chains through their implementation of process optimization, risk management, resource allocation and continuous improvement which makes them dependable in operational activities and disruptions. Supply chain discipline stands vital since companies needing ongoing supply throughout crises obtain their competitive advantage and long-term prosperity (Piprani et al.,2022).

Operation management's enhancement of supply chain resilience requires technology integration with strategic partnership building along with adaptable coordination methods and proactive risk evaluations. Organizations that implement data-driven solutions such as AI and predictive analytics and IoT enable better disruption anticipation which allows them to detect system vulnerabilities and take immediate damage-control actions. The commitment to effective

operations management creates supply chain partnerships to share knowledge and resources that businesses need during crisis times (Spieske & Birkel,2021).

A resilient supply chain consists of both post-disruption reaction abilities and preceding intervention capabilities and recovery mechanisms to handle such incidents. Operations management enables the execution of preventive measures which includes expanding supplier networks and keeping essential stock reserves as well as developing backup supply relationships to minimize risks from individual supply failures. Organizations that add flexibility components alongside redundant systems to their supply chains will face minimum disruption to service quality and maintain high customer satisfaction (Lu et al.,2024).

Operations management enables companies to strengthen supply chain resilience through their ongoing focus on continuously enhancing processes as well as systems. Agile practices together with lean management allow businesses to improve their operational efficiency as well as their ability to adapt to market changes. The ongoing operation monitoring and analytical process allows businesses to develop preparedness against both gradual changes and unexpected disruptions (Shaik, 2021). The essential function of operations management for strengthening supply chains helps organizations construct enduring sustainability practices. Organizational practices that match strategic goals with supply chain resilience objectives form an integrated system which enables businesses to tackle disruptions alongside leveraging new growth prospects during periods of crisis.

1.2. Problem Statement

As a globally prominent petrochemical firm Saudi Basic Industries Corporation (SABIC) operates within a complex marketplace which experiences substantial difficulties. Saudi Basic

Industries Corporation (SABIC) faces multiple market challenges whereas global demand shifts and geopolitical instabilities and natural disaster disruptions and fast-moving technological development. SABIC has committed major funds toward supply chain optimization yet unexpectedly disruptive conditions still present a serious risk to the company. SABIC faces substantial risks because its incomplete resilient supply chain leads to delays and increased operational costs and diminished market share. By putting operations management into practice organizations can increase their supply chain's readiness to adapt and maintain its performance while recovering from stressful situations. SABIC confronts barriers to implement progressive operations management approaches which aim to dissipate disruptions and boost its total resilience. The effectiveness of SABIC's supply chain operations remains restricted by factors which include supplier dependence on particular sources and lack of coordination backup systems and technology infrastructure connectivity issues.

1.3. Research Significance

1.3.1 Theoretical Significance:

The analysis of operations management practices for supply chain resilience in Saudi Basic Industries Corporation (SABIC) makes substantial contributions to academic knowledge in supply chain management and operations management fields. Thus, theoretically this investigation provides in-depth knowledge about creating operational strategies systematically for establishing supply chain resilience. The study provides insights about the mutual connections between risk management practices and process optimization methods and technological systems which make supply chains stronger. Through examination of the existing concepts the research provides detailed insights about supply chain agility models as well as resilience approaches and risk reduction methods suitable for industrial operations at the highest level. The study serves to build

new operational frameworks connecting activities with resilience results which could act as research resources for upcoming scholarly work. The paper studies the petrochemical industry to address limited literature about industry-specific analyses thus providing an in-depth view of industrial constraints against operations management practice success.

1.3.2 Practical Significance:

This research offers substantial practical value to operational and coordinating experts working at SABIC and large-scale industrial corporations as well as their related supply chain management teams. This research provides important findings that enable decision-makers to determine successful methods for strengthening supply chain resilience. The implementation of research results enables SABIC to enhance disruption control, enhance crisis response speed and minimize crisis-driven operational impacts that result in cost reductions and better operational reliability. The findings have direct business value beyond SABIC while assisting any organization in the petrochemical sector or manufacturing sector to address their current challenges. Managers should use this research to design flexible supply chains which combine risk management procedures with predictive technologies and supply chain digitization for better disruption anticipation.

The research delivers viable suggestions consisting of adaptable coordination frameworks also including supplier network diversity with ongoing enhancement procedures that preserve operational steadiness in the long run. The research delivers methods organizations need to construct resilient supply chains in accordance with strategic goals that drive enhanced market competitiveness during uncertain global conditions.

1.4. Research Objectives:

1. To assess the current level of application of operations management practices within the Saudi Basic Industries Corporation (SABIC).
2. To examine the role of operations management in enhancing the flexibility and adaptability of SABIC's supply chain.
3. To identify and analyze the challenges SABIC faces in implementing operations management practices within its supply chain.
4. To propose strategies and best practices for improving the integration of operations management in SABIC's supply chain to strengthen its resilience.

1.5. Research Questions:

1. What is the level of application of operations management in the Saudi Basic Industries Corporation (SABIC)?
2. What is the role of operations management in improving the flexibility of the supply chain in the Saudi Basic Industries Corporation (SABIC)?
3. What are the challenges facing the application of operations management to the supply chain in the Saudi Basic Industries Corporation (SABIC)?
4. How can SABIC effectively overcome these challenges to ensure a more resilient and adaptive supply chain?

1.6. Research Hypotheses

It is clear to us from the earlier figure, that the current research attempts to The Role of Operations Management in Improving Supply Chain Resilience at Saudi Basic Industries Corporation (SABIC)

- ✓ Independent Variable : Operations Management with Dimensions (**Quality Management, Process Optimization, Risk Management**)
- ✓ Dependent Variables: Supply Chain Resilience

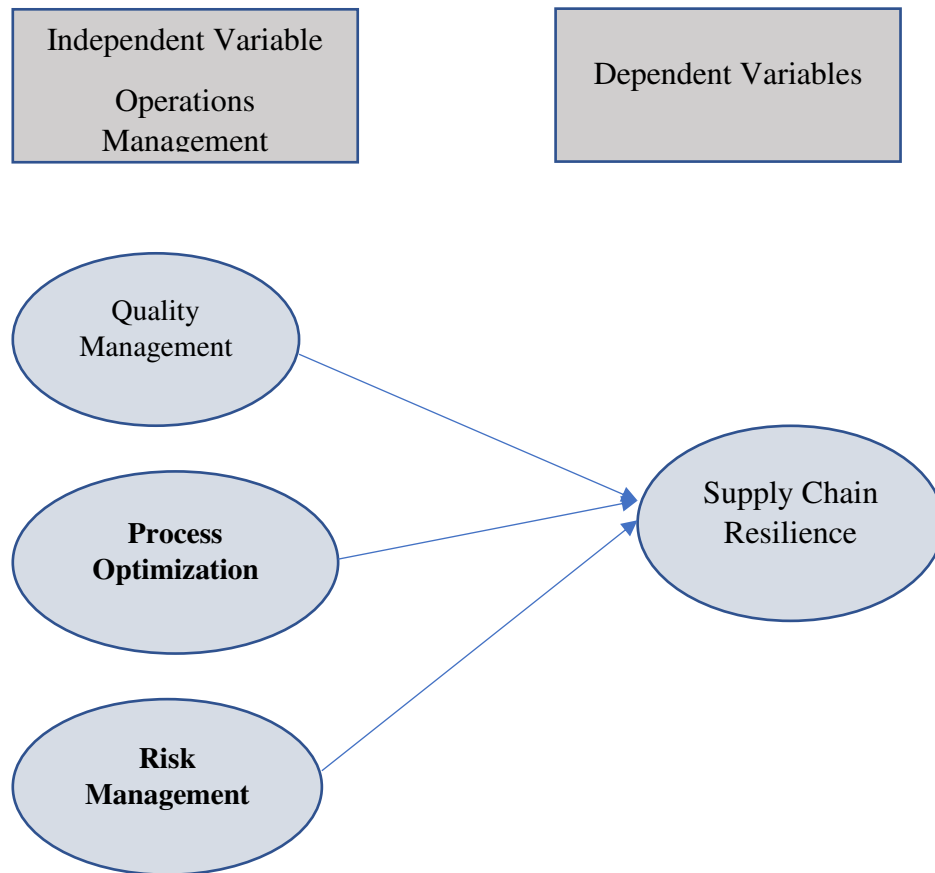


Figure 1 Variables of Study

1. H1: There is a statistically significant effect of quality management within operations management on the supply chain resilience at Saudi Basic Industries Corporation (SABIC).
2. H2: There is a statistically significant effect of process optimization within operations management on the supply chain resilience at Saudi Basic Industries Corporation (SABIC).
3. H3: There is a statistically significant effect of risk management within operations management on the supply chain resilience at Saudi Basic Industries Corporation (SABIC).

1.7. Study limitations

2. **Temporal Limitations:** This study will be conducted over the course of 2024, ensuring that the data collection and analysis capture contemporary practices and challenges within the specified time.
3. **Spatial Limitations:** The research will be limited to the Saudi Basic Industries Corporation (SABIC), focusing specifically on its operations and supply chain management practices within its various facilities and operational units.
4. **Objective Limitations: The study aims to**

Comprehensively evaluate the current level of implementation of operations management practices at SABIC. Systematically investigate the role of these practices in enhancing the flexibility and adaptability of SABIC's supply chain. Identify and thoroughly analyze the challenges SABIC encounters in applying operations management practices within its supply chain framework. Develop and propose targeted strategies and best practices to improve the integration of operations management into SABIC's supply chain, with the ultimate goal of enhancing its flexibility and resilience.
5. **Human Limitations:** The study will involve a targeted sample of employees at SABIC, including managers, operations specialists, supply chain professionals, and other relevant staff members. These individuals will provide critical insights into the practical application and effectiveness of operations management practices within the organization.

Chapter 2 : Literature review

2.1. Introduction

The research section focuses on operations management effects on supply chain resilience through Saudi Basic Industries Corporation (SABIC). Strategic solutions for risk management should combine supplier collaboration and digital transformation and crisis response methods to guarantee continuous operations during uncertain market conditions. The assessment provides a definition of supply chain resilience while it examines how operations management acts during disasters and boosts efficiency levels. Risk management methods receive examination within this section along with technical effects and lean and agile supply chain models for attaining efficiency and flexibility. We observe in this part how supplier relationship management maintains stable supply chains alongside explanations about business continuity planning and crisis management which enable long-term operations. A research foundation based on academic literature as well as industry reports includes practical case studies needed to develop an understanding of proven supply chain resilience methods that shows how SABIC runs operations and detects areas to improve performance quality.

2.2. Literature review

Zherlitsyn and Kravchenko (2016) carried out research to study the interaction of operations and financial management systems that enhance supply chain resilience. Through their research Zherlitsyn and Kravchenko explored how efficient implementation of management strategies would create resilient supply chains with durability to business environment disruptions. The researchers analyzed their subject through existing research and case-based analysis to examine operations and finance interactions that affect supply chain resilience. Through their evaluation of diverse supply chain disruption instances the researchers

documented the organizational approaches for utilizing operations and finance management practices to counter disruption effects. The researchers gathered qualitative data from secondary studies while analyzing established supply chain companies that showed resilience. The analysis validated that successful organizations need operational with financial management synergies to develop supply chain resilience capabilities. Organizations gained motivational results when they merged their operational decision-making with financial planning and demonstrated better capabilities to manage disruptions. Organizations that sustain emergency funds together with financial buffers for emergency preparedness show exceptional value for making rapid operational adjustments when crises occur. Joint financial-operational teamwork produced coordinated response plans through the research enabling organizations to respond faster and restore operations quickly. The research reveals two essential aspects for developing supply chain resilience which consist of technological investments and continuous process enhancement because better decision-making emerges through improved visibility..

Sayed (2017) conducted his doctoral research to analyze safety and resilience engineering approaches within Saudi Arabian industrial environments. The study evaluated essential safety frameworks and operational methods in different industries to boost systems resilience which produces superior performances in high-risk operational settings. Sayed conducted research based on qualitative methods by uniting extensive literature research with industrial field investigations in Saudi Arabian industries. Expert interviews with industry professionals and engineers and intelligent staff members and documentary analysis of industry reports and operational statistics formed the core of this research method. Research findings on Saudi Arabian industrial safety practices could be obtained through the integration of mixed qualitative and quantitative research methods. Industrial sectors in Saudi Arabia have implemented safety

and resilience engineering techniques primarily in their oil and gas facilities as well as manufacturing facilities and petrochemical sites. Safety protocols achieved noticeable improvement however the region stagnated in complete resilience development because of resource shortages alongside employee training inadequacies and assessment shortages. Industrial operation continuity and disruption management performance improved when proactive safety systems were used together with resilience engineering methods. A complete risk management system needed companies to unite preventive maintenance with real-time monitoring systems and emergency response preparation to defend themselves from disruptions. The research study showed how important it is for monitoring bodies and technological partners and industry entities to establish cooperative linkages in order to address existing operational barriers. Safety and resilience frameworks showed major developments according to the dissertation yet need to be enhanced further. Better workforce training combined with modern risk evaluation technology and an improvement-oriented environment would create stronger industrial systems in Saudi Arabia according to the author.

The researchers from Kamalahmadi et al.,2022 investigated the supply chain resilience enhancement from strategic flexibility and redundancy utilization in disruption situations. Research activities measured important operational characteristics and determining traits of these supply chain adaptation and crisis response and operational continuation strategies. Other supply chain professionals helped the authors conduct their survey to generate quantitative results across different sectors. The authors used structural equation modeling (SEM) as their statistical tool to analyze how supply chain resilience relates to flexibility with redundancy. Through their methodology researchers measured and established the primary and secondary relations among variables linked to supply chain resilience. The analysis proved how supply chain resilience

grows better by combining organization flexibility with well-established backup plans. Flexible conditions that let supply chains restructure processes and supplier partnerships helped them react fast to unpredictable events. Supply chains operated without interruptions thanks to backup resources and additional suppliers that were referred to as redundant resources. Research data shows both methods achieved successful results based on the nature of brief versus long-term interruptions which occurred in the supply chain. Short-term disruptions required flexible supply chains yet it was redundancy that provided the best solution for handling long-term substantial challenges needing continuous operational backup resources. The combination of flexibility measures with redundancy strategies proved to be the most effective approach in disruption prevention for organizations. Supply chain resilience enhancement demands businesses to strike a balance when implementing flexibility together with redundancy measures according to the authors. The authors proposed that business success could arise from investing in worker education together with technology acquisition and strategic alliance development to boost operational capacities. Organizations determine their resource distribution between flexibility and redundancy implementation through detailed supply chain requirement analysis.

Aljabhan (2023) executed research at the doctoral level to study Supply Chain Risk Management (SCRM) practices within Saudi Arabian maritime businesses. The research examined established risks these firms encounter alongside their employed techniques for minimizing and handling those threats effectively. The research objective explored maritime sector SCRM practices to develop better strategies which establish operational stability and enhance resilience levels. Due to the design of their research Aljabhan collected data by using both qualitative and quantitative methods through case study analysis. The research methodology performed extensive analysis of how realization practices operate in genuine maritime

operations. Different SCRM elements received examination from risk identification through analysis and risk management to their application within maritime supply chain structures. The application of supply chain risk management practices throughout Saudi Arabian maritime companies operated at various implementation degrees. Operations encountered potential difficulties because logistical situations united with geopolitical intensities and environmental threats along with other risks. The combination of strategic partnership agreements and extensive assessment methods among companies led to successful disruption stability. The research revealed positive results across certain areas yet it discovered three core problems that stemmed from insufficient resources combined with staff readiness deficits and insufficient quick risk detection technology. Several organizations encountered obstacles that prevented them from determining robust SCRM practice implementation success. Aljabhan proposed the integration of predictive analytics with maritime tracking systems in operations since this combination would enhance instant risk detection capabilities and emergency response capabilities. The research in the dissertation shows that maritime firms need a single approach to supply chain risk management for better enterprise resilience. To achieve its recommendations the organization should establish technological partnerships and provide financial support to train supply chain personnel and implement an integrated platform for organizational risk management across the board. The organization implemented these steps to secure maritime supply chain operations stability throughout the Kingdom of Saudi Arabia.

Research conducted by Hussain et al. (2023) proved that implementing lean transformation principles brings improved resilience to disaster relief operation management systems. Researchers conducted the study to evaluate how lean principles function in disaster response operations and develop their strength against unexpected events. The research

investigators employed qualitative case-study methods to acquire information by interviewing disaster relief organizations during field research while also examining operational reports. By using this research method the authors measured lean principles deployment in operational contexts to determine their involvement in securing disaster relief program resilience features. The implementation of Lean transformation strengthened disaster relief operation resilience through the development of improved systems that were faster and more responsive. When these conditions were present the main benefits enabled faster actions through optimized processes and superior supply chain management thus improving equipment functioning and stakeholder coordination. The research revealed three main barriers to implementing lean practices during disasters involving reluctant personnel who also needed long training and complex management systems in evolving emergency scenarios. The research showed that correct lean implementation led to stable operational bases to manage unexpected severe events despite implementation challenges.. The examination suggests dedicating funds for employee development along with innovation deployment as well as strategic planning techniques which reinforce both lean practice adoption and operational resilience. The research demonstrated that disaster response capabilities would gain additional strength through lean and agile combination strategies which create adaptable relief operations.

Hafidy et al. (2024) conducted research about the connection between operations management integration with Industry 4.0 technologies which enhances supply chain resilience. The study tracked traditional operation management strategies which unite with contemporary technological solutions of automation and Internet of Things and data analytics to enhance supply chain flexibility as well as stability. The authors analyzed Industry 4.0 by reviewing literature and performing case studies on adopting industries. _different aspects of quantitative data processing

techniques and expert interviews and industry report data analysis helped evaluate the impact of Industry 4.0 technologies on advanced operations management deployment_ The research achieved complete comprehension through detailed examination of traditional supply chain management benefits and hurdles along with potential products that combined old methods with modern techniques. Operational management systems linked with Industry 4.0 technologies generated significant outcomes for supply chain stability enhancement. Companies that utilize Internet of Things technology with predictive analytics along with real-time data processing acquire disruption prediction capabilities and various levels of uninterrupted business operations and logistics optimization. The combination of operations management practices with these technologies developed a structured system which boosted organizational flexibility and response readiness. The authors determined that supply chain maximum resilience occurs when automation connects with real-time monitoring systems and advanced data analytical solutions to enable fast responses to unpredictable changes. The research shows that Industry 4.0 provides major benefits to companies provided they solve challenges regarding worker expertise development and budgeting and technological infrastructure requirements for successful implementation. Operational achievement through Industry 4.0 becomes possible when organizations properly train their workers following planned implementations supported by departmental teamwork for optimal supply chain resilience results. This method enables companies to establish adaptable supply chains which handle problems and preserve their competitive position in business.

2.3. Theoretical foundations of the study

First Axis: Operations Management.

2.3.1. Definition of Operations Management

An organization heavily depends on operations management leadership to execute efficient production together with service delivery tasks effectively. As an organizational discipline operations management plans transformation activities by organizing supervision over material factors together with personnel and energy inputs toward generating output results between products and services. The main task needs process enhancement for premium output creation at reduced costs to satisfy client requirements and fulfill organizational targets (Terwiesch,2023).

Operations management progresses beyond conventional daily tasks because it contains strategic planning mechanisms that both sustain organizations and enhance their market position over the long term. Operations management consists of multiple activities which include process design together with capacity planning and inventory management and supply chain coordination and quality control functions. Operation efficiency maximization results from these activities when they reform resource management and organizational workflow systems.

Modern operations management experiences continuous development through technological transformations as well as global changes in business operations. Operational management contains two crucial elements which incorporate Lean Management for waste reduction together with Total Quality Management for establishing continuous quality improvement needs. The Six Sigma methodologies help organizations reduce process volatility by enhancing production quality which produces more dependable outputs. Sheer coordination of activities through different supply chain levels depends directly on operations management for supply chain management. Collaborating with suppliers enables the company to create improved delivery logistics that lowers costs and circumvents interruptions. The implementation of business-oriented operations management practices ensures successful customer satisfaction and lasting sustainable growth for companies (Choi et al.,2022).

2.3.2. Scope of Operations Management

1. The creation and distribution of products and services operates through vital broad-spectrum activities within the scope of operations management. Organizations operate smoothly when operational and strategic systems join forces to obtain their objectives. This scope of operations management includes the explanation of its essential components (Helo & Hao, 2022).
2. A variety of operational methods enable the creation of protocols for managing service delivery systems and production processes which enhance operational performance and output excellence. Operations managers develop system workflows based on organizational targets that transform inputs consistently into outputs following predefined specifications. Operations managers apply methodology tools named Lean and Six Sigma for streamlining organizational processes that aim to reduce waste..
3. To achieve production goals and service delivery organizations must establish just enough resource availability. Organizations employ capacity planning systems for meeting altering customer needs through suitable resource allocation. Operation excellence through cost efficiency stems from achieving both resource optimization and meeting all customer requirements.
4. Supply Chain Management and Coordination involves the management of supply streams through supplier material acquisition along with sustained product/service delivery speed. The excellence of operation management in supply chain coordination reduces costs by enhancing operational effectiveness which creates competitive opportunities and delivers higher customer satisfaction.

5. The management of operations requires ideal inventory control to serve clients effectively without spending excessive funds on storage needs. The inventory performance under JIT and EOQ control techniques improves when business operations managers determine optimal inventory levels while reducing storage expenses.
6. The verification of customer-defined standards alongside industry-specific requirements falls under Quality Control and Assurance measures which operations management must execute. Quality control incorporates both continuous output testing and process monitoring yet Total Quality Management develops an environment which drives standard maintenance through continuous improvement.
7. Operation managers execute effective goods transportation from source to customers using their logistics and distribution management capabilities. Operations managers oversee transportation methods and directing distribution centers together with storage systems to achieve efficient and cost-effective delivery of goods. Operation management focused on efficiency leads organizations to distribute products faster and maintain superior service results.
8. The foundation of operations management includes technological resources which enable efficiency improvements by means of data-based decision-making. ERP software and predictive analytics work with automation technologies in operating systems to automate workflow processing and generate immediate operational data assessment.

2.3.3. Principles of Operations Management

1. Planning steps for production and service functionality need these core principles to support proper execution of operations optimization processes. The main operational principles integrate into one single framework (Benjaafar & Hu 2020).

2. To achieve the highest levels of customer satisfaction organizations arrange their operational processes which deliver value superior or equivalent to all customer requirements.
3. Continuous Improvement (Kaizen) demonstrates the systematic process development that ensures both higher efficiency and enhanced quality standpoints across all stages of operations
4. The system delivers productivity-related results by utilizing efficient resource management to reach operational cost reductions.
5. Quality Management implements Total Quality Management (TQM) and Six Sigma systems to deliver standardized quality performance in operational methods as well as service and product deliverables.
6. The organization needs to establish flexible processes that adjust to market changes and emerging technologies as well as industrial disruptions.
7. The organization implements practices for maintaining environmental sustainability.
8. Standards in processes allow users to receive more consistent outputs while reducing random outcomes.
9. The process of gathering and analyzing data through analytics for strategic decision making leads to better process performance.
10. Through Risk Management organizations detect safety threats then implement strategies to decrease threats that sustain operations during unpredictable crises.
11. Collaboration and Communication: Enhancing coordination among teams and departments for smoother operations.

12. Supply Chain Integration works to develop streamlined cooperation between suppliers as well as partners and internal business processes.
13. Employee engagement programs run throughout an organization help staff members actively participate in innovative initiatives while simultaneously driving productivity performance growth.

2.3.4. Dimensions of Operations Management

1. Multiple operational areas in operations management unite to achieve proper process execution in organizations. These dimensions include (Babich et al.,2020).
2. Process Optimization serves the process improvement practice which enhances organizational workflow standards.
3. The Supply Chain Coordination mechanism aligns every supply chain point through complete material exchange and information flow.
4. Effective product movement through managed transportation systems enables delivery distribution to provide prompt delivery services.
5. Technology Integration: Implementing tools such as ERP systems, IoT, and automation for enhanced efficiency.
6. Businesses must create systems to detect foreseeable threats followed by countermeasures to stop undesirable outcomes from happening.
7. A successful and sustainable operation demands an organization to adopt environmentally friendly strategies for business development.
8. The organization dedicates its efforts to workforce management because it trains employees to achieve high levels of productivity which leads to operational success.

2.3.5. The Importance of Operations Management

Operations management stands as an essential organizational factor for achieving sustained success and continuation. The following points explain its importance according to (Araz et al.,2020).

1. Operations management enhances productivity together with efficiency due to its optimized resource allocation and process optimization capabilities.
2. Trust among customers form along with loyalty strengthens from Quality Assurance services which uphold high standards in service provision.
3. The organization achieves satisfaction from customers by linking its operational systems with what customers need to improve service delivery thus producing superior customer experiences overall.
4. Through operations management organizations gain full capabilities to react swiftly to market changes without halting their regular business activities.
5. The organization implements broad risk management systems that minimize structural disturbances which can damage operational efficiency.
6. Operation costs become more efficient by utilizing effective procedures thus delivering better financial outcomes.
7. Operations management incorporates sustainability practices that enable organizations to conduct responsible ecological management and achieve regulatory requirements.
8. The enterprise follows an innovation-driven approach to improve operational methods continually thus staying ahead of the market while maintaining current methods.
9. Operations management works with processes to support the organization's strategic targets while following fundamental strategy principles.

10. The system establishes better teamwork by advancing communication methods and implementing coordinated department strategies that produce structured operational systems.

Second Axis :Supply Chain Resilience:

2.3.6. Definition of Supply Chain Resilience

1. Supply chain resilience represents the capability of supply chain networks to predict and prepare for disruptions as well as respond effectively to and recover from them without operational disruption or considerable damages. Reliability in supply chains comprises their capacity to adjust operations to changing environments caused by extreme events including disasters, pandemics, geopolitical tensions and other unanticipated occurrences (Shamsuddin, 2020).
2. A supply chain which demonstrates resilience functions as both a reactive system and a proactive one which continues identifying possible points of weakness and developing strategic approaches that strengthen its ability to survive and rebound from difficulties. An organization can achieve resilience by implementing strategic planning with flexible processes while adding redundancy and integrating technology and developing strong partnerships with suppliers and stakeholders. Supply chain resilience works to preserve operational effectiveness together with customer contentment and organizational market supremacy throughout major disruption events. The fundamental components of supply chain resilience include adaptable logistical and processual systems together with varied sourcing networks and robust risk utility along with real-time data analytics-based risk detection and response capabilities. Organizations can achieve business survival through long-term achievement by incorporating these supply chain

elements which minimize disruptions and help restore operations while sustaining customer service levels (Lohmer & Lasch, 2020).

2.3.7. Importance of Supply Chain Resilience

Organizations need supply chain resilience to sustain operational stability alongside achieving long-term business success especially when operating in the unpredictable global market. Supply chain resilience holds importance because of the following factors (Dohaney et al.,2020).

1. Operations within resilient supply chains remain operational without significant interruptions because they can resist obstacles from natural disasters and pandemics and geopolitical conflicts and other challenges. Business continuity remains intact because disruptions would otherwise trigger major revenue loss along with negative effects on company reputation.
2. Through supply chain resilience organizations acquire the ability to detect upcoming risks which they can actively minimize. Organizations protect their supply chain against major problems through strategies that include diverse supplier networks combined with adaptive transportation methods along with backup systems.
3. The maintenance of affordable quality service at a steady level directly influences achievement of customer satisfaction goals. A resistant supply chain system provides timely delivery of products and services regardless of disruptions. The reliability of these business operations helps build customer trust which results in stronger market position together with better customer retention..
4. Organizations that create resilient supply chains establish superior speed to market disturbances than other businesses in the marketplace. The agility of these companies

creates market advantages which let them successfully capture available opportunities and preserve their supplier reputation throughout uncertain periods.

5. A resilient supply chain adapts its operations through changes in market dynamics plus governmental rules and all types of technological progress. Operating adaptively enables businesses to redirect their approach and operate under changing circumstances thus improving their long-term business survival.
6. A resilient supply chain serves as a protective measure for financial stability by reducing costs that naturally occur from supply disruptions and extra emergency purchasing demands along with unexpected sales losses. Better financial results become achievable for businesses that successfully reduce disruption-related costs since cash flow patterns become more stable.
7. Having operational efficiency is a natural outcome of implementing resilient strategies through better process flexibility and enhanced technological integration. These methods help both normal and stable market conditions by strengthening operational processes and waste reduction along with elevated productivity outcomes.
8. Certain market sectors require companies to meet environmental standards and safety requirements for enhancing their resilience status and protecting their reputation. For companies to achieve regulatory standards supply chain resilience creates better compliance which prevents monetary penalties and defends their organizational reputation.
9. Supply chain resilience creation requires developing more effective relationships among suppliers and stakeholders as well as partners. Enhanced supply chain collegiality together with transparent communication leads to a unified network system that deals with disruptions effectively while improving its operational efficiency.

2.3.8. Components of Supply Chain Resilience

1. Organizations that create resilient supply chains establish superior speed to market disturbances than other businesses in the marketplace. Through their agility companies secure competitive advantages which help them win marketplace opportunities while keeping their supplier reputation intact when markets become unstable.
2. Supply chains that can adjust to market demands together with regulatory and technological changes constitute resilient supply chains. Operating adaptively enables businesses to redirect their approach and operate under changing circumstances thus improving their long-term business survival.
3. A resilient supply chain serves as a protective measure for financial stability by reducing costs that naturally occur from supply disruptions and extra emergency purchasing demands along with unexpected sales losses. Better financial results become achievable for businesses that successfully reduce disruption-related costs since cash flow patterns become more stable.
4. Certain market sectors require companies to meet environmental standards and safety requirements for enhancing their resilience status and protecting their reputation. Supply chain resilience achieves regulatory standards through compliance which protects both the company from penalties and maintains its good reputation.
5. Supply chain resilience creation requires developing more effective relationships among suppliers and stakeholders as well as partners. Improved supply chain connections and clear communication between stakeholders create an united network able to handle disruptions together while obtaining better efficiency and resilience.

6. Company resilience drives support for innovative strategies and growth can be achieved through adopting predictive analytics and automation technologies together with other new solutions. Businesses which merge these technologies in their supply chain operations gain the ability to handle disruptions while taking advantage of new growth possibilities..
7. Organizations that create resilient supply chains establish superior speed to market disturbances than other businesses in the marketplace. Agility provides organizations with a competitive benefit to grab market benefits while maintaining their reputation as dependable suppliers in challenging market conditions.
8. Supply chains equipped with resilience can modify themselves when dealing with shifts in market wants and regulatory requirements and technological developments. Operating adaptively enables businesses to redirect their approach and operate under changing circumstances thus improving their long-term business survival.
9. A resilient supply chain serves as a protective measure for financial stability by reducing costs that naturally occur from supply disruptions and extra emergency purchasing demands along with unexpected sales losses. Better financial results become achievable for businesses that successfully reduce disruption-related costs since cash flow patterns become more stable.
10. Operational Efficiency increases when companies adopt strengthening strategies such as process adaptability innovation along with technological advancements to reach increased overall operational performance levels. These methods help both normal and stable market conditions by strengthening operational processes and waste reduction along with elevated productivity outcomes.

11. Certain market sectors require companies to meet environmental standards and safety requirements for enhancing their resilience status and protecting their reputation. A resilient supply chain protects the company from penalties and reputation damage because it maintains full adherence to regulatory standards.
12. Supply chain resilience creation requires developing more effective relationships among suppliers and stakeholders as well as partners. Together these elements drive development of a tightly connected supply chain which operates as one unit to tackle disruptions while boosting operational effectiveness and resilient performance.
13. Organizational resilience-based approaches drive organizations to adopt predictive analytics and automation and other new technologies that result in innovative solutions together with sustainable growth. Businesses which merge these technologies in their supply chain operations gain the ability to handle disruptions while taking advantage of new growth possibilities.

Successful resilient supply chains need essential contracting management practices for their development. Operations management uses a risk assessment process that incorporates preventive measures for discovering weaknesses throughout supply chain systems. When historical data analysis meets issue prediction organizations develop multiple response strategies to help them swiftly handle interruptions. The incorporation of risk management within operational planning strategies by companies helps their operations continue effectively without unexpected disruptions (Helo & Hao, 2022).

Through its supply chain operations management develops flexibility together with agility as fundamental operational elements. Businesses need flexibility to change both their production and logistics systems but agility defines their speed of alteration. Business processes that

organizations make adaptable enable swift responses to unexpected supply chain disruptions making them better equipped for such situations (Terwiesch ,2023).

Operations management in modern times requires substantial technological integration as this factor plays an essential role in building strong supply chains. Through advanced IoT technology and predictive analysis and real-time data monitoring operators obtain better product surveillance and enhanced decision-making capabilities. Operation management implements technological methods to detect upcoming disruptions before it improves response speed and maintains operational stability. During disruptive situations response times accelerate while effectiveness boosts because of automation systems and artificial intelligence analytics.

The success of business resilience depends on effective inventory management practice. Successful operational management allows organizations to keep their inventory at optimal levels thus ensuring readiness with cost-effective distribution systems. Operational continuity for organizations is sustained through the implementation of two inventory management methods including Just-In-Time (JIT) and strategic buffer stocks. The supply chain remains operational due to proper inventory management since unpredictable conditions arise which prevents both stock outages and overstock conditions. Formal and informal communication channels operated by the organization within its department and beyond create resilience in the supply chain. Operations management enables all departments and suppliers and external partners to work as a cohesive unit by developing strategic alignment between their response plans with organizational objectives. The presence of strong open communication tools enables both quick information flow and supports teams in making strided decisions during disruptions thereby keeping the group cohesive and minimizing detrimental effects (Benjaafar & Hu,2020).).

Successful resilient supply chains need essential contracting management practices for their development. Operations management uses a risk assessment process that incorporates preventive measures for discovering weaknesses throughout supply chain systems. When historical data analysis meets issue prediction organizations develop multiple response strategies to help them swiftly handle interruptions. The incorporation of risk management within operational planning strategies by companies helps their operations continue effectively without unexpected disruptions (Helo & Hao, 2022).

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Operations management in modern times requires substantial technological integration as this factor plays an essential role in building strong supply chains. Better decision-making through predictive analytics combined with real-time data processing along with IoT technology enables enhanced visibility. Operation management implements technological methods to detect upcoming disruptions before it improves response speed and maintains operational stability. Disruptive event responses get stronger and more efficient through combinations of automation systems and artificial intelligence which generates insights.

Risk management within supply chains stands as an essential operational need for businesses to maintain operations along with stability especially when they maintain complex international production systems in manufacturing and chemical production. The supply chain faces many various threats that encompass natural catastrophes alongside geopolitical tensions

together with failing suppliers and economic instability and cyber threats and unanticipated disturbances including pandemic occurrences. Organizations deploy risk management systems that allow them to identify and limit and adjust to unpredictability in order to protect their operational stability and workflow effectiveness (Kuffner et al.,2022).

To begin their risk management process businesses identify all potential vulnerabilities that emerge throughout their supply network infrastructure during the initial stage. The risk identification procedure requires organizations to observe each supply chain segment for key supplier identification then analyze dependencies before reviewing past risks. Businesses identify risks during the process to enable them select appropriate risk mitigation strategies through supplier diversity and backup development along with technological means to monitor supply chain activities. Mobile suppliers play an essential role in combination with supply chain adaptability to form the basis of successful operations. Agile implementation combined with digital transformation enables businesses to maintain appropriate speed which lets them handle disturbances effectively. Cloud-based supply chain management joined with blockchain technology implemented through artificial intelligence enables business entities to establish precautionary measures that counter risks before they occur instead of simply reacting as per existing risks. A risk-sharing system within the supply chain becomes feasible due to partnerships formed between suppliers and stakeholders that help organizations distribute potential financial losses better (Cinti et al.,2024.. Organization resilience through supply chains develops when managers enhance operational communication systems because stakeholders can maintain teamwork regardless of crisis situations. Operations management maintains critical value because it shows organizations how to develop robust relationships which facilitate seamless supply chain communication (Lohmer & Lasch, 2020).

Operations management uses the Resource-Based View (RBV) theory by evaluating unique organizational resources for developing competitive advantages. Operations management develops resilient supply chain infrastructure by utilizing organization resources. The effectiveness of utilizing skilled personnel with advanced technologies and strategic partnerships creates supply chains that function well under normal circumstances as well as adapt to evolving situations (Wong et al.,2020).

The core elements of the TOE framework use operations and environment together with technology to demonstrate how operations management adopts technology while enhancing resilience. By implementing predictive analytics together with AI and IoT components as part of the TOE Framework organizations can obtain real-time data-monitoring ability which enables them to make data-driven choices. Operations management uses technological tools to track supply chain processes as well as respond to disruptions which enhances its resilience according to Shishodia et al. (2023).

Although Just-In-Time (JIT) philosophy concentrates on inventory reduction and operational efficiency it shows essential attributes of resilience. Operation efficiency and expense reduction capabilities from JIT implementations diminish during supply disruptions that arise from inadequate inventory supply. Operations management needs to create strategies that unite JIT approaches with properly timed reserves of inventory in order to maintain resilience capabilities. Companies require adaptable inventory methods which synchronize their lean systems with emergency readiness by maintaining proper reserves.

Various theoretical concepts show that operational methods within management directly enhance supply chain resilience development. Operations management creates an end-to-end framework for supply chain transformations because it integrates multiple management

approaches such as lean management with TQM and dynamic capabilities and risk management to protect business operations and retain market competitiveness (Zamani et al.,2023).

2.3.9. Challenges and Barriers in Implementing Operations Management for Resilience

Organizations need operation management practices to build supply chain resilience in order to successfully adapt during periods of disruption. The process to implement operations management practices faces multiple challenges together with a variety of barriers. The main challenge the system encounters concerns available resources. Organizations need to invest big amounts of money in technology systems and staff development sessions and process redesign projects to achieve operations management resilience goals. Small organizations together with those operating on budgets face challenges when trying to dedicate sufficient funds to execute these transformations successfully. Inadequate budget allocation for resilience projects leads to reduced enhancement of operational resilience since systems do not receive full implementation (Spieske et al.,2021).

The implementation of operations management for resilience faces obstacles through the barriers created by technological integration. Implementing predictive analytics and Internet of Things (IoT) technology together with artificial intelligence (AI) presents significant implementation challenges that require substantial resources. Entities encounter two significant obstacles when integrating these technologies with present systems because they struggle to match them to current methods and they do not possess enough knowledge to oversee maintenance and operation. The challenge to integrate systems acts as an obstacle when organizations attempt to leverage technology for obtaining necessary real-time data alongside predictive analytics needed to establish resilient supply chains.

Organizations face numerous hurdles when implementing resilience-focused operations management because training the workforce constitutes a critical but complex task.

Organizations must prepare their staff members with necessary skills to handle technological systems and execute modern procedures and manage disruptions effectively. Organizations face two primary hurdles when implementing workforce training: high cost and extended time requirements as well as the difficulty of preparing an entire workforce especially when dealing with large organizations or those facing frequent employee replacement. The success of resilience-building initiatives will suffer when employees lack necessary training because they cannot optimize new operational processes and tools (Zhao et al.,2023).

The organization often faces internal resistance as a major obstacle when introducing changes. New operations management practices resemble major organizational transformation that usually sparks employee opposition because these changes disrupt traditional workflow systems. The resistance to change diminishes the speed of new practice adoption and reduces their ability to produce successful results. Organizations need structured change management approaches to reduce resistance yet these approaches need thorough planning before execution to build an organization-wide mindset of evolving efficiently together.

The complexities found in supply chains introduce significant hurdles when performing resilience-oriented operations management activities. Multiple organizations function with complex supply chains which connect many suppliers to partner organizations through a worldwide network of logistics providers. Operating resilience throughout extensive multistakeholder networks becomes troublesome since regular communication together with strategy alignment and stakeholder partnership management are necessary for partners with different priorities and capabilities. The management of data alongside operational transparency stands essential for operational success even though it creates specific challenges to tackle. The flow of precise and timely data throughout the complete supply chain network remains vital for

making well-informed decisions that occur during disruptions. The data management systems within organizations face challenges because of fragmented data storage systems and poor-quality data which reduces partner collaboration through information sharing. Inefficient and unreliable data sets barriers against implementing strategies that can effectively build resilience (Ozdemir et al.,2022).

Efficiency and resilience represent opposing demands that supply chains need to handle. Operations management as a field concentrates on process optimization with goals of cost reduction and process efficiency improvement. The strategies used to develop supply chain resilience through increased stock levels or supplier diversity create challenges because they confront the lean management approach which reduces waste and inventory. Organizations struggle to achieve compatibility between running cost-efficient operations while also guaranteeing an effective supply chain response to disruptions. External environmental factors combined with regulatory demands and geopolitical problems limit the ability of organizations to put operation management practices into effect for resilience. Supply chains dealing with regions where regulatory standards are tough and political conditions are unstable need extra efforts to synchronize their resilience strategies. The organization's ability to create uniform resilience practices becomes restricted by having to comply with different market regulations. Sustainability issues now strongly affect the development of resilience solutions. Traditional sustainable practices foster supply chain resilience over the long run yet many companies struggle to execute operation modifications needed for these approaches. Operations management becomes more complex because of the logistical and financial challenges presented by the transition to eco-friendly processes and carbon footprint management (Adekola & Clelland,2020).

2.3.10. Risk Management in Supply Chains

Risk management within supply chains stands as an essential operational need for businesses to maintain operations along with stability especially when they maintain complex international production systems in manufacturing and chemical production. The supply chain faces many various threats that encompass natural catastrophes alongside geopolitical tensions together with failing suppliers and economic instability and cyber threats and unanticipated disturbances including pandemic occurrences. Organizations deploy risk management systems that allow them to identify and limit and adjust to unpredictability in order to protect their operational stability and workflow effectiveness (Kuffner et al.,2022).

To begin their risk management process businesses identify all potential vulnerabilities that emerge throughout their supply network infrastructure during the initial stage. The risk identification procedure requires organizations to observe each supply chain segment for key supplier identification then analyze dependencies before reviewing past risks. Businesses identify risks during the process to enable them select appropriate risk mitigation strategies through supplier diversity and backup development along with technological means to monitor supply chain activities. Supply chain flexibility together with adaptability stand as primary requirements. Agile implementation combined with digital transformation enables businesses to maintain appropriate speed which lets them handle disturbances effectively. Companies using cloud-based supply chain management paired with blockchain-connected artificial intelligence (AI) for demand forecasting have the ability to stop risks from developing in the first place instead of only acting in response to existing risks. A risk-sharing system within the supply chain becomes feasible due to partnerships formed between suppliers and stakeholders that help organizations distribute potential financial losses better (Cinti et al.,2024.).

Companies need an organized business continuity plan (BCP) to regain their operations rapidly whenever disruptions occur. Organizations that comply with regulatory frameworks together with industry standards create risk resilient entities because their implementation forces organizations to follow best practice risk management guidelines such as ISO 31000 (Risk Management) or ISO 28000 (Supply Chain Security).

Saudi Basic Industries Corporation (SABIC) relies on risk management to preserve its supply chain stability which becomes necessary when global demand shifts and new regulations occur while raw material supply interruptions occur. SABIC implements proactive risk assessment together with technological advancements and strategic partnerships which ensure its supply chain operates with sustained operational efficiency (Min,2019).

Organizations need to maintain consistent vigilance while embracing innovation along with supporting a resilient commitment to build a never-ending process of supply chain risk management).

2.3.11. Digital Transformation and Technology Integration

Modern supply chain management has been transformed by digital innovation together with technological integration which helps businesses develop enhanced operational effectiveness and market demand flexibility and system stability. Supply chain visibility along with automation and decision-making abilities have been enhanced dramatically by the implementation of modern technologies consisting of Artificial Intelligence (AI), the Internet of Things (IoT), blockchain, cloud computing, and big data analytics. Advanced technologies allow Saudi Basic Industries Corporation (SABIC) as well as other companies to optimize their operations through risk reduction and sustainable growth (Belhadi et al.,2024).

The main advantage of supplying digital transformations in supply chains derives from enhanced real-time tracking together with heightened visibility. The implementation of IoT devices composed of sensors and RFID tags enables businesses to supervise raw materials and finished goods in their supply chain path. The real-time tracking system enables improved inventory control while minimizing delivery time and provides leaders with enough time to respond promptly to supply chain problems. Using big data analytics enterprises can analyze massive amount of data to optimize distribution routes as well as forecast upcoming market needs and boost their supply chain operations efficiency.

The supply chain benefits from artificial intelligence technology (AI) together with machine learning (ML) because it completes operational automation while building better forecasting systems. Through AI predictive analytics companies can predict supply chain disturbances while they simultaneously optimize stock levels to generate data-based decisions which improve supply chain resistance. AI algorithms analyze historical patterns and external conditions such as weather patterns and geopolitical events to forecast future market shifts which allows supply chain operators to modify their planning strategy accordingly. Blockchain technology has proven to be an influential breakthrough that delivers excellent transparency along with security to supply chain operations. Blockchains function through an unalterable digital ledger system which establishes transaction trust and provides complete trackable security between suppliers and distributors and manufacturers. The industry sectors which produce chemicals plus manufacture goods get major benefits from this technology because they need assured raw material verification and standard compliance monitoring. Blockchain technology enables SABIC to track supply chain products better also helps prevent fraud and strengthens cooperation with worldwide business partners (Chowdhury et al.,2024).

Cloud-based supply chain management systems allow departments and suppliers together with logistics providers to join forces through their integrated interface. The cloud infrastructure enables instant data exchange and improved collaboration and enables better organizational decision processes. The systems enable efficient business expansion in addition to decreasing infrastructure expenses. Organizations now use robotic process automation (RPA) and smart manufacturing as key elements of digital transformation along with other important tools. RPA technology operates across three key areas to process orders and manage inventories together with supplier interactions while decreasing worker mistakes and enhancing operational speed.).

The intersection of digital transformation with technological implementation has transformed supply chain management which now allows companies to better their operational performance through enhanced resistance against market shifts and improved operational efficiency. Supply chain visibility and automation and decision-making capabilities have grown tremendously because businesses adopted advanced technological tools such as Artificial Intelligence (AI), the Internet of Things (IoT), blockchain, cloud computing and big data analytics. Advanced technologies allow Saudi Basic Industries Corporation (SABIC) as well as other companies to optimize their operations through risk reduction and sustainable growth (Belhadi et al.,2024).

The main advantage of supplying digital transformations in supply chains derives from enhanced real-time tracking together with heightened visibility. The implementation of IoT devices which include sensors and RFID tags enables companies to track their raw materials and finished products from beginning to end in the supply chain. The real-time tracking system enables improved inventory control while minimizing delivery time and provides leaders with enough time to respond promptly to supply chain problems. Big data analytics enables

companies to process substantial data quantities that leads to optimal route planning and prediction of future demand levels and better overall supply chain performance.

The supply chain benefits from artificial intelligence technology (AI) together with machine learning (ML) because it completes operational automation while building better forecasting systems. Through AI predictive analytics companies gain abilities to foresee supply chain disruptions while maximizing inventory levels to establish data-based choices that fortify supply chain durability. The evaluation of historical patterns and external influences through AI algorithms helps determine future demand changes which allows supply chains to modify their operational structures. Blockchain technology represents a major advancement for supply chain security through its ability to provide full transparency across multiple operations. Blockchains function through an unalterable digital ledger system which establishes transaction trust and provides complete trackable security between suppliers and distributors and manufacturers. The industry sectors which produce chemicals plus manufacture goods get major benefits from this technology because they need assured raw material verification and standard compliance monitoring. Blockchain technology enables SABIC to track supply chain products better also helps prevent fraud and strengthens cooperation with worldwide business partners (Chowdhury et al.,2024).

Cloud-based supply chain management systems allow departments and suppliers together with logistics providers to join forces through their integrated interface. The cloud infrastructure enables instant data exchange and improved collaboration and enables better organizational decision processes. The systems enable efficient business expansion in addition to decreasing infrastructure expenses. The digital transformation includes two substantial elements which are robotic process automation (RPA) and smart manufacturing. RPA technology operates across three

key areas to process orders and manage inventories together with supplier interactions while decreasing worker mistakes and enhancing operational speed.

2.3.12. Agile Operations in Supply Chains

The main focus of agile supply chain operations stands on rapid market demand response and flexible adaptability and quick response capabilities. The method proves helpful for industries which face unpredictable market shifts because it helps businesses respond fast to changing customer needs alongside demand alterations and sudden disruptions (Riad et al.,2024).

The essential elements in agile supply chain operations consist of:

The system uses present-time data and predictive analytics for production planning needs that match market needs.

Organizations can make fast decisions because of this approach which helps them address market disturbances and potential opportunities.

The approach of modular supply chain design enables business flexibility across all supply chain aspects including sourcing along with production as well as distribution.

Technology Integration: Leverages AI, IoT, and cloud-based systems for enhanced supply chain visibility and responsiveness.

SABIC needs to stay agile to handle critical supply chain challenges that include raw material shortages and regulatory changes together with geopolitical problems. Through agile methodology adoption the company improves its market competitiveness by boosting speed to customer service delivery and gaining greater global market effectiveness.

The Hybrid Approach: Lean-Agile Integration for Resilience

SABIC along with other companies achieves operational excellence through their adoption of lean and agile standards together. The Lean-Agile approach maintains flexibility which enables

organizations to achieve optimization of costs along with disruption-responsive capabilities (Pertheban & Arokiasamy, 2019).

The application of lean principles in stable conditions results in elimination of unnecessary costs together with enhanced operational performance.

Agile systems excel in environments featuring high uncertainty since they let organizations transform rapidly when demand patterns change.

AI-driven analytics along with blockchain and cloud computing utilize digital tools to build stronger relationships between lean and agile processes.

SABIC can construct a flexible supply chain system with cost-effective features and adaptive capabilities through lean and agile strategy implementation. Sustainable growth together with operation enhancements and long-term business survival can be achieved through this method in our changing global environment. Supply chain resilience requires lean and agile operations to function properly because they deliver distinct advantages to the management system. The combination of lean practices and agile methodologies produces cost-efficient waste reduction which accompanies organizational agility. A balanced hybrid system enables SABIC and other companies to tackle supply chain issues and build sustainability while sustaining market competitiveness in changing market conditions.

2.3.13. Collaboration and Supplier Relationship Management

1. Resilient and efficient supply chains need collaboration with Supplier Relationship Management (SRM) especially when operating complex global networks such as chemicals manufacturing and energy sectors. Strong relationships between Saudi Basic Industries Corporation (SABIC) and its suppliers deliver stability to supply chains and help mitigate risks along with improving operational effectiveness. Quality collaborative work between supply

chain partners drives mutual goal achievement which produces enhanced resource optimization and decreased costs and improved market disruption responses (Attah et al.,2024).

2. The Importance of Supplier Collaboration in Supply Chain Resilience
3. Supply chains remain at strong risk of attack from worldwide uncertainties which originate from geopolitical complications and raw material deficiencies and regulatory modifications and economic instabilities. Businesses must develop enduring supply chain partnerships rather than merely conduct business deals with their suppliers to handle present and emerging threats.
4. Supplier collaboration brings the following main advantages to organizations:
5. A supply chain benefits from real-time data exchange which results in better forecasting together with reduced forecast uncertainty.
6. The close bond with suppliers creates opportunities to conduct combined risk assessments which leads to preventive measures development.
7. The development of strategic alliances helps organizations maintain high levels of quality compliance with industry standards.
8. Businesses that implement agile collaborative networks can make rapid market adaptation through swift changes in their production and distribution methods.
9. Buyers and suppliers unite to create new ideas and improve processes which drives development of sustainable product solutions together.
10. Effective supplier collaboration represents a vital practice for SABIC to maintain reliable raw material supply alongside improved logistics and sustainable achievement.
11. An effective Supplier Relationship Management (SRM) requires implementation of the following vital strategies.

12. The method of Supplier Relationship Management (SRM) consists of thorough planning with essential suppliers and their evaluation as part of an approach to maximize value creation. SRM strategies should incorporate the following elements according to (Ergun et al.,2023).
13. Organizations divide their suppliers into groups based on both strategic value factors and performance evaluation criteria. At the same time they assess supplier exposure to risk and their dependency on key supplier relationships. The process lets companies direct their relationship development the most promising and critical suppliers among their supply chain network.
14. Real-time data exchange through cloud-based platforms together with blockchain technology establishes transparent information flow which builds trust also strengthens supply chain coordination. Transparent communication methods create cross-stakeholder consensus about their activities for demand planning as well as inventory control and production scheduling.
15. The collaboration between businesses and suppliers through joint risk management and contingency planning allows both parties to predict material scarcity events and transportation hold-ups and regulatory changes along with their corresponding responses. The combination of scenario planning techniques with dual sourcing strategies successfully cuts down supply chain weaknesses..
16. Long-Term Strategic Partnerships: Building long-term supplier relationships rather than engaging in short-term, cost-driven contracts enhances supply reliability and mutual trust. Strategic agreements enable shared investments in research, innovation, and process optimization.
17. Performance Monitoring and Continuous Improvement: Companies use Key Performance Indicators (KPIs) to assess supplier performance in terms of quality, delivery reliability, cost

efficiency, and compliance. Regular audits and feedback mechanisms help suppliers improve and align with corporate objectives.

For SABIC, a robust SRM framework ensures efficient procurement, strengthens sustainability initiatives, and enhances supply chain resilience against external shocks (Gao et al.,2022).

Technology's Role in Supplier Collaboration and SRM

Modern digital tools and automation have transformed supplier relationship management, making collaboration more efficient and data-driven. Key technologies include:

- **Blockchain for Transparency:** Ensures secure, tamper-proof transactions and traceability of raw materials.
- **Artificial Intelligence (AI) and Big Data:** Predicts supply chain risks and optimizes supplier selection based on historical performance.
- **Cloud-Based Procurement Platforms:** Facilitate real-time communication, document sharing, and performance tracking.
- **Internet of Things (IoT):** Enhances real-time tracking of shipments and inventory levels, improving operational efficiency.

By integrating technology-driven SRM solutions, SABIC can enhance supplier collaboration, ensure sustainability compliance, and create a more resilient supply chain. Effective supplier collaboration and SRM are essential for building a resilient, flexible, and competitive supply chain. By fostering long-term partnerships, improving transparency, leveraging technology, and engaging in joint risk management, companies like SABIC can mitigate supply chain disruptions, enhance operational efficiency, and drive innovation. A proactive and strategic SRM approach ensures sustainable growth and long-term supply chain stability in a rapidly evolving global market (Mandal,2012).

2.3.14. Crisis Management and Business Continuity planning

Crisis management and business continuity planning (BCP) are essential strategies for ensuring the resilience and stability of supply chains, especially in industries like manufacturing, chemicals, and energy, where disruptions can have severe financial and operational consequences. Companies such as Saudi Basic Industries Corporation (SABIC) must proactively develop and implement crisis management frameworks and continuity plans to mitigate risks, minimize downtime, and sustain operations during unforeseen events.

✓ Crisis Management in Supply Chains

Crisis management involves identifying, preparing for, and responding to disruptions that could impact supply chain operations. These disruptions may arise from natural disasters, economic fluctuations, cyber threats, regulatory changes, geopolitical tensions, pandemics, or supplier failures. A well-structured crisis management strategy enables companies to respond quickly and effectively, reducing operational and financial impacts (Nikookar & Yanadori, 2022).

Key Phases of Crisis Management

1. Risk Identification and Assessment

- Analyzing vulnerabilities within the supply chain, such as dependencies on single-source suppliers or critical infrastructure.
- Conducting risk mapping and scenario analysis to anticipate potential threats.
- Implementing predictive analytics and AI-driven monitoring tools for early warning systems.

2. Crisis Preparedness and Contingency Planning

- Establishing proactive risk mitigation strategies, including diversified sourcing, strategic inventory buffers, and supplier collaboration.

- Training employees on crisis response protocols and decision-making frameworks.
- Developing communication strategies to ensure real-time coordination with suppliers, stakeholders, and regulatory bodies.

3. Crisis Response and Execution

- Implementing emergency response plans to minimize disruption.
- Activating alternative supply chain routes or backup suppliers when necessary.
- Using digital platforms for real-time visibility and collaboration across supply chain partners.

4. Post-Crisis Recovery and Lessons Learned

- Assessing the effectiveness of the crisis response through data analysis and stakeholder feedback.
- Identifying gaps and areas for improvement in crisis management procedures.
- Refining and updating the crisis management framework based on past experiences.

For SABIC, an effective crisis management strategy ensures continued production and distribution, even in the face of global disruptions, by leveraging digitalization, predictive analytics, and strategic supplier partnerships.

✓ **Business Continuity Planning (BCP) in Supply Chains**

Business Continuity Planning (BCP) is a proactive approach to ensuring that critical supply chain functions continue during and after a crisis. BCP minimizes downtime, ensures operational resilience, and helps companies recover quickly from disruptions (Um & Han, 2021).

Key Components of a Strong Business Continuity Plan

1. Business Impact Analysis (BIA)

- Identifying mission-critical supply chain operations that must remain functional during a crisis.
- Evaluating the financial, operational, and reputational risks associated with supply chain disruptions.
- Determining recovery time objectives (RTOs) and recovery point objectives (RPOs) to guide post-crisis operations.

2. Supply Chain Redundancy and Diversification

- Maintaining alternative suppliers and manufacturing sites to ensure continued production in case of disruptions.
- Establishing dual-sourcing strategies to prevent reliance on a single supplier or region.
- Using regional distribution hubs to minimize dependency on long-distance logistics.

3. Technology Integration for Resilience

- Implementing cloud-based supply chain management (SCM) systems for real-time data access and coordination.
- Using artificial intelligence (AI) and machine learning to predict and respond to disruptions.
- Employing blockchain technology for transparency and secure transaction management.

4. Emergency Response and Crisis Communication

- Creating clear communication protocols for employees, suppliers, and stakeholders.

- Leveraging IoT-enabled monitoring for real-time tracking of inventory, shipments, and production status.
- Engaging in stakeholder collaboration and supplier agreements to ensure mutual support in crises.

5. Testing, Training, and Continuous Improvement

- Conducting regular crisis simulations and supply chain stress tests to assess preparedness.
- Training employees and suppliers on business continuity best practices.
- Updating the BCP based on post-crisis evaluations and emerging risks.

For SABIC, a robust BCP ensures that critical supply chain functions—such as raw material procurement, production, and distribution—remain operational even during disruptions, securing business continuity and long-term market stability.

The Role of Digital Transformation in Crisis Management and BCP

Technology plays a critical role in strengthening crisis management and BCP by providing real-time insights, automation, and enhanced decision-making. Key digital enablers include:

- **Predictive Analytics & AI:** Helps anticipate potential supply chain disruptions and optimize response strategies.
- **IoT & Real-Time Monitoring:** Enables tracking of shipments, inventory, and supplier performance.
- **Blockchain for Supply Chain Transparency:** Ensures secure and tamper-proof documentation of transactions and logistics.
- **Cloud-Based Business Continuity Platforms:** Facilitate seamless collaboration among supply chain partners during crises.

By leveraging advanced technologies, SABIC can improve its crisis response capabilities, enhance operational resilience, and maintain business continuity across its global supply chain network. Crisis management and business continuity planning are essential pillars of supply chain resilience. By proactively identifying risks, implementing contingency measures, and leveraging technology, companies like SABIC can mitigate disruptions, minimize downtime, and sustain long-term operational success. To ensure supply chain resilience, organizations must continuously assess vulnerabilities, engage in strategic supplier partnerships, invest in digital transformation, and refine their business continuity strategies. A well-structured crisis management and BCP framework not only protects against supply chain disruptions but also enhances competitive advantage, customer trust, and long-term sustainability in an unpredictable global market.

Chapter 3: Methodology

3.1. Research Approach

This chapter, the methodology of the study that was followed during the research will be presented by presenting the methodology used as well as a description of the sample that was applied to it, in addition to a comprehensive and accurate description of the tool that was used and the method used in its preparation and displaying the extent of its validity and reliability, in addition to clarifying the statistical methods and treatments used. It was mainly relied upon in analyzing the hypotheses of the study in order to reach reliable scientific results.

3.2. Research Design

Study was conducted to answer the questions that were raised, and therefore the study relied on the quantitative approach in order to Identify The role of internal audit in enhancing organizational sustainability: a comparative study

3.3. Research Sample

A random sampling method was used to select the study sample. Where the questionnaire was applied electronically via social networking sites to obtain the study sample, and the study sample consisted of (130) individuals ,

Table 1 Showing the Characteristics of the research sample

Characteristics	Sub Characteristics	N	%
Gender	Male	77	59.2%
	Female	53	40.8%

Age Group	From 25 - 30 years	50	38.5%
	31–35 years .	46	35.4%
	More than 35 years	34	20.7%
Years of experience	less than 5 years	29	22.3%
	From 5 to 10 years	65	50%
	More than 10 years	31	27.7%
Educational Level	Middle	30	23.1%
	Bachelor's degree	36	27.7%
	Master's degree	54	41.5%
	Doctorate degree	10	7.7%
Total		130	100%

3.4. Data Collection

The study tool consisted of a questionnaire applied electronically, and the questionnaire consisted of two main parts:

- The first part: contains the basic data of the study sample.
- The second part: related to the items of the questionnaire, and it was divided into Four sub-axes, as follows:
 - ✓ Section 1: Quality Management, It consists of 5 items
 - ✓ Section 2: Process Optimization, It consists of 5 items

- ✓ Section 3: Risk Management, It consists of 5 items
- ✓ Section 4: Supply Chain Resilience, It consists of 5 items

The questionnaire will be used in order to collect data through the Three-point Likert scale, which can be expressed through the following table:

Table 2 The five- point Likert scale

Term	Strongly Agree	Agree	Neutral	Strongly Disagree	Disagree
Answer degree	1	2	3	4	5

3.5. The Validity

Internal consistency was used to measure the validity of the tool by assessing the extent to which each item of the questionnaire is consistent with its corresponding construct. Pearson correlation coefficient was used to measure the correlation between each item and the total score of the construction it belongs to, as shown in the following table:

Table 3 Shows the results the validity of the tool.

Pattern Scale											
Section 1: Quality Management			Section 2: Process Optimization			Section 3: Risk Management			Section 4: Supply Chain Resilience		
No	Pearson Correlation	Sig	No	Pearson Correlation	Sig	No	Pearson Correlation	Sig	No	Pearson Correlation	Sig

1	0.683	0.000	1	0.675	0.000	1	0.594	0.000	1	0.716	0.000
2	0.391	0.000	2	0.682	0.000	2	0.530	0.000	2	0.426	0.000
3	0.675	0.000	3	0.540	0.000	3	0.593	0.000	3	0.660	0.000
4	0.717	0.000	4	0.634	0.000	4	0.621	0.000	4	0.544	0.000
5	0.738	0.000	5	0.544	0.000	5	0.376	0.000	5	0.561	0.000

Through this table, it is evident that all items have correlation coefficients ranging from 0.376 to 0.717, and all of them were significant at a significant level of (0.000), indicating that the questionnaire has an elevated level of reliability.

3.6. Reliability

To calculate the questionnaire's reliability coefficient, we used Cronbach's alpha coefficient to determine the degree of stability of the tool. The following table shows the reliability coefficient

Table 4 Shows the results of Cronbach's alpha coefficient

The Dimension	Number of Phrases	Axis Stability
Section 1: Quality Management	5	0.74
Section 2: Process Optimization	5	0.79
Section 3: Risk Management	5	0.76
Section 4: Supply Chain Resilience	5	0.73

The previous table shows that the questionnaire has an elevated level of reliability, as the questionnaire as a whole obtained a reliability score of 0.75, with Cronbach's alpha coefficient values for the questionnaire's axes ranging from 0.74 to 0.79. This indicates that the scale has a high degree of reliability, meaning that the results are consistent every time the scale is applied. Therefore, this questionnaire can be relied upon to generalize the results

3.7. Study Procedures

In the beginning, the questionnaire was designed by looking at the previous studies on the subject of the research, and through the theoretical frameworks that were collected. After designing the questionnaire, it was presented to a number of arbitrators, and the necessary amendments were made through deletion and addition. Then both the validity and reliability criteria of the tool were calculated. After that, the questionnaire was prepared electronically and distributed for the use of social networking sites such as Facebook and WhatsApp, and after application, data were collected in order to reach reliable scientific results.

3.8. The Statistical Methods used

The data collected from the sample were entered using the program (SPSS-V.22). The statistical methods that were used to process the data varied, including:

- Cronbach's Alpha coefficient to ensure consistent performance.
- Use frequencies and percentages to determine the significance of the sample's responses to the questionnaire items.
- Correlation coefficient for the calculation of honesty.
- Regression analysis.

Chapter 4: Analysis and Results

4.1. Introduction:

This chapter discusses the statistical analysis of the collected data. It consists of a set of analytical processes that are followed to obtain clear and meaningful scientific information and results that meet the objectives of the study and answer its research questions

4.2. Statistical Analysis and Results Interpretation

4.2.1. Section 1: Quality Management

Table 5 The Results of First Axis First Dimension : Independence

No	phrases	Mean	SD	Order
1	SABIC's quality management processes ensure consistency in product and service delivery.	3.85	0.799	1
2	The company maintains strict quality control standards to prevent supply chain disruptions.	3.63	1.069	5
3	Continuous improvement programs are implemented to enhance product and process quality.	3.85	0.881	2
5	Quality audits and compliance checks are regularly conducted within the supply chain.	3.85	0.799	3
6	Supplier quality management is a key priority to ensure resilient supply chain operations.	3.63	1.069	4

The results of the Quality Management section highlight the significance of SABIC's quality assurance practices in maintaining supply chain resilience. The highest-rated statements, with a mean score of 3.85, indicate that respondents perceive SABIC's quality management

processes as consistent in ensuring product and service delivery. This suggests that the company's structured quality management systems play a vital role in minimizing errors, enhancing efficiency, and maintaining supply chain stability. The same score was observed for the statements on continuous improvement programs and quality audits, reflecting a strong commitment to ongoing enhancements in quality control and regulatory compliance within the supply chain. The relatively low standard deviation values ($SD = 0.799$ and 0.881) indicate consistent agreement among respondents regarding these practices. However, the aspects related to supplier quality management and strict quality control standards received slightly lower mean scores (3.63), suggesting areas for potential improvement. Supplier quality management is critical in ensuring raw material integrity, compliance with industry standards, and overall supply chain reliability. A higher standard deviation ($SD = 1.069$) for these statements indicates greater variability in responses, suggesting that some stakeholders may perceive inconsistencies in supplier quality control measures. This highlights the need for enhanced supplier collaboration, stricter compliance monitoring, and more rigorous quality enforcement policies to further strengthen supply chain resilience. Overall, the findings emphasize that while SABIC has a strong foundation in quality management, there is room for improving supplier quality oversight and refining quality control processes to enhance supply chain efficiency and adaptability. By focusing on supplier partnerships, advanced quality monitoring systems, and continuous process optimization, SABIC can further mitigate risks, reduce disruptions, and ensure long-term operational success.

4.2.2. Section 2: Process Optimization

Table 6 The Results of Process Optimization

No	Phrases	Mean	SD	Order
2	SABIC utilizes advanced technologies to optimize supply chain operations.	3.64	0.984	4
3	Process improvements have significantly reduced inefficiencies and delays in supply chain activities.	3.75	0.648	1
4	Automated systems and data analytics contribute to better decision-making and operational efficiency.	3.74	1.867	2
5	Lean management practices are applied to enhance supply chain productivity.	3.62	1.245	5
6	There is a strong emphasis on streamlining workflows to minimize waste and improve performance.	3.69	0.917	3

The results of the Process Optimization section provide valuable insights into SABIC's operational strategies and their effectiveness in enhancing supply chain efficiency. The highest-rated statement, with a mean score of 3.75, indicates that respondents acknowledge the positive impact of process improvements in reducing inefficiencies and delays. This suggests that continuous improvement initiatives and operational streamlining have contributed significantly to enhancing workflow efficiency and minimizing disruptions in the supply chain. Additionally, this statement has a relatively low standard deviation (SD = 0.648), which indicates strong agreement among respondents, further reinforcing the effectiveness of these efforts. The statement regarding automated systems and data analytics improving decision-making and operational efficiency received a mean score of 3.74, ranking second. However, the high standard deviation (SD = 1.867) suggests variability in responses, implying that while many perceive automation as beneficial, some may feel that these technologies are not yet fully optimized across all supply chain processes.

This highlights the need for better integration of AI-driven analytics, predictive modeling, and real-time monitoring systems to enhance decision-making consistency.

The statement on streamlining workflows to minimize waste and improve performance ranked third, with a mean score of 3.69 and a relatively low standard deviation ($SD = 0.917$). This indicates that while workflow optimization is a priority, there is still room for improvement in eliminating redundancies, refining process flows, and enhancing coordination across supply chain activities. The statement regarding SABIC’s use of advanced technologies for supply chain optimization scored 3.64, ranking fourth. This suggests that while technology adoption is evident, it may not yet be fully leveraged to maximize supply chain efficiency. A possible recommendation would be to further invest in digital transformation, AI-powered automation, and IoT-based supply chain monitoring to enhance performance and resilience. Finally, lean management practices ranked lowest, with a mean score of 3.62 and a relatively high standard deviation ($SD = 1.245$), indicating diverse perspectives on the effectiveness of lean methodologies. While lean principles are beneficial in eliminating waste and improving productivity, the results suggest that further efforts are needed to implement and sustain lean initiatives effectively across all supply chain operations. Overall, the findings suggest that process optimization plays a crucial role in enhancing SABIC's supply chain resilience, with process improvements and automation showing notable positive impacts. However, challenges remain in fully integrating advanced technologies, improving workflow optimization, and strengthening lean management practices. To maximize efficiency, SABIC should focus on expanding digital transformation efforts, reinforcing lean strategies, and ensuring seamless automation across all supply chain processes.

4.2.3. Section 3: Risk Management

Table 7 The Results of Risk Management

No	phrases	Mean	SD	Order
2	The company has a well-defined risk management framework to address supply chain disruptions.	3.85	0.949	3
3	Risk assessment and mitigation strategies are regularly reviewed and updated.	3.74	1.270	5
4	Supplier risk management is a critical component of SABIC's supply chain strategy.	3.89	0.983	2
5	Contingency plans and alternative sourcing strategies are in place for crisis situations.	3.82	0.871	4
6	The organization leverages predictive analytics to identify and address potential supply chain risks.	3.93	1.163	1

The findings from the Risk Management section highlight the effectiveness of SABIC's strategies in mitigating supply chain disruptions and ensuring operational stability. The highest-rated statement, with a mean score of 3.93, indicates that respondents acknowledge SABIC's use of predictive analytics to identify and address potential supply chain risks. This suggests that data-driven risk management approaches, such as AI-powered forecasting and real-time monitoring, play a crucial role in enhancing supply chain resilience. However, the relatively high standard deviation (SD = 1.163) indicates some variation in perceptions, implying that predictive analytics may not be uniformly applied across all supply chain operations or that its effectiveness varies based on different supply chain segments. The second highest-rated statement, with a mean score of 3.89, emphasizes the importance of supplier risk management as a critical component of SABIC's supply chain strategy. This suggests that supplier relationships and risk mitigation

frameworks are well-integrated into the company's supply chain policies, ensuring greater resilience against supplier-related disruptions. The relatively moderate standard deviation ($SD = 0.983$) indicates a consistent level of agreement among respondents regarding the company's commitment to managing supplier risks effectively. The statement regarding the company's well-defined risk management framework to address supply chain disruptions ranked third, with a mean score of 3.85. This result suggests that SABIC has a structured approach to risk identification, assessment, and mitigation, helping the company maintain operational continuity during supply chain challenges. However, a standard deviation of 0.949 shows some variation in responses, indicating that while the framework is effective, there may be gaps in its implementation or communication across different departments. Contingency planning and alternative sourcing strategies ranked fourth, with a mean score of 3.82 and the lowest standard deviation ($SD = 0.871$), indicating that respondents generally agree on SABIC's preparedness for supply chain disruptions. This suggests that the company actively develops backup supply sources, strategic partnerships, and crisis response plans to minimize the impact of unexpected disruptions. However, the relatively lower ranking indicates that there may still be opportunities for improvement in diversifying supply sources and strengthening contingency measures. The lowest-ranked statement, with a mean score of 3.74, pertains to the regular review and updating of risk assessment and mitigation strategies. While this score still reflects a positive perception of SABIC's risk management efforts, the high standard deviation ($SD = 1.270$) suggests variability in responses, implying that some departments or supply chain functions may not have a standardized approach to risk assessment updates. This finding highlights the need for more frequent risk evaluations, enhanced communication of risk management policies, and improved training programs to ensure company-wide alignment in risk mitigation efforts. The results demonstrate that SABIC has a

strong foundation in risk management, particularly in leveraging predictive analytics and supplier risk management strategies to enhance supply chain resilience. However, the findings suggest areas for further improvement, such as ensuring more consistent implementation of risk frameworks, strengthening contingency planning, and regularly updating risk mitigation strategies. By enhancing data-driven risk analysis, diversifying sourcing strategies, and promoting a culture of proactive risk assessment, SABIC can further reinforce its supply chain resilience and minimize the impact of potential disruptions.

4.2.4. Section 4: Supply Chain Resilience

Table 8 The Results of Supply Chain Resilience

No	phrases	Mean	SD	Order
1	SABIC's supply chain can quickly adapt to unexpected changes and disruptions.	3.79	0.860	1
2	The company effectively balances flexibility and efficiency in supply chain operations.	3.63	1.059	5
3	Strategic supplier partnerships contribute to long-term supply chain resilience.	3.71	1.549	3
4	Digital transformation has improved supply chain visibility and responsiveness.	3.77	0.911	2
5	Continuous monitoring and performance evaluation enhance supply chain sustainability.	3.69	0.891	4

The results of the Supply Chain Resilience section highlight SABIC's ability to adapt to supply chain challenges and maintain operational stability. The highest-rated statement, with a

mean score of 3.79, indicates that respondents generally agree that SABIC's supply chain can quickly adapt to unexpected changes and disruptions. This suggests that the company has effective risk response mechanisms, agile operational strategies, and contingency planning in place. The relatively low standard deviation ($SD = 0.860$) indicates a strong consensus among respondents regarding SABIC's adaptability in managing disruptions. The second highest-rated statement, with a mean score of 3.77, highlights that digital transformation has improved supply chain visibility and responsiveness. This suggests that investments in digital technologies, such as real-time tracking, AI-driven analytics, and cloud-based platforms, have enhanced SABIC's ability to monitor and react to supply chain disruptions efficiently. The moderate standard deviation ($SD = 0.911$) indicates some variation in perceptions, suggesting that while digital transformation has been beneficial, certain areas within the supply chain may still require further technological integration and optimization. The statement regarding strategic supplier partnerships contributing to long-term supply chain resilience ranked third, with a mean score of 3.71. This indicates that respondents recognize the importance of strong supplier relationships in maintaining supply chain stability, ensuring consistent material flow, minimizing supply risks, and improving collaborative decision-making. However, the high standard deviation ($SD = 1.549$) suggests significant variation in responses, which may indicate differences in supplier performance, dependency levels, or challenges in supplier collaboration across different regions or supply chain functions. The statement that continuous monitoring and performance evaluation enhance supply chain sustainability received a mean score of 3.69, ranking fourth. This suggests that SABIC has mechanisms in place to track supply chain performance, assess risks, and implement continuous improvement initiatives. However, the standard deviation ($SD = 0.891$) indicates some level of variability, suggesting that while monitoring processes are in place, there may be inconsistencies

in their implementation or effectiveness across different supply chain segments. The lowest-rated statement, with a mean score of 3.63, relates to SABIC's ability to balance flexibility and efficiency in supply chain operations. The higher standard deviation ($SD = 1.059$) suggests varying perceptions among respondents, indicating that while some areas of the supply chain effectively balance efficiency and flexibility, others may struggle with trade-offs between cost reduction, operational agility, and resource optimization. This highlights an opportunity for improvement in enhancing operational flexibility while maintaining efficiency in supply chain processes. The findings indicate that SABIC's supply chain is resilient and adaptable to disruptions, with digital transformation and strategic supplier partnerships playing a significant role in ensuring operational stability. However, there are areas for further enhancement, particularly balancing flexibility with efficiency, strengthening supplier collaboration, and ensuring consistent monitoring and performance evaluation. To further enhance supply chain resilience, SABIC should continue investing in digital transformation, optimize supplier management strategies, and refine operational flexibility to adapt to market fluctuations and unforeseen disruptions.

There is a statistically significant effect of operations management—encompassing quality management, process optimization, and risk management—on the supply chain resilience at Saudi Basic Industries Corporation (SABIC)

Table 9 statistics of the model related to H

R	R²	R² Modified	F	Sig
0.29	0.09	0.273	5.76	0.000

Table 10 Parameters estimates and significance for H1

Variables	
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	Regression Factor	Standard error	Beta	T- Value	Significance Level
Effect of operations management—encompassing quality management, process optimization, and risk management—on the supply chain resilience	0.34	0.18	0.62	2.23	0.000

The statistical analysis of H1 examines the effect of operations management—encompassing quality management, process optimization, and risk management—on supply chain resilience at Saudi Basic Industries Corporation (SABIC). The findings, as presented in Table 10, indicate that the model has an R-value of 0.29, which suggests a moderate correlation between operations management and supply chain resilience. The R^2 value of 0.09 implies that approximately 9% of the variation in supply chain resilience can be explained by operations management, highlighting the influence of quality management, process optimization, and risk management on improving supply chain stability. The adjusted R^2 value of 0.273 further suggests that when adjusting for the number of predictors, operations management still plays a meaningful role in explaining the variation in supply chain resilience.

The F-statistic value of 5.76, with a significance level of 0.000, confirms that the model is statistically significant, indicating that the relationship between operations management and supply chain resilience is not due to random chance. Further analysis in Table 11, which presents the parameter estimates and significance for H1, reinforces these findings. The regression coefficient (B) of 0.34 suggests that a unit increase in operations management effectiveness leads

to a 0.34 increase in supply chain resilience. The standard error of 0.18 indicates a moderate level of variability in the estimated effect. The Beta coefficient of 0.62 suggests that operations management has a strong positive impact on supply chain resilience. Additionally, the T-value of 2.23 and the significance level of 0.000 confirm that the effect of operations management on supply chain resilience is statistically significant, reinforcing the reliability of the model. The results of the regression analysis support the hypothesis that operations management, including quality management, process optimization, and risk management, has a significant and positive impact on supply chain resilience at SABIC. These findings highlight the importance of strategic operational improvements in enhancing supply chain efficiency, reducing vulnerabilities, and ensuring long-term stability in a competitive market environment. However, while the model demonstrates a significant effect, the moderate R^2 value suggests that additional factors beyond operations management may also contribute to supply chain resilience, warranting further investigation into complementary strategies such as supplier collaboration, digital transformation, and agility in supply chain processes.

Chapter : Discussion and conclusion

1.1. Discussion

The findings of this study emphasize the critical role of operations management in enhancing supply chain resilience at Saudi Basic Industries Corporation (SABIC). By evaluating the effects of quality management, process optimization, and risk management, the research highlights how these operational factors contribute to ensuring a robust, adaptable, and efficient supply chain. The results indicate that quality management significantly impacts supply chain resilience by ensuring consistency, regulatory compliance, and supplier reliability. The highest-rated statements suggest that continuous improvement programs, quality audits, and compliance measures are strongly embedded within SABIC's operational framework. However, areas related to supplier quality management and strict quality control standards received slightly lower scores, indicating potential gaps in supplier oversight. These findings suggest that while SABIC maintains strong internal quality standards, further enhancements in supplier collaboration and quality enforcement could further strengthen supply chain resilience.

Process optimization emerged as a key driver of supply chain resilience, with respondents recognizing the positive impact of process improvements on reducing inefficiencies and delays. The findings suggest that SABIC has successfully implemented automation, data analytics, and workflow optimization to improve operational efficiency. However, high variability in responses regarding the effectiveness of digital transformation and lean management practices suggests that these strategies are not yet fully optimized across all supply chain operations. This highlights an opportunity for SABIC to expand digital transformation efforts, integrate AI-driven decision-making, and refine lean methodologies to maximize efficiency and adaptability. Risk management plays a pivotal role in mitigating disruptions and ensuring business continuity. The findings confirm that SABIC has a well-defined risk management framework, incorporating predictive analytics and supplier risk assessment to enhance supply chain stability. The high rating for predictive analytics suggests that data-driven risk management strategies are effective; however, variability in responses indicates inconsistencies in risk assessment updates and contingency planning across different departments. This underscores the need for more frequent risk evaluations, better communication of risk policies, and standardized implementation of mitigation strategies to enhance resilience. The statistical analysis supports the hypothesis that operations management—encompassing quality management, process optimization, and risk management—has a statistically significant effect on supply chain resilience at SABIC. The model demonstrates a moderate correlation ($R = 0.29$) and a significant relationship ($p = 0.000$) between these

operational dimensions and supply chain resilience. However, the moderate R^2 value (0.09) suggests that while operations management contributes to supply chain resilience, other external factors may also play a significant role. These may include supplier relationships, technological advancements, regulatory frameworks, and global market dynamics, which warrant further exploration. The findings of this study highlight several strategic recommendations for SABIC to further enhance its supply chain resilience:

1. Strengthening Supplier Quality Management – Improving supplier collaboration, quality audits, and compliance monitoring will help ensure consistency in raw material integrity and minimize supply chain risks.
2. Expanding Digital Transformation – Further investments in AI-powered analytics, IoT-based monitoring, and blockchain for supply chain transparency can enhance real-time decision-making and operational efficiency.
3. Optimizing Risk Management Frameworks – Regular updates to risk assessment methodologies, contingency planning, and crisis response strategies will help mitigate vulnerabilities across the supply chain.
4. Balancing Flexibility and Efficiency – Integrating lean and agile operational models will help optimize cost-efficiency while maintaining supply chain adaptability to disruptions.

This study provides valuable insights into the relationship between operations management and supply chain resilience at SABIC. While the findings confirm a statistically significant impact of quality management, process optimization, and risk management, the moderate R^2 value suggests that additional factors influence supply chain resilience. Future research should explore the role of supplier collaboration, emerging technologies, and regulatory changes in further strengthening supply chain stability. By implementing the recommended strategic improvements, SABIC can enhance its competitive advantage, minimize risks, and sustain long-term supply chain resilience in an increasingly dynamic global market.

1.2. Recommendations

Based on the findings of this study, the following recommendations are proposed to enhance supply chain resilience at Saudi Basic Industries Corporation (SABIC) through improved operations management:

- Establish more rigorous supplier evaluation and certification programs to ensure consistent quality standards.
- Implement real-time quality monitoring systems to track supplier performance and detect potential risks early.
- Enhance IoT-enabled monitoring systems to track shipments, inventory levels, and supplier performance in real-time.
- Integrate blockchain technology to improve supply chain transparency, traceability, and fraud prevention.
- Automate workflow processes and data-driven decision-making to enhance operational efficiency and reduce human error.
- Develop dual-sourcing strategies for critical raw materials to reduce dependency on single suppliers.
- Improve communication and coordination between supply chain partners by leveraging cloud-based collaboration platforms.
- Strengthen cross-functional collaboration within the organization to align operations, procurement, and logistics teams for faster decision-making.
- Develop scenario-based planning models to proactively respond to unexpected market changes or supply chain disruptions.
- Establish a comprehensive KPI framework to measure supply chain resilience, focusing on efficiency, responsiveness, and risk mitigation.
- Foster a culture of continuous improvement (Kaizen) within supply chain operations to ensure ongoing enhancements in processes.

1.3. Future Work

While this study provides valuable insights into the impact of operations management on supply chain resilience at Saudi Basic Industries Corporation (SABIC), there are several areas that warrant further investigation to deepen understanding and enhance practical applications. The following future research directions are proposed:

- Conduct a comparative study analyzing supply chain resilience across multiple industries, such as oil and gas, pharmaceuticals, and automotive sectors, to benchmark SABIC's performance against global best practices.
- Extend the study to include other multinational corporations in the petrochemical sector, assessing how different organizations implement operations management strategies for supply chain resilience.
- Investigate regional variations in supply chain resilience within different global supply chains to identify location-specific challenges and opportunities.
- Explore the role of artificial intelligence (AI), blockchain, and Internet of Things (IoT) in optimizing supply chain operations and enhancing risk mitigation strategies.
- Assess the effectiveness of predictive analytics in forecasting disruptions and improving proactive decision-making in supply chain operations.
- Investigate the potential of robotic process automation (RPA) and digital twin technology in simulating supply chain scenarios to enhance crisis preparedness.
- Analyze the role of sustainable supply chain practices, circular economy strategies, and carbon footprint reduction initiatives in enhancing long-term supply chain resilience.

Future research should focus on leveraging emerging technologies, expanding sustainability initiatives, enhancing supplier collaboration, and evaluating human factors in supply chain management. By addressing these areas, researchers can provide more comprehensive strategies for enhancing supply chain resilience in the face of global uncertainties, technological disruptions, and evolving market demands. This will enable organizations like SABIC to remain competitive, agile, and sustainable in the rapidly changing industrial landscape.

1.4. Conclusion

This study examined the impact of operations management—encompassing quality management, process optimization, and risk management—on supply chain resilience at Saudi Basic Industries Corporation (SABIC). The findings confirm that effective operational strategies play a significant role in enhancing supply chain stability, efficiency, and adaptability in response to disruptions. The results indicate that quality management practices, including strict quality control measures and supplier oversight, contribute to minimizing errors and ensuring product consistency. However, there is a need for stronger supplier quality monitoring and enhanced compliance mechanisms to further strengthen resilience. Process optimization efforts, particularly automation and workflow improvements, have been instrumental in reducing inefficiencies, but challenges remain in fully integrating lean and digital transformation strategies. Additionally, risk management, particularly predictive analytics and contingency planning, emerged as a key factor in mitigating supply chain disruptions. Despite these strengths, more frequent risk assessments and enhanced coordination across departments are required to standardize risk mitigation efforts. The statistical analysis supports the hypothesis that operations management has a statistically significant effect on supply chain resilience. However, the moderate R^2 value suggests that additional external factors—such as supplier collaboration, market dynamics, and regulatory influences—also contribute to resilience, highlighting the need for a more holistic approach. To further enhance supply chain resilience, SABIC should focus on supplier quality assurance, digital transformation, risk mitigation frameworks, and an optimal balance between efficiency and flexibility. Implementing advanced technologies such as AI, IoT, and blockchain, alongside sustainable supply chain practices and strategic supplier partnerships, will be essential in strengthening long-term operational stability and competitiveness.

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Appendix

SURVEY INSTRUMENT

Introduction to the Questionnaire

This questionnaire is designed to assess the role of Operations Management in enhancing Supply Chain Resilience at Saudi Basic Industries Corporation (SABIC). As supply chains face increasing challenges due to global uncertainties, businesses must implement effective strategies in quality management, process optimization, and risk management to ensure stability and efficiency. The objective of this survey is to gather insights from employees and stakeholders involved in supply chain operations to evaluate the effectiveness of SABIC's operational strategies in maintaining resilience. The questionnaire is divided into four key sections: Quality Management, Process Optimization, Risk Management, and Supply Chain Resilience. Each section consists of five items designed to measure respondents' perceptions and experiences regarding the impact of operations management on supply chain performance. The collected data will be analyzed using quantitative methods to identify trends, challenges, and areas for improvement. Your participation in this survey is highly valuable, as it will contribute to understanding how SABIC can strengthen its supply chain resilience through effective operational strategies. All responses will be kept confidential and used solely for research purposes.

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Section 1: General Information

Please answer the following questions

Gender:

Male

Female

Age group:

- ✓ I'm under 30 years old.
- ✓ 30 –40 years old.
- ✓ 40- 50 years old.
- ✓ 50 or more.

Educational level:

- ✓ Bachelor's degree
- ✓ Master's degree
- ✓ Doctorate degree

Years of experience:

- ✓ 1 – 5 years.
- ✓ 6- 10 years.
- ✓ 11- 15 years.
- ✓ 16 or more years.

1. Questionnaire terms

Please, mark with (✓) on your selection.

No	Term	Strongly agree	Agree	Neutral	disagree	Strongly disagree
Section 1: Quality Management						
1	SABIC's quality management processes ensure consistency in product and service delivery.					
2	The company maintains strict quality control standards to prevent supply chain disruptions.					
3	Continuous improvement programs are implemented to enhance product and process quality.					
4	Quality audits and compliance checks are regularly conducted within the supply chain.					
5	Supplier quality management is a key priority to ensure resilient supply chain operations.					

Section 2: Process Optimization					
1	SABIC utilizes advanced technologies to optimize supply chain operations.				
2	Process improvements have significantly reduced inefficiencies and delays in supply chain activities.				
3	Automated systems and data analytics contribute to better decision-making and operational efficiency.				
4	Lean management practices are applied to enhance supply chain productivity.				
5	There is a strong emphasis on streamlining workflows to minimize waste and improve performance.				
Section 3: Risk Management					

1	The company has a well-defined risk management framework to address supply chain disruptions.					
2	Risk assessment and mitigation strategies are regularly reviewed and updated.					
3	Supplier risk management is a critical component of SABIC's supply chain strategy.					
4	Contingency plans and alternative sourcing strategies are in place for crisis situations.					
5	The organization leverages predictive analytics to identify and address potential supply chain risks.					
Section 4: Supply Chain Resilience						
1	SABIC's supply chain can quickly adapt to unexpected changes and disruptions.					
2	The company effectively balances flexibility and efficiency in supply chain operations.					

3	Strategic supplier partnerships contribute to long-term supply chain resilience.					
4	Digital transformation has improved supply chain visibility and responsiveness.					
5	Continuous monitoring and performance evaluation enhance supply chain sustainability.					

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