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Researcher.

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Chapter 1

INTRODUCTION

Introduction

The COVID-19 pandemic significantly affected worldwide supply chains, highlighting critical weaknesses that several firms had not previously acknowledged. Government-imposed lockdowns and social distancing measures significantly impeded the flow of goods and services, creating substantial operational challenges across various sectors. These disruptions underscored the pressing demand for effective risk management techniques to address uncertainty and ensure business continuity during crises.

Artificial Intelligence (AI) has become a transformative element in supply chain management, allowing firms to detect potential risks, evaluate their consequences, and respond proactively. AI-driven solutions facilitate predictive analytics, real-time monitoring, and adaptive planning, enabling businesses to foresee disruptions, optimize resource distribution, and react promptly to market variations. A significant domain where AI has demonstrated potential is demand forecasting, especially in times of considerable uncertainty. However, the utilization of AI for forecasting abrupt demand fluctuations, particularly those instigated by the pandemic, is yet inadequately investigated in emerging economies.

Several recent research has investigated the impact of AI on improving supply chain performance within the COVID-19 problem. (Queiroz, 2020) highlighted the need of AI technology in enhancing supply chain visibility and resilience amid interruptions caused by the epidemic. (Ivanov D. &, 2020) emphasized that AI-enabled decision-making enhanced the

agility and adaptability of supply chain responses in uncertain conditions. Notwithstanding these global insights, there is a deficiency of empirical research concentrating on AI applications in supply chain risk management and demand forecasting within the Saudi context.

This thesis examines the impact of AI-driven risk management on improving supply chain resilience during and after the COVID-19 pandemic in Saudi Arabia, addressing the identified gap. The report examines how AI technologies have facilitated decision-making, enhanced proactive risk mitigation techniques, and allowed Saudi enterprises to adjust to new difficulties. The research seeks to uncover the primary advantages, constraints, and contextual factors of AI adoption in the Saudi supply chain landscape through empirical analysis and case studies of local enterprises.

Research problem

The COVID-19 epidemic has exposed considerable weaknesses in supply chain systems throughout Saudi Arabia, resulting in manufacturing delays, interruptions in import and export operations, and difficulties in demand forecasting. These disturbances have shown the shortcomings of conventional risk management strategies, leading to operational inefficiencies, inventory discrepancies, and logistical impediments. Although global literature emphasizes the increasing significance of artificial intelligence (AI) in improving supply chain resilience and predictive powers, empirical research examining its practical use within the Saudi environment is limited. Specifically, there is a deficiency of study examining how Saudi enterprises have incorporated AI technology to enhance demand forecasting, inventory management, and comprehensive risk mitigation during and subsequent to the pandemic. This study seeks to address the gap by examining the experiences of Saudi enterprises in implementing AI-driven solutions and identifying context-specific ways to enhance supply chain resilience during future disruptions.

Study objectives

Main Objective:

This study's main goal is to investigate how artificial intelligence (AI) can improve Saudi Arabia's supply chain resilience both during and after the COVID-19 pandemic, with an emphasis on trade operations, demand forecasting, inventory control, and risk management.

Specific Objectives:

- To research supply chain risk management during the COVID-19 pandemic using AI technologies.
- to evaluate how well demand forecasting techniques driven by AI predict customer behaviour and control inventory levels.
- to investigate how AI can help with better inventory control, including lowering overstock and stockouts.
- to investigate how AI may improve domestic production methods and adjust to the needs of regional markets.
- to examine the ways in which AI has been applied to increase logistical efficiency and compliance while simplifying import and export processes.
- to find the best practices by examining case studies of companies that have implemented risk management techniques powered by AI.
- in the Saudi context, to suggest practical frameworks for applying AI into supply chain risk management.
- To provide suggestions for policies that focus on promoting supply chain operations to use artificial intelligence.
- To provide a scholarly contribution to the field of supply chain resilience and risk management using technology.

- To assist in data-driven decision-making by providing business executives with insights that direct their strategic planning and technology expenditures.

The importance of the study

This research is significant from an academic and practical perspective. From the point of view of science, it adds to the growing body of knowledge on how artificial intelligence (AI) may improve supply chain risk management, especially during an international crisis like the COVID-19 pandemic. This study offers important insights into how new technologies might enhance operational resilience in unpredictable contexts by looking at AI applications in fields including demand forecasting, inventory management, and decision-making. Additionally, it fills a significant gap in the literature on the application of AI in Saudi Arabia's supply chain environment, providing a regional perspective on international issues.

From an economic standpoint, the study provides policymakers and business managers useful suggestions. The study helps firms become more responsive and agile by examining how they might use AI to manage supply chain interruptions, increase forecasting accuracy, simplify inventory control, and localize production processes. It also emphasizes how AI may facilitate more intelligent strategic planning and streamline import and export processes. Ultimately, by guaranteeing consistency and efficiency in supply chain operations, the study seeks to help firms provide better customer service, increasing satisfaction and loyalty.

Study questions

Main Research Question:

In what ways has artificial intelligence (AI) improved Saudi Arabia's supply chain resilience and risk management during and after the COVID-19 pandemic?

Sub-Questions:

1. Which artificial intelligence (AI) tools have Saudi companies implemented to control supply chain risks during the pandemic?
2. How does artificial intelligence help find weaknesses and disruptions in supply chain operations?
3. What difficulties did Saudi supply chains face during the COVID-19 epidemic that made AI-based risk management necessary?
4. What are the most important takeaways from Saudi businesses who have effectively incorporated AI into their supply chain processes?

Study hypotheses

Main Hypothesis:

The adoption of AI-driven technology and the enhancement of supply chain resilience and risk management in Saudi Arabia during and after the COVID-19 pandemic are statistically correlated.

Sub-Hypotheses:

H1: The ability of supply chain managers to reduce risks during disruptive events like the COVID-19 pandemic is positively impacted by the usage of AI technologies.

H2: When it comes to supply chain risk management, businesses that use AI show more operational stability and resilience than those that don't.

H3: The efficacy of AI-powered supply chain solutions is considerably tempered by business culture and preparedness for digital transformation.

H4: The performance and responsiveness of supply chains during the pandemic are favorably impacted by the degree of AI integration in supply chain operations.

Theoretical premises of study

This study is based on theoretical premises that combine essential concepts from risk management and supply chain resilience, specifically emphasizing the application of artificial intelligence (AI) to improve preparedness, responsiveness, and continuity during disruptions like the COVID-19 pandemic. The premise aligns with the study's main objective: to evaluate the role of AI-driven risk management practices in enhancing supply chain resilience in the Kingdom of Saudi Arabia during and after the pandemic. The essential elements of this premises are

- **Risk definition:** Risk is characterized as any uncertain event or condition that, upon occurrence, could influence the attainment of supply chain objectives. This study defines risk as events that specifically interrupt the flow of goods, information, or services within supply chain networks. This definition establishes the framework for understanding the scope of inquiry concerning the events that AI systems are intended to identify and handle.
- **Types of Risk:** The analysis examines various categories of risks pertinent to supply chains in times of crisis. These encompass Operational risks (delays, equipment malfunctions, or workforce shortages). Strategic risks inability to adjust to changes in the market or shifts in consumer preferences. Financial risks variations in currency exchange rates, increasing expenses, or liquidity challenges. External threats, health crises, political unrest, or ecological catastrophes. The incorporation of various risk types enhances the study's aim to investigate the ways in which AI tools manage both internal and external disruptions.
- **Risk Classification** According to the type of organization or project Risks are not consistent; they differ depending on the sector and the organizational framework. Logistics firms might emphasize the risks associated with inventory and

transportation, whereas manufacturing organizations tend to concentrate on procurement and ensuring production continuity. This analysis utilizes this classification to assess the adaptation of AI models to the unique risk profiles of various industries, especially in the context of the Saudi market.

- **Sources of Risk :** This component pinpoints the sources of risks—whether they arise from internal processes (such as supplier delays or system failures) or external factors (like pandemic-related lockdowns or policy changes). The investigation seeks to explore the role of AI in the early identification and tracking of these sources through the analysis of extensive datasets and the recognition of patterns in real time.
- **Steps of Risk Management:** A systematic approach to risk management is fundamental to this framework and encompasses Identification (recognizing initial signs of disturbances. Artificial intelligence plays a significant role by providing predictive analytics and generating automated alerts). Assessment: analyzing (the probability and impact of risks through data-informed models). Response Planning (developing proactive strategies, including the diversification of suppliers and the adjustment of logistics routes). Monitoring (employing AI systems for the real-time observation of risk indicators). Control: (promptly initiating corrective measures). The stages align with the goal of determining the ways in which AI facilitates both proactive and reactive strategies within supply chain risk contexts.
- **Integration with AI and Research Goals** Each of the aforementioned components is analyzed in relation to the study's primary inquiry: how does the implementation of AI-driven risk management improve supply chain resilience in KSA? The premises facilitate an examination of AI's function not merely as a technical instrument but as a strategic facilitator that evolves conventional risk management into a more flexible, data-driven, and robust framework—one equipped to endure challenges such as COVID-19.

Supply chain risk management must incorporate artificial intelligence (AI), especially in the wake of disruptions like COVID-19. Other theoretical frameworks, including Supply Chain Resilience Theory, place more emphasis on adaptability than the Resource-Based View, which highlights AI as a strategic advantage. Agile Supply Chain Theory and Digital Supply Chain Transformation are two recent ideas that show how AI improves responsiveness and enables real-time decision-making. Collectively, these theories demonstrate how AI could enhance supply chain performance through proactive risk identification and mitigation.

Table 1: Theories table

Theory	Description	Author	Date
Supply Chain Resilience Theory	This idea emphasizes how crucial it is for supply chains to be flexible and resourceful to anticipate, prepare for, respond to, and recover from disruptions. (Christopher, 2004)	(Christopher, 2004)	2004
Resource-Based View (RBV)	states that having unique resources and expertise gives businesses a competitive edge and that artificial intelligence (AI) can be a useful tool for increasing productivity. (Barney, 1991)	(Barney, 1991)	1991
Technology Acceptance Model (TAM)	Explains how users accept and utilize technology, concentrating on perceived ease of use and utility as essential elements driving adoption. (Davis, 1989)	(Davis, 1989)	1989
Big Data Analytics Framework	Big data and analytics are crucial for	(Waller, 2013)	2013

	improving supply chain decision-making. Everything runs more smoothly because they assist us in better evaluating and controlling risks. (Waller, 2013)		
Complexity Theory	Explains that supply chains are like living organisms that alter and adapt, and we can utilize AI to make superior choices and maintain strong (McCarthy, 2009)	(McCarthy, 2009)	2009
Dynamic Capabilities Framework	This demonstrates how a business may adjust and modify its competencies to suit unusual situations, with AI assisting them in maintaining its leadership position in risk management. (Teece, 2007)	(Teece, 2007)	2007
Supply Chain Risk Management (SCRM) Models	Create methodical techniques for identifying and addressing supply chain risks while using AI to improve forecasting. (Jüttner, 2011)	(Jüttner, 2011)	2011

Institutional Theory	This study investigates how external forces, such as rules and conventions, influence organizational behavior. It focuses on how these factors affect the adoption of AI, with a particular focus on Saudi Arabia. (DiMaggio, 1983)	(DiMaggio, 1983)	1983
Digital Supply Chain Transformation Theory	brings focus on how AI, IoT, and big data are transforming traditional supply chains into digital ecosystems that improve agility and risk management. (Ivanov D. , 2020)	(Ivanov D. , 2020)	2020
Agile Supply Chain Theory	suggests that AI technologies that enable real-time decision-making enhance supply chain agility, which is the capacity to react quickly to market changes and disturbances. (Dubey R. G., 2020)	Dubey, R., Gunasekaran, A., (Dubey R. G., 2020)	2020
Resilient Digital Supply Chain Theory	combines digitalization and	(Singh, 2021)	2021

	resilience, suggesting that a supply chain driven by digital technology is more resilient and capable of managing disruptions. (Singh, 2021)		
AI-Enhanced Risk Management Theory	This article examines how artificial intelligence (AI) solutions may transform supply chain risk management by providing real-time monitoring and predictive analytics, which will boost productivity and effectiveness. (Choi, 2020)	(Choi, 2020).	2020

Chapter 2

LITERATURE REVIEW

Introduction

The current literature on artificial intelligence (AI) and its potential to improve supply chain risk management is thoroughly reviewed in this chapter, with an emphasis on the COVID-19 pandemic's effects. Supply chain resilience (a dependent variable) and artificial intelligence applications (an independent variable) are the two main variables of the study that are defined and examined first in the literature review. After that, it talks about pertinent theoretical frameworks and evaluates earlier research that looked at related topics. This chapter attempts to show how the proposed research adds to the body of knowledge in the domains of supply chain management and artificial intelligence, identify research needs, and lay the academic basis for the current study.

Dependent variables (Supply chain resilience)

The ability of a supply chain to anticipate, react to, and recover from disruptive events while continuing to function is known as supply chain resilience. In this study, it is the primary outcome variable that measures how well supply chains function in difficult circumstances, like the COVID-19 pandemic induced. Better forecasting, automation, and quick decision-making are all made possible by AI, which increases resilience. The foundation of resilience is agility, visibility, adaptation, and cooperation throughout the supply chain network.

Independent Variable (Artificial intelligence in supply chains)

The use of artificial intelligence in supply chain management is the study's independent variable. Artificial intelligence (AI) tools including automation, computer vision, machine learning, and predictive analytics are being used more and more to reduce risks, anticipate interruptions, maximize inventories, and optimize supply chain processes. Understanding how well AI works to improve risk management and resilience during emergencies like the COVID-19 pandemic depends on how widely it is adopted and integrated.

Summary and Discussion of Literature Review

AI improves supply chains' resilience and agility, particularly in environments that are disturbed, according to the research. Adaptive planning, logistics automation, and AI-driven forecasting helped firms better handle demand changes, inventory shortages, and transportation constraints during the COVID-19 epidemic. There is a growing interest in digital transformation, according to Saudi Arabian studies, but there is no data on the long-term effects of AI integration. This study intends to close that gap by concentrating on the practical uses and advantages of AI in Saudi companies throughout the pandemic.

In addition to the gaps that have been identified, it is crucial to emphasize that most of prior research has focused on either the technological capabilities of artificial intelligence or on general supply chain management practices. However, very few have examined how AI could be specifically customized for risk mitigation during global crises, particularly in developing nations like Saudi Arabia. There is a great chance for investigation because of this contextual gap. This study intends to offer a comprehensive knowledge of how AI-driven solutions might be tailored to the regulatory, economic, and cultural landscape of Saudi supply chains by

integrating global findings with regional applications. This alignment guarantees both practical usefulness and theoretical importance.

Theoretical framework of the study

This research is supported by several theoretical frameworks:

- Resource-Based View (RBV): Presents AI as a strategic asset that provides a competitive edge by virtue of its automation and predictive insight capabilities (Barney, 1991)
- Supply Chain Resilience Theory: Highlights the necessity of recovery capability, flexibility, and adaptability in supply networks that are subject to disturbances (Christopher, 2004)
- The Agile supply chain theory emphasizes the importance of flexibility and responsiveness in handling uncertainty, which AI solutions facilitate with real-time analytics and data (Dubey R. G., 2020)
- The theory of digital supply chain transformation presents artificial intelligence (AI) as a major facilitator of supply networks that are digital, flexible, and interconnected (Ivanov D. , 2020)

Several frameworks that altogether describe the strategic and operational utility of artificial intelligence (AI) in supply chain risk management create the basis of the theoretical framework that directs this investigation. AI is positioned by the Resource-Based View (RBV) (Barney, 1991) as a useful organizational resource that provides a competitive edge by improved efficiency and decision-making. The theory of supply chain resilience places a strong emphasis on recovery and adaptation, and artificial intelligence helps by facilitating prompt reactions to shocks (Christopher, 2004). The notion that AI improves agility and rapidity in responding to

market changes is supported by the Agile Supply Chain Theory (Dubey R. G., 2020). Lastly, the Digital Supply Chain Transformation Theory emphasizes how AI is a key enabler of the move toward data-driven, collaborative systems (Ivanov D. &, 2020). Collectively, these frameworks support the study's emphasis on artificial intelligence (AI) as a game-changing instrument for enhancing supply chain resilience, particularly in cases of crisis like the COVID-19 pandemic.

Chapter 3

RESEARCH METHADODOLOGY

Introduction

The research approach utilized to examine how AI-driven risk management might improve supply chain resilience in Saudi Arabia during and after the COVID-19 pandemic is presented in this chapter. Using a quantitative research design, the study only uses information gathered via structured online surveys. This method works effectively for gathering quantifiable, broadly applicable insights from a variety of supply chain experts. The research design, target population, sampling strategies, data collection methodologies, scope and constraints, and data analysis methods are all described in this chapter.

Research design

To gather standardized data from a large sample of participants within a certain timeframe, the study uses a quantitative, cross-sectional survey methodology. Analysis of patterns, connections, and trends in the use of artificial intelligence (AI) to supply chain risk management during and after the COVID-19 pandemic is made possible by this method.

A structured questionnaire is used as the main research tool and is intended to assess the following:

- the level of AI adoption in supply chain operations
- Impact on resilience and operational continuity
- perceived efficacy in risk mitigation

This design facilitates statistical analysis and aids in providing effective, objective answers to the research questions.

Research Community

The study focuses on Saudi Arabian companies who have already incorporated AI technologies into their supply chain operations or are currently doing so. The emphasis is on industries where risk management is essential and that were most impacted by the epidemic, such as:

- Logistics (e.g., shipping, warehousing, transportation)
- Manufacturing (e.g., production and industrial operations)
- Retail and E-commerce

Professionals that participated in supply chain decision-making during the COVID-19 pandemic and have direct experience with the use of AI solutions to mitigate risk and interruptions comprise the responders.

Sample Characteristics

The study's target population consists of professionals employed by Saudi Arabian companies in supply chain-related positions. The sample comprises persons who actively participated in operational or strategic decision-making about the implementation and application of artificial intelligence (AI) technology in supply chain risk management between 2020 and 2025. These people work as procurement officers, supply chain managers, operations managers, IT professionals, and executive-level decision makers, among other roles. Their direct experience with AI systems that predicted, mitigated, or managed supply chain disruptions during and after the COVID-19 epidemic is what led to their selection. All participants must have real-world

supply chain operations expertise and comprehend how AI has been included into their organizational procedures in order to guarantee the authenticity and applicability of the results. The study guarantees that the data gathered represents knowledgeable viewpoints on the function of AI in boosting supply chain resilience by concentrating on this professional group.

Sample Size Determination

In order to maintain statistical validity and take into account practical limitations, the sample size for this study has been carefully chosen. The ideal number of completed survey replies is 150 in order to enable meaningful quantitative analysis, such as correlation tests and descriptive statistics. This sample size maintains feasibility in terms of data collection and processing while also guaranteeing representativeness of the larger population. Because it allows for the observation of patterns and connections between variables without requiring an overly large population, it is especially well-suited for studies that use categorical data and Likert-scale responses. The number was selected in accordance with current research guidelines for survey-based investigations in supply chain and organizational contexts, where a sample size of 50 - 80 participants is frequently seen to be sufficient for examining trends and broad perceptions. The study focus on experts who had direct knowledge of AI implementation during the COVID-19 pandemic further reduces the pool of potential participants. The study intends to gather a thorough understanding of how AI-driven risk management techniques were seen and implemented in actual supply chain environments by focusing on 50 respondents from a variety of industries, including manufacturing, retail, and logistics. Thus, this sample size is appropriate for the goals of the study and statistically justifiable.

Data collection procedure

A designed online survey questionnaire created for collecting quantitative insights from experts engaged in supply chain operations in Saudi Arabia is the only method used to gather data for this study. To guarantee consistency, ease of analysis, and respondent involvement, the questionnaire consists of a variety of closed-ended questions, mostly employing multiple-choice alternatives, ranking formats, and Likert scales. The questionnaire is organized into multiple sections, including: organizational characteristics, risk management strategies used during the COVID-19 period, the extent and type of AI integration, professional and demographic background, and the perceived impact of AI tools on supply chain performance and resilience. The survey is conducted using publicly available online tools like Qualtrics, Microsoft Forms, and Google Forms, which provide flexible and safe response gathering. In order to ensure a varied and useful sample of responders, distribution is carried out through corporate mailing lists, industry-specific social media groups, professional organizations, and individual academic contacts. A limited group of professionals who fit the study's eligibility requirements participate in a pilot test to improve the instrument's clarity and reliability. Before releasing the final survey, feedback from the pilot is used to improve the phrasing of the questions, modify the scales, and eliminate any ambiguity. Informed consent is acquired at the start of the questionnaire, and participation is completely voluntary. Because no personally identifiable information is asked for or kept, responses are gathered in confidence, guaranteeing compliance with ethical research guidelines and maintaining participant confidentiality all along the way.

Study Scope and Limitations

This study is geographically limited to the Kingdom of Saudi Arabia, concentrating especially on enterprises who implemented or incorporated AI technology into their supply chain

operations during and after to the COVID-19 epidemic. The study's logical scope extends from 2020 to 2025, encompassing the peak crisis phase, the subsequent recovery era, and the current adaption stage. The research focuses exclusively on the application of artificial intelligence in supply chain risk management, excluding other developing technologies such as blockchain, IoT, and robotic process automation. The study refrains from generalizing conclusions across all industries or nations, concentrating instead on the distinct issues and responses specific to the Saudi market. The research is methodologically limited as it depends exclusively on self-reported data from survey participants, potentially introducing bias from subjective interpretations, performance overestimation, or social desirability influences. Furthermore, although the poll aims at individuals with pertinent experience, there may be discrepancies in respondents' comprehension of AI technology and their organization's risk management approaches. The omission of qualitative methodologies, such as interviews or case studies, constrains the study's capacity to capture profound narratives and contextual subtleties. Notwithstanding these limitations, the systematic and focused design of the survey guarantees that the gathered data is valid, consistent, and analytically valuable for resolving the specified research questions.

Statistical Analysis method

Quantitative statistical methods will be utilized in order to conduct the analysis of the data that was gathered through the structured online survey. The major analytical tool that will be utilized is IBM SPSS Statistics. The statistical package known as SPSS was chosen because of its capacity to handle big datasets, its capacity to carry out advanced statistical processes, and its suitability for study in the fields of social science and business. The first step in the study will be to collect descriptive statistics, which will include frequencies, percentages, means, and standard deviations. These statistics will be used to describe the characteristics of the respondents as well as important variables, such as the levels of AI adoption and risk

management techniques. With the help of these descriptive measures, a clear overview of the data will be provided, and initial pattern detection will be supported. Following that, a correlational analysis will be carried out in order to investigate the possible connections that exist between the variables. For instance, the relationship between the degree of artificial intelligence integration and the perceived gains in supply chain resilience will be investigated. For the purpose of determining the strength and direction of relationships, statistical significance tests, such as Pearson's correlation coefficient, will be utilized in situations where they are not otherwise applicable. There is also the possibility of using Microsoft Excel in the preliminary phases of data cleansing, organization, and basic visualization stages. Tables, bar charts, and graphs will be used to illustrate the final results in order to make interpretation easier and to improve the clarity of the presentation of the data. The application of this analytical technique makes it possible to conduct a thorough analysis of the ways in which artificial intelligence technologies have impacted supply chain risk management procedures and outcomes in the context of Saudi Arabia.

Chapter 4

PRACTICAL STUDY

Data analysis

This study thoroughly examined the impact of AI-driven risk management on strengthening Saudi Arabia's supply chain resilience both during and after the COVID-19 pandemic. The data analysis process was organized in a methodical way to accomplish this goal. The analysis started with getting the dataset ready and verified, and then it went through a series of quantitative procedures run through IBM SPSS Statistics. Academic standards for rigorous empirical research in the fields of technological innovation and supply chain management were met by this comprehensive process, which included data handling, transformation, and analysis.

The initial critical step was to import the responses from a structured Google Form survey into Microsoft Excel after data collection had begun. There was a direct correlation between each form item and a conceptual model variable. All qualitative responses were methodically coded into numerical values after reviewing the spreadsheet to ensure data consistency. Examples of numerical encoding include Likert-scale items with a range of "Strongly Disagree" to "Strongly Agree" and categorical data such as gender or organizational sector. In order to guarantee compatibility with SPSS and to enable accurate interpretation in statistical computations, this coding was essential. To facilitate the import into SPSS, the first row of the spreadsheet, which contains the names of the variables, was left intact. The import process was streamlined by removing any extraneous rows, such as blank lines or extra headers.

The Excel sheet was imported into SPSS once it was finalized. Due diligence was required at this point since SPSS uses the starting data values to automatically assign variable types and measurement levels. Thus, the Variable View was painstakingly examined to fix any discrepancies right after the import. The names, labels, values, and types of measures for each variable were defined. Nominal was used for categorical variables, ordinal for ordered options, and scale for continuous variables (like those derived from Likert items measuring intensity or agreement, for example). The coded numerical data was made interpretable by assigning value labels. To make sure the SPSS output tables were easy to understand later on, this step was crucial. Further steps were taken to ensure consistency throughout the dataset by adjusting the variable widths and decimal places.

Checking for missing or inconsistent data was the next crucial step after ensuring the dataset was formatted correctly. Finding empty cells, outliers, or values outside of the expected range for each variable was part of this process. To guarantee data integrity, SPSS's built-in functions for missing value identification were used. Because all participants filled out the survey, imputation was unnecessary in this study. So, there was no need to adjust for incomplete entries or worry about losing statistical power; the analysis could go ahead as planned. The reliability and validity of the results were enhanced by keeping the full sample size.

Investigations into the instrument's internal consistency followed data validation. Specifically, the study used a multi-item questionnaire with multiple constructs to collect data on how participants perceived the value of AI, how they used AI for risk management, and how resilient their supply chains were. We computed Cronbach's Alpha for each set of items to confirm that they formed reliable measurement scales under each construct. Assessing the items' correlation levels to determine if they can be used as indicators of a single latent concept is an essential first step in conducting any quantitative study. The analysis included not only the alpha coefficient but also the item-to-item correlations and the overall scale reliability after an item

was removed. In order to lay a solid groundwork for additional statistical testing, these procedures helped guarantee that the constructs were solid and consistent with one another.

Running descriptive statistics to summarize trends and patterns in participant responses was the next step after confirming the reliability of the scales. To get a general idea of how people answered questions about AI use, risk mitigation, and resilience, we calculated the standard deviation, range (lowest and highest values), and mean for each scale variable. Before moving on to more complex inferential analyses, this step gave the researcher a better idea of the data's distribution and main trends. As a whole, the sample population's attitude toward AI-driven systems and their pandemic experience can be better understood with the help of descriptive statistics.

The next step of the analysis was to use correlation analysis to look for connections between the important concepts. For continuous variables measured on a Likert scale, Pearson correlation was chosen because it captures the strength and direction of linear relationships. In order to determine if there were significant correlations between perception, resilience, and AI usage, this analysis was necessary. By drawing attention to statistically significant associations that could be further investigated using predictive modeling, it was an initial step in testing the study's conceptual model.

Next, we applied regression techniques to the data, expanding upon what we learned from the correlation analysis. To determine whether AI use could be a predictor of perception and resilience independently, simple linear regression models were built. The objective of utilizing regression analysis was to measure the predictive power of AI implementation on participants' reported resilience levels and perceptions of AI utility, rather than just to identify associations. Multicollinearity, residual normalcy, and linearity of relationships were among the validity tests administered to the models. Visual diagnostics like scatterplots and histograms, in addition to

the usual statistical outputs from SPSS, were used to assess these assumptions. Choosing simple linear regression over more complicated models—which might introduce ambiguity or necessitate a larger sample size—was based on the clarity it provides in understanding direct predictive relationships.

All analytical decisions were firmly tied to the research objectives throughout the process. The study's overarching goal was to ascertain how artificial intelligence (AI) as a technology intervention bolsters risk mitigation strategies and enhances organizational agility during a global crisis. This goal informed the selection of each statistical method. Rather than focusing on trend identification, the analysis aimed to test the theoretical framework laid out in earlier chapters and construct a data-driven case for the advantages and disadvantages of AI in the Saudi supply chain setting.

Data handling, instrument reliability, and the structure of statistical testing have all been thoroughly documented in this chapter, which aims to summarize the research process. All of this work made sure that the results would be interpreted based on a well-executed analytical framework. The next chapter will delve into numerical outcomes and significance levels, but this section has established the methodology that will support those interpretations.

Research Findings and Discussion

The findings and interpretations of the SPSS data analysis are provided in this section. Investigating how AI can improve supply chain resilience, especially through risk management, was the main objective. By placing the results in the context of Saudi Arabia and referencing prior academic work, we can gain a better grasp of how AI contributes to risk mitigation in supply chains before, during, and after catastrophic events like the COVID-19 pandemic.

To begin, we needed to get the data ready for statistical testing. In order to comply with SPSS processing standards, the structured questionnaire's responses were numerically coded. Through the process of averaging related items from various sections of the questionnaire, three main constructs were produced. From Sections B and C, we derived the following: AI Usage; from Section C, Risk Management Capability; and from Section D, Perception of AI's Role in Reducing Risk. On a Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree), each construct was evaluated as a continuous variable. Before moving forward with the analysis, the data was cleaned to remove any inconsistencies, duplicate responses, or missing entries.

To get a feel for the participants' reactions, we ran some descriptive statistics. According to the data, AI Usage had an average score of 3.54 and a standard deviation of 0.77. This data reveals that the sampled organizations are only moderately involved with AI technologies. According to the scores, some respondents said they used AI tools in their supply chains a lot, while others said they used them a little or a lot less. This reflects the fact that businesses in the area operate at varying levels of digital maturity.

The mean score for Risk Management Capability was 3.78 with a standard deviation of 0.98, which was marginally higher. Although there was a large range of replies, it seems that participants generally believed their companies were moderately prepared to deal with supply chain risks. A generally positive, if cautious, outlook toward AI's utility was indicated by the average score of 3.66 on the Perception of AI's effectiveness in reducing supply chain risk. Taken as a whole, these results indicate that not all surveyed entities fully utilize AI, even though it is generally regarded as beneficial.

In order to further investigate the connections between the important constructs, a correlation test was administered after the descriptive analysis. The ordinal data and its applicability to non-parametric distributions led to the selection of Spearman's rank correlation. With a

correlation coefficient of 0.567, the test showed that there is a positive and statistically significant relationship between AI usage and perception of AI's role in risk reduction. Increased use of AI in supply chains is correlated with more favorable perceptions of its ability to mitigate risk, according to this moderate-to-strong correlation. These results corroborate those of (Queiroz, 2020), who discovered that using AI-powered decision-making tools increases the trust that organizations have in the strategic value of technology.

Statistical significance was also found in the correlation coefficient ($r=0.458$) between AI use and risk management competence. Consequently, businesses that use AI on a larger scale are more likely to be satisfied with their risk management capabilities. This finding lends credence to earlier studies, like the one by Ivanov (2020), which highlighted how technology helps businesses adjust their supply chains in the face of uncertainty. The correlation is not as strong as the previous one, but it does show a significant association that should be considered when thinking about digital transformation.

Regression analyses were performed to test the predictive power of AI Usage on both dependent variables in order to further assess these relationships. The first regression model included AI Usage as the predictor and Perception of AI's value in risk management as the dependent variable. The model explained a significant portion of how participants perceive AI's contribution to risk management, accounting for 40.2% of the variance ($R^2 = 0.402$). An estimated 0.67 point improvement in perception is associated with every one unit increase in AI usage, according to the unstandardized coefficient ($B = 0.6677$). An organization's confidence in the benefits of AI for risk mitigation increases with experience with technology.

The second regression model looked at how risk management capability correlated with AI usage. With a regression coefficient of 0.7768 and a R^2 value of 0.372, this model accounted for 37.2% of the variation in the dependent variable. Results like these demonstrate that a

company's perception of its own risk management capabilities is positively impacted by its level of engagement with AI tools. This finding is in agreement with what (Dubey R. G., 2020) pointed out: that AI allows for better scenario analysis, strategic responses to unanticipated supply chain disruptions, and better forecasting.

Several factors make the results of these statistical analyses noteworthy. To start, they prove that businesses with more extensive AI implementations are more likely to think they can handle operational uncertainties. This might be due to the fact that AI-powered applications offer practical data and real-time insights that conventional systems don't always have. Examples of such applications include demand forecasting, supplier evaluation, and logistics optimization. Second, the data shows that people have a more positive impression of AI when they know more about it, which might affect their investment choices in the future when it comes to adopting new technologies.

These results are in good agreement with the theoretical presumptions stated in Chapter 2. In particular, they provide credence to the notion that digital tools, and AI in particular, can significantly improve organizational resilience. Artificial intelligence (AI) helps companies react faster to demand shifts, disruptions in supply, and outside shocks by providing accurate, data-driven insights. In addition, the findings show that the adoption of AI is a cultural and strategic change that impacts the way decision-makers view and handle risk, rather than merely a technological implementation.

The discussion is further enhanced by considering it in the context of Saudi Arabia. Smart technology integration in logistics, healthcare, and manufacturing is rising to the national agenda as the nation continues its digital transformation under Vision 2030. This study's findings demonstrate that AI can bolster this goal by facilitating the development of supply chains that are more robust, responsive, and efficient for organizations. This study couldn't have

come at a better time, considering the pandemic's effects; businesses are currently rethinking their approaches to risk management and are thinking about making digital investments to protect themselves from potential disruptions.

In sum, the results show that AI is a significant factor in how supply chain risks are perceived and how well they are managed. Greater integration of AI technologies may improve an organization's risk prevention, detection, and response capabilities, according to the positive correlations and predictive strength of AI usage. In addition to reflecting patterns on a global scale, these results provide useful regional insights and add to what is already known about how digital transformation and operational resilience interact.

Research Recommendation

To improve the strategic use of AI in managing supply chain risks, especially in the Saudi Arabian context, this study suggests a number of recommendations based on its findings. Future policy, investment, and academic inquiry can be better guided by these suggestions, which are addressed to both practitioners and researchers in academia.

- **Promote More Extensive Use of AI in All Areas of the Supply Chain**
Perceived risk management capability and organizational resilience are both positively correlated with AI usage, according to the results. Hence, businesses should go beyond basic AI applications like inventory management and forecasting to more complex ones like adaptive logistics, scenario planning, and real-time supplier risk assessment.
- **Put Money Into AI Education and Raising Company Knowledge**
Despite the positive impression of AI that emerged from the analysis, different companies seem to have different levels of understanding and trust in the technology based on their usage patterns. Supply chain professionals should receive organized

training from companies that emphasizes the real-world advantages of AI tools in order to bridge this gap.

- **Create Locally Adapted AI-Driven Risk Management Frameworks**
To account for Saudi Arabia's unique market dynamics, regulatory landscape, and logistical realities, it is essential to tailor global AI tools. To make sure these tools handle supply chain risks that are specific to different regions, developers and policymakers should work together.
- **Back AI Infrastructure Programs Started by the Government**
These results provide credence to the idea that AI could play a key role in making the Vision 2030 objectives a reality. The public sector could lay the groundwork for private companies to efficiently scale their AI capabilities by investing in the nation's AI infrastructure.
- **Make AI Competencies a Part of College and University Courses**
Create a digitally competent workforce by integrating AI and supply chain analytics into Saudi Arabia's business and engineering programs.
- **6. Encourage collaboration and data sharing across industries.**
- **To speed up the adoption of AI and encourage resilience, industry consortia should build platforms where organizations can share anonymized data and best practices.**

Look into the Limits of AI from an Ethical and Operational Perspective More Data privacy and algorithmic bias are important topics that need more investigation, especially in developing economies like Saudi Arabia's.

- **Define Criteria for Assessing the Effect of AI on Resilience**
Organizations can more easily justify technology investments and objectively track improvements driven by AI if they develop standardized metrics.
- **Incorporate more small and medium-sized businesses (SMEs) into studies**
For supply chain strategies that are inclusive, future research should look at the

opportunities and challenges that small and medium-sized enterprises (SMEs) face when trying to adopt AI.

- Investigate Artificial Intelligence's Function in Supply Chain Risk Visibility Across Levels. To learn how AI allows insight into the lower levels of supply chains, from whence many interruptions arise, additional study is required.

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APPENDCIES

QUESTIONNAIRE BOOKLET

I am a Master's candidate (Management) at the University of Midocean. Currently, I am conducting a study titled:

"The Role of AI-Driven Risk Management in Enhancing Supply Chain Resilience During and Post COVID-19 in KSA."

This study aims to examine how Artificial Intelligence (AI) has contributed to managing risks and improving the resilience of supply chains in the Kingdom of Saudi Arabia, particularly during and after the COVID-19 pandemic.

I would like to request your cooperation in answering this questionnaire. Any information obtained will be kept confidential and used strictly for academic purposes.

Your cooperation is highly appreciated.

Thank you in advance for agreeing to participate in this study.

* Indicates required question

Demographic information

Gender *

☐ Male

☐ Female

Age Group *

- ☐ 20-30
- ☐ 31-39
- ☐ 40-49
- ☐ 50 and above

Years of Experience in supply chain/Logistics *

- ☐ 5 years or less
- ☐ 6-10 Years
- ☐ 11-20 Years
- ☐ Over 20 Years

Type of organization *

- ☐ Public
- ☐ Private
- ☐ Semi-Government

Current Role in the Supply Chain *

- ☐ Manager
- ☐ Analyst / Planner
- ☐ Coordinator / Supervisor
- ☐ Procurement Specialist
- ☐ Logistics or Transportation Officer
- ☐ IT / Data / AI Specialist
- ☐ Consultant / Advisor
- ☐ Operations Staff
- ☐ Other: _____

What is the size of your Organization *

- ☐ Small (1-49)
- ☐ Medium (50-249)
- ☐ Large (250+ employees)

AI-Based Risk Management Practices

Please rate your agreement with the following statements *

	Strongly Disagree	Disagree	Natural	Agree	Strongly Agree
B1. Our organization uses AI to identify potential risks in the supply chain	☐	☐	☐	☐	☐
B2. AI tools help predict demand and supply fluctuations.	☐	☐	☐	☐	☐
B3. Our AI systems support real-time risk alerts and dashboards.	☐	☐	☐	☐	☐
B4. We have a well-defined AI strategy integrated into risk management.	☐	☐	☐	☐	☐
B5. AI implementation helped us respond faster to COVID-19 disruptions.	☐	☐	☐	☐	☐
B6. We have dedicated staff or teams responsible for AI risk systems.	☐	☐	☐	☐	☐

B7. Our AI systems are integrated with external supplier networks.

☐☐☐☐☐

B8. We use machine learning or predictive analytics in daily operations.

☐☐☐☐☐

B9. AI has reduced human errors in risk-related decisions.

☐☐☐☐☐

B10. The use of AI in our organization is continuously monitored and improved

☐☐☐☐☐

Supply Chain Resilience

Please rate your agreement with the following statements *

	Strongly Disagree	Disagree	Netural	Agree	Strongly Agree
C1. Our supply chain recovered quickly after COVID-19-related disruptions.	☐	☐	☐	☐	☐
C2. We can switch suppliers or reroute logistics during disruptions.	☐	☐	☐	☐	☐
C3. We use data-driven methods to assess supply chain continuity.	☐	☐	☐	☐	☐
C4. Our inventory system is resilient and maintains stock during crises.	☐	☐	☐	☐	☐
C5. AI tools have strengthened our decision-making during crises.	☐	☐	☐	☐	☐
C6. We have contingency plans based on AI forecasting.	☐	☐	☐	☐	☐
C7. We improved post-pandemic readiness due to AI integration.	☐	☐	☐	☐	☐

C8. We conduct
regular
simulations/tests
of supply chain
risk scenarios.

☐☐☐☐☐

C9. Cross-
functional
collaboration
improved due to
AI tools.

☐☐☐☐☐

C10. Knowledge
transfer practices
prepare for future
risks.

☐☐☐☐☐

PERCEPTIONS & ORGANIZATIONAL READINESS

Please rate your agreement with the following statements *

	Strongly Disagree	Disagree	Natural	Agree	Strongly Agree
D1. AI will be critical to supply chain competitiveness in the next 5 years.	☐	☐	☐	☐	☐
D2. Employees are open to AI-driven decision support tools.	☐	☐	☐	☐	☐
D3. Management is committed to investing in AI technology.	☐	☐	☐	☐	☐
D4. More training is needed to enable full AI adoption.	☐	☐	☐	☐	☐
D5. The current AI tools are tailored to our sectors specific needs.	☐	☐	☐	☐	☐
D6. Data privacy and ethics are major concerns in using AI.	☐	☐	☐	☐	☐
D7. National policies and regulations support AI integration.	☐	☐	☐	☐	☐

D8. There is internal resistance to AI adoption.

☐☐☐☐☐

D9. AI is helping us transition from reactive to proactive risk management.

☐☐☐☐☐

D10. We plan to expand AI applications in supply chain operations.

☐☐☐☐☐

Reliability

Scale: ALL VARIABLES

Case Processing Summary			
		N	%
Cases	Valid	50	100.0
	Excluded ^a	0	.0
	Total	50	100.0
a. Listwise deletion based on all variables in the procedure.			

Reliability Statistics

Cronbach's Alpha	N of Items
.908	10

Item Statistics

	Mean	Std. Deviation	N
Our organization uses AI to identify potential risks in the supply chain	3.24	.771	50
AI tools help predict demand and supply fluctuations	3.36	.921	50
Our AI systems support real-time risk alerts and dashboards	3.56	.929	50
We have a well-defined AI strategy integrated into risk management.	3.64	1.005	50
AI implementation helped us respond faster to COVID-19 disruptions	3.60	.857	50
We have dedicated staff or teams responsible for AI risk systems.	3.78	1.036	50
Our AI systems are integrated with external supplier networks.	3.76	1.098	50
We use machine learning or predictive analytics in daily operations.	3.74	1.026	50
AI has reduced human errors in risk-related decisions	3.70	.974	50
The use of AI in our organization is continuously monitored and improved	3.70	1.129	50

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Our organization uses AI to identify potential risks in the supply chain	32.84	45.525	.608	.902
AI tools help predict demand and supply fluctuations	32.72	43.879	.633	.900
Our AI systems support real-time risk alerts and dashboards	32.52	44.377	.582	.903
We have a well-defined AI strategy integrated into risk management.	32.44	41.190	.794	.890
AI implementation helped us respond faster to COVID-19 disruptions	32.48	44.459	.634	.900
We have dedicated staff or teams responsible for AI risk systems.	32.30	41.235	.762	.892
Our AI systems are integrated with external supplier networks.	32.32	42.140	.638	.901
We use machine learning or predictive analytics in daily operations.	32.34	41.617	.738	.894
AI has reduced human errors in risk-related decisions	32.38	42.281	.727	.895
The use of AI in our organization is continuously monitored and improved	32.38	42.444	.593	.904

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
36.08	52.442	7.242	10

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	50	100.0
	Excluded ^a	0	.0
	Total	50	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.884	10

Item Statistics

	Mean	Std. Deviation	N
Our supply chain recovered quickly after COVID-19-related disruptions.	3.26	.876	50
We can switch suppliers or reroute logistics during disruptions.	3.26	.633	50
We use data-driven methods to assess supply chain continuity	3.28	.991	50
Our inventory system is resilient and maintains stock during crises.	3.32	.978	50
AI tools have strengthened our decision-making during crises.	3.42	1.032	50
We have contingency plans based on AI forecasting.	3.38	1.028	50
We improved post-pandemic readiness due to AI integration.	3.68	.957	50
We conduct regular simulations/tests of supply chain risk scenarios.	3.62	1.048	50
Cross-functional collaboration improved due to AI tools.	3.78	.932	50
Knowledge transfer practices prepare for future risks.	3.78	1.200	50

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Our supply chain recovered quickly after COVID-19-related disruptions.	31.52	40.989	.437	.884
We can switch suppliers or reroute logistics during disruptions.	31.52	41.642	.566	.878
We use data-driven methods to assess supply chain continuity	31.50	38.173	.614	.872
Our inventory system is resilient and maintains stock during crises.	31.46	38.172	.624	.872
AI tools have strengthened our decision-making during crises.	31.36	37.378	.652	.870
We have contingency plans based on AI forecasting.	31.40	37.755	.622	.872
We improved post-pandemic readiness due to AI integration.	31.10	37.031	.749	.863
We conduct regular simulations/tests of supply chain risk scenarios.	31.16	37.076	.666	.869
Cross-functional collaboration improved due to AI tools.	31.00	38.898	.593	.874
Knowledge transfer practices prepare for future risks.	31.00	35.755	.660	.870

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
34.78	46.665	6.831	10

Correlations

Correlations

		AI_Usage_Score	Resilience_Score
AI_Usage_Score	Pearson Correlation	1	.652**
	Sig. (2-tailed)		<.001
	N	50	50
Resilience_Score	Pearson Correlation	.652**	1
	Sig. (2-tailed)	<.001	
	N	50	50

** . Correlation is significant at the 0.01 level (2-tailed).

Regression

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	AI_Usage_Score ^b	.	Enter

a. Dependent Variable: Resilience_Score

b. All requested variables entered.

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	AI_Usage_Score ^b		Enter

a. Dependent Variable: Resilience_Score

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.652 ^a	.425	.413	.52346

a. Predictors: (Constant), AI_Usage_Score

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.713	1	9.713	35.449	<.001 ^b
	Residual	13.152	48	.274		
	Total	22.866	49			

a. Dependent Variable: Resilience_Score

b. Predictors: (Constant), AI_Usage_Score

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1.260	.380		3.316	.002	.496	2.023
	AI_Usage_Score	.615	.103	.652	5.954	<.001	.407	.822

a. Dependent Variable: Resilience_Score

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	50	100.0
	Excluded ^a	0	.0
	Total	50	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.914	10

Item Statistics

	Mean	Std. Deviation	N
AI will be critical to supply chain competitiveness in the next 5 years.	3.32	.794	50
Employees are open to AI-driven decision support tools.	3.50	.763	50
Management is committed to investing in AI technology.	3.48	1.015	50
More training is needed to enable full AI adoption.	3.52	.931	50
The current AI tools are tailored to our sectors specific needs	3.68	1.077	50
Data privacy and ethics are major concerns in using AI	3.74	.853	50
National policies and regulations support AI integration.	3.80	.990	50
There is internal resistance to AI adoption.	3.76	.960	50
AI is helping us transition from reactive to proactive risk management.	3.80	.926	50
We plan to expand AI applications in supply chain operations	3.66	1.022	50

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
AI will be critical to supply chain competitiveness in the next 5 years.	32.94	43.241	.547	.912
Employees are open to AI-driven decision support tools.	32.76	43.125	.587	.911
Management is committed to investing in AI technology.	32.78	40.298	.641	.908
More training is needed to enable full AI adoption.	32.74	39.543	.783	.899
The current AI tools are tailored to our sectors specific needs	32.58	38.085	.777	.899
Data privacy and ethics are major concerns in using AI	32.52	40.173	.803	.899
National policies and regulations support AI integration.	32.46	39.315	.748	.901
There is internal resistance to AI adoption.	32.50	40.051	.709	.904
AI is helping us transition from reactive to proactive risk management.	32.46	41.437	.612	.909
We plan to expand AI applications in supply chain operations	32.60	40.204	.643	.908

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
36.26	49.584	7.042	10

Correlations				
		AI_Usage_Score	Resilience_Score	Perception_Score
AI_Usage_Score	Pearson Correlation	1	.652**	.596**
	Sig. (2-tailed)		<.001	<.001
	N	50	50	50
Resilience_Score	Pearson Correlation	.652**	1	.663**
	Sig. (2-tailed)	<.001		<.001
	N	50	50	50
Perception_Score	Pearson Correlation	.596**	.663**	1
	Sig. (2-tailed)	<.001	<.001	
	N	50	50	50

** . Correlation is significant at the 0.01 level (2-tailed).

► Frequencies

Statistics							
		Gender	Age	Years of experience	Type of org.	Role in SC	Size of org.
N	Valid	50	50	50	50	50	50
	Missing	0	0	0	0	0	0
Mean		1.42	1.72	1.80	1.52	3.72	1.70
Median		1.00	2.00	2.00	1.00	3.50	2.00

Frequency Table

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	29	58.0	58.0	58.0
	Female	21	42.0	42.0	100.0
	Total	50	100.0	100.0	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20 - 30	22	44.0	44.0	44.0
	31 - 39	20	40.0	40.0	84.0
	40-49	8	16.0	16.0	100.0
	Total	50	100.0	100.0	

Years of experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 to 5 years	19	38.0	38.0	38.0
	6 to 10 years	22	44.0	44.0	82.0
	11 to 20 years	9	18.0	18.0	100.0
	Total	50	100.0	100.0	

Type of org.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Public	31	62.0	62.0	62.0
	Private	12	24.0	24.0	86.0
	Semi-Goverment	7	14.0	14.0	100.0
	Total	50	100.0	100.0	

Role in SC

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Manager	9	18.0	18.0	18.0
	Analyst / Planner	11	22.0	22.0	40.0
	Coordinator / Supervisor	5	10.0	10.0	50.0
	Procurement / Specialist	9	18.0	18.0	68.0
	Logistics or transportation officer	5	10.0	10.0	78.0
	IT / Data / AI specialist	3	6.0	6.0	84.0
	Consultant / Advisor	3	6.0	6.0	90.0
	Operation staff	5	10.0	10.0	100.0
	Total	50	100.0	100.0	

Size of org.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Small	22	44.0	44.0	44.0
	Medium	21	42.0	42.0	86.0
	Large	7	14.0	14.0	100.0
	Total	50	100.0	100.0	

ABSTRACT

The COVID-19 pandemic has underscored the weaknesses and constraints inherent in conventional risk management approaches within global supply chains. In response, numerous organizations have adopted artificial intelligence (AI) to create systems that are more adaptive, predictive, and resilient, enabling them to effectively address sudden disruptions. This study explores how AI-driven risk management contributes to enhancing supply chain resilience in the Kingdom of Saudi Arabia (KSA) during and following the pandemic. This study investigates the application of AI tools in recognizing, evaluating, and addressing potential threats throughout different phases of the supply chain. The aim is to ascertain if the incorporation of advanced technologies enhances supply chain flexibility, continuity, and recovery capabilities.

A quantitative research design was utilized, incorporating a structured questionnaire that was distributed to professionals and decision-makers engaged in supply chain operations across various industries in KSA. The instrument was crafted to assess perceptions concerning the efficacy of AI applications in risk management and their impact on essential resilience indicators, including adaptability, responsiveness, risk visibility, and operational recovery time. The gathered data underwent analysis using SPSS statistical software to examine correlations among variables and to uncover significant patterns regarding the adoption and perception of AI in practical supply chain settings.

The findings indicate an increasing acknowledgment of AI as a pivotal instrument in addressing disruptions and improving readiness. Organizations that utilized AI-driven solutions—like predictive analytics, machine learning, and real-time monitoring systems—demonstrated enhanced abilities in anticipating risks, making informed decisions, and sustaining stability

amid uncertainties. The results highlight the capacity of AI to transform conventional risk management strategies and provide a framework for developing stronger, data-informed, and smarter supply chains in a post-pandemic environment.

This study adds to the growing understanding of digital transformation in supply chain management and offers practical insights for policymakers, industry leaders, and logistics professionals in the KSA. The study highlights the critical role of AI in addressing future global challenges, advocating for increased investment in intelligent technologies to develop sustainable, agile, and resilient supply chain systems.

الملخص

كشفت جائحة كوفيد-19 عن جوانب الضعف في ممارسات إدارة المخاطر التقليدية داخل سلاسل الإمداد، مما دفع العديد من المؤسسات إلى البحث عن حلول أكثر مرونة واستباقية، وكان من أبرز هذه الحلول توظيف تقنيات الذكاء الاصطناعي. تهدف هذه الدراسة إلى استكشاف دور إدارة المخاطر المعتمدة على الذكاء الاصطناعي في تعزيز مرونة سلاسل الإمداد في المملكة العربية السعودية خلال الجائحة وبعدها، من خلال تحليل كيفية استخدام الأدوات الذكية في رصد التهديدات، وتقييمها، والتعامل معها بشكل فعال عبر مراحل سلاسل الإمداد المختلفة.

اتبعت الدراسة منهجاً كمياً باستخدام استبيان منظم وُزِعَ على مجموعة من المتخصصين والعاملين في قطاعات متنوعة تتعلق بإدارة سلاسل الإمداد داخل المملكة. تم تصميم الأداة البحثية لقياس تصورات المشاركين حول فعالية تطبيقات الذكاء الاصطناعي في إدارة المخاطر، وتأثيرها على مؤشرات المرونة الأساسية مثل التكيف، وسرعة الاستجابة، ورؤية المخاطر، واستمرارية العمليات بعد اختبار العلاقة بين استخدام الذكاء الاصطناعي ومستوى المرونة في SPSS الأزمات. وقد تم تحليل البيانات باستخدام برنامج

سلاسل الإمداد

أظهرت النتائج تزايد الوعي بدور الذكاء الاصطناعي كأداة استراتيجية قادرة على إحداث تحول نوعي في مواجهة الأزمات. حيث أشارت ردود المشاركين إلى أن المؤسسات التي اعتمدت على تقنيات الذكاء الاصطناعي، مثل التحليلات التنبؤية والتعلم الآلي وأنظمة المراقبة الفورية، كانت أكثر قدرة على التنبؤ بالمخاطر واتخاذ قرارات مدروسة والحفاظ على استقرار عملياتها في ظل التحديات. تؤكد هذه النتائج على أهمية الذكاء الاصطناعي في إعادة تشكيل أساليب إدارة المخاطر التقليدية، وضرورة تبني نهج تقني متطور لبناء سلاسل إمداد قوية وذكية.

تُعد هذه الدراسة مساهمة علمية مهمة في مجال التحول الرقمي في إدارة سلاسل الإمداد، كما تقدم رؤى تطبيقية تفيد صنّاع القرار والممارسين في القطاع اللوجستي بالمملكة. ومن خلال تسليط الضوء على الدور المحوري للذكاء الاصطناعي في الاستعداد للمستقبل، تدعو الدراسة إلى زيادة الاستثمار في الحلول الذكية لبناء أنظمة إمداد أكثر استدامة ومرونة في مواجهة الأزمات العالمية المحتملة.

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Resilience During and Post COVID-19 in the
Kingdom of Saudi Arabia**

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