ARTIFICIAL INTELLIGENCE AND BIG DATA ANALYTICS CAPABILITIES FOR ENHANCING SUPPLY CHAIN RESILIENCE AND SUPPLY CHAIN PERFORMANCE: THE MEDIATING ROLE OF ADAPTIVE CAPABILITIES

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by

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LIST OF ABBREVIATIONS

AC	Adaptive Capabilities
AI	Artificial Intelligence
BDAC	Big Data Analytics Capabilities
DCT	Dynamic Capabilities Theory
DDC	Data-Driven Culture
IS	Information Sharin
OIPT	Organizational Information Processing Theory
PLS-SEM	Partial Least Squares Structural Equation Modeling
SCP	Supply Chain Performance
SCRes	Supply Chain Resilience
SCM	Supply Chain Management
SEM	Structural Equation Modeling
SPSS	Statistical Package for Social Science

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KEMAMPUAN KECERDASAN BUATAN DAN ANALITIK DATA BESAR UNTUK MENINGKATKAN KETAHANAN RANTAI BEKALAN DAN PRESTASI RANTAI BEKALAN: PERANAN PERANTARA KEMAMPUAN ADAPTIF

ABSTRAK

Industri pembuatan masa kini sentiasa dicabar oleh persaingan global, kemajuan teknologi yang pesat, dan guncangan ekonomi, yang diperparah lagi dengan kebimbangan alam sekitar dan keperluan untuk inovasi berterusan. Sebagai respons, pengilang semakin mengadopsi teknologi canggih seperti Kecerdasan Buatan (AI) dan Analisis Data Besar (BDAC) untuk meningkatkan kecekapan operasi dan ketahanan (SCRes) serta prestasi rantaian bekalan (SCP). Kajian ini meneroka kesan langsung dan tidak langsung kemampuan AI dan BDAC terhadap SCRes dan SCP, menggunakan Teori Pemprosesan Maklumat Organisasi (OIPT) dan Teori Keupayaan Dinamik (DCT) sebagai asas teorinya. Penyelidikan ini dilakukan menggunakan Model Struktur Persamaan Pemalar Terkecil (PLS-SEM) pada sampel 208 syarikat pembuatan yang pelbagai di Jordan. Penemuan kajian ini menekankan peranan penting Keupayaan Adaptif (AC) sebagai mediator, mengubah pelaburan AI dan BDAC menjadi peningkatan signifikan dalam SCRes dan SCP. Walaupun AI dan BDAC secara langsung menguatkan AC, yang meningkatkan kebolehan adaptasi rantaian bekalan, kesan Budaya Berpandu Data (DDC) dan Perkongsian Maklumat (IS) terhadap kemampuan ini berbeza. DDC biasanya memperkuat manfaat AI dan BDAC terhadap AC, walaupun kesannya terhadap SCRes dan SCP melalui AC adalah tidak konsisten. Sebaliknya, IS secara signifikan meningkatkan hubungan antara AC dan SCRes, namun pengaruhnya terhadap SCP adalah tidak menentu. Wawasan ini tidak

hanya memperdalam pemahaman teoretikal tentang bagaimana kemampuan digital secara strategik menguatkan ketahanan dan prestasi rantaian bekalan tetapi juga menawarkan panduan praktikal untuk pemimpin industri dan pembuat dasar dalam menavigasi gangguan rantaian bekalan dengan lebih efektif. Penyelidikan ini merupakan langkah penting dalam menunjukkan manfaat empirikal dari pemanfaatan AI untuk peningkatan berterusan dalam prestasi rantaian bekalan.

ARTIFICIAL INTELLIGENCE AND BIG DATA ANALYTICS CAPABILITIES FOR ENHANCING SUPPLY CHAIN RESILIENCE AND SUPPLY CHAIN PERFORMANCE: THE MEDIATING ROLE OF ADAPTIVE CAPABILITIES

ABSTRACT

Today's manufacturing industry is constantly challenged by global competition, rapid technological advancements, and economic shocks, compounded by environmental concerns and the need for continuous innovation. In response, manufacturers are increasingly adopting advanced technologies such as Artificial Intelligence (AI) and Big Data Analytics (BDAC) to enhance operational efficiency and supply chain resilience (SCRes) and performance (SCP). This study explores the direct and indirect effects of AI and BDAC capabilities on SCRes and SCP, employing Organizational Information Processing Theory (OIPT) and Dynamic Capabilities Theory (DCT) as its theoretical bases. The research was conducted using Partial Least Squares-Structural Equation Modelling (PLS-SEM) on a sample of 208 diverse manufacturing firms in Jordan. The findings underscore the pivotal role of Adaptive Capabilities (AC) as mediators, transforming AI and BDAC investments into significant improvements in SCRes and SCP. While AI and BDAC directly bolster AC, enhancing supply chain adaptability, the effects of Data-Driven Culture (DDC) and Information Sharing (IS) on these capabilities vary. DDC typically amplifies the benefits of AI and BDAC on AC, although its impact on SCRes and SCP through AC is inconsistent. Conversely, IS significantly boosts the linkage between AC and SCRes, yet its influence on SCP is irregular. These insights not only deepen the theoretical understanding of how digital capabilities strategically fortify supply chain

resilience and performance but also offer practical guidance for industry leaders and policymakers to navigate supply chain disruptions more effectively. This research marks a significant step in demonstrating the empirical benefits of leveraging AI for sustained enhancements in supply chain performance.

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

In the current industrial environment, which is dynamic and interconnected, supply chains increasingly face a wide variety of obstacles. Globalization as a driving force affected market conditions along with rapid technological advancements. These challenges need Supply Chain Resilience (SCRes) to remain operational and competitive. The integration of artificial intelligence (AI) and big data analytics capabilities (BDAC) has been transformative and outstandingly affected by how organizations predict, react, and also recover from disruptions (Choi et al., 2018; Ivanov et al., 2019). Using predictive analytics, BDAC strengthens companies to detect probable sources of disruption, thus fortifying supply chain resilience (Scholten et al., 2019a; Wong et al., 2020a).

Concurrently, the emergence of Industry 4.0 and the adoption of AI, cloud computing, and also big data have drastically changed the business field (Tang et al., 2022), bringing significant operational benefits, particularly in supply chain management (SCM). These technologies have refined decision-making processes (Mageto, 2021) and boosted information-sharing efficiency (Jia et al., 2020), allowing businesses to better manage their supply chains, mitigate risks from unstable external environments, and enhance supply chain performance (SCP) (Kache & Seuring, 2017). Although cloud computing is a critical enabler of AI and BDAC (Hashem et al., 2015; Marston et al., 2011) , this study deliberately excludes it for two reasons. First, grounded in the Dynamic Capabilities View, the focus is on capabilities that directly enhance adaptive decision-making and resilience (Wamba et al., 2017; Belhadi et al., 2021), rather than infrastructural enablers. Second, in Jordan's industrial sector, cloud adoption faces regulatory and infrastructural barriers, which makes its impact less visible compared to AI and BDAC initiatives (Al-Okaily et al., 2020). To maintain parsimony in the model (Hair et al., 2022), AI and BDAC were selected as the most relevant capabilities.

Despite growing academic interest in how Industry 4.0 enhances supply chain performance (Koh et al., 2019) and organizational performance (Barata, 2021), companies in industries heavily depend on supply chains, face significant pressures due to new challenges (Grida et al., 2020). The COVID-19 pandemic, for instance, hindered global supply chains, limiting access to goods and services and consequently, destabilizing markets (Hohenstein, 2022).

This period revealed the key role of advanced technologies such as big data analytics (BDA) in crisis management (Al-Bashayreh et al., 2022; Al-Okaily et al., 2022). BDA has an essential role in generating insights into potential crises, triggering innovative decision-making and addressing pressing challenges (Mehta & Shukla, 2022). The COVID-19 pandemic severely impacted global supply chains (Joshi & Sharma, 2022), Many investment strategies were identified to sustain supply chains under unpredictable conditions (Goel et al., 2021). Industry 4.0 technologies have been paid due consideration for their potential to adapt SCM processes rapidly and suggest innovative procedures that elevate supply chain performance (Friedman & Ormiston, 2022).

Currently, organizations using digital transformation and Industry 4.0 are equipped better to innovate new products quickly (Tuukkanen et al., 2022), ultimately, increasing their resilience against external disruptions. These innovations not only bring added value to customers (Ayoub & Abdallah, 2019) but also improve the processes and performance of companies within the supply chain (Abdallah et al., 2021). In addition, innovation in supply chains causes resource wastage minimization (Seo et al., 2014) and ensures efficient transmission and information exchange across all supply chain facets (Abdallah et al., 2021), ultimately accelerating the efficiency and overall performance of the supply chain.

The concept of supply chain performance refers to “the ability of a supply chain to achieve its operational and strategic goals effectively and efficiently” (Gomaa, 2024). It includes many attributes, such as sustainability, responsiveness, and flexibility, which enable a supply chain to adapt to changes easily, reduce the risk of inefficiencies, and respond to customer needs (Abushaega et al., 2024; Bentahar & Belhadi, 2024). The concept heavily relies on the integration of processes and collaboration between supply chain partners to improve the flow of goods and information and as a result competitiveness between them (Luo et al., 2024). In general, supply chain performance highlights the capacity of a supply chain to maintain and enhance value creation in companies with dynamic market environments using operational excellence and strategic alignment (Bin, 2024; Jiang et al., 2024).

Supply chain performance is a controversial topic in management studies, and due to the continuous and complex disruptions impacting markets, it has become significant among companies worldwide (Al-qasimi et al., 2024; Sultan, 2024). Unexpected events such as the COVID-19 pandemic, geopolitical tensions, and natural disasters highlighted the importance of strong supply chain strategies to ensure operational stability and resilience (Bentahar & Belhadi, 2024; Moder & Hoberg, 2024). For example, during the pandemic, supply chain disruptions in the semiconductor industry showed the significance of predictive analytics in heading and managing order fulfillment (Moder & Hoberg, 2024). Similarly, big data analytics has a key role in optimizing supply chain performance by improving resilience and flexibility in response to disruptions (Sultan, 2024). As such, to maintain competitiveness and achieve strategic development in an unstable world, it is necessary to address these challenges (Alsakhen et al., 2024; Torralba-Carnerero et al., 2024).

Disruptions caused by the COVID-19 pandemic are one of the latest examples to show how unexpected events affect supply chain performance. The pandemic changed global trade and supply chain dynamics, causing businessmen to look at trade from a new perspective. Within a short period, organizations had to investigate the abrupt closure of factories, transportation bottlenecks, and the shortage of materials, which limited operations (Sultan, 2024). Obligations imposed on people in societies such as lockdowns, social distancing, and movement restrictions further intensified these challenges, resulting in delays in delivery and unmet customer demands. In this situation, operational stagnation and financial losses were the consequences of businesses failing to adapt.

Organizations could survive using digitalization and automation, leveraged big data analytics, and sustained diversified supplier networks showed remarkable resilience. For example, companies in the field of pharmaceutical industry selected new cold-chain logistics to distribute vaccines effectively, and deliver with delay despite global restrictions (Alsakhen et al., 2024). In the retail sector, Amazon, an e-commerce giant, scaled its operations using predictive inventory management systems and expanded warehouse capacities to respond to the rising demand (Bentahar & Belhadi, 2024). In agriculture, producers employed direct-to-consumer models to reduce the risk of food supply chain disruptions due to movement restrictions

(Torralba-Carnerero et al., 2024). It can be concluded that organizations using techniques such as robust resources, creative leadership, and adaptive strategies could survive and succeed in disruptive periods that occurred recently.

In Jordan, the integration of advanced technologies such as AI-powered analytics, blockchain, Building Information Modeling (BIM), and the Internet of Things (IoT) is beginning to transform industries. Although these technologies are emerging globally, the adoption level of AI and BDAC in Jordan remains relatively low and uneven across industries. While the healthcare and ICT sectors have made some early progress in applying AI-powered diagnostics, predictive analytics, and digital service platforms (Wei et al., 2022; Yu et al., 2021), most manufacturing sub-sectors -including textiles, chemicals, furniture, and food processing- are still in the initial stages of adoption. Many firms rely on traditional systems, face infrastructural and regulatory barriers, and lack the necessary skilled workforce to fully exploit these technologies (Moktadir et al., 2019; Wamba et al., 2020). The Jordanian government's Digital Agenda recognizes the importance of AI and data analytics, but integration into supply chain management remains fragmented and lacks a unified national strategy (Kankam, 2022). This gap reinforces the urgency of exploring how AI and BDAC can be systematically embedded into Jordan's industrial supply chains to enhance resilience and competitiveness. In the construction sector, these tools improve inventory management, material tracking, and logistical planning (Ali et al., 2024; Matarneh & Mohsen, 2024). Leveraging such technologies not only enhances efficiency but also strengthens resilience and global competitiveness (Al-Ma'aitah, 2024). demonstrating their potential for broader industrial transformation.

The Economic Modernisation Vision (2033) (RHC, 2022) , reflects the Jordanian authorities' commitment to leveraging technological growth to accelerate resilience and performance in the industry. As illustrated in Figure 1.1, the industrial sector highlights its leading role in economic growth, indicating the need for technological investments to sustain its constructive effect. The strategic importance of advancing the industrial sector which guarantees long-term economic stability and competitiveness in Jordan is emphasized (Jordan Chamber of Industry, 2024).

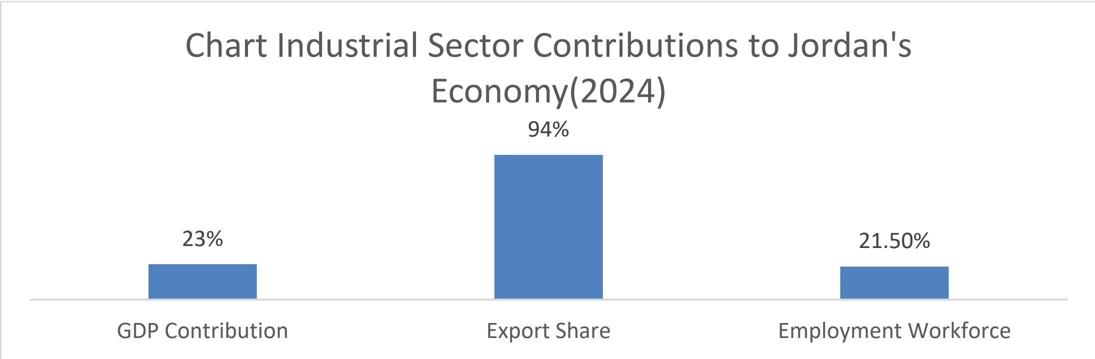

Figure 1.1 Industrial Sector Contributions to Jordan's Economy (2024).

In this respect, the industrial sector as the cornerstone of Jordan's economic stability and growth needs due consideration. The performance of this sector is crucial because of its role in household incomes, job creation, and supply chain stability (*Jordan Chamber of Industry*, 2024). Over 264,000 workers were employed in this sector. It represents 21.5% of the country's workforce, and accounts for 23% of Jordan's GDP, making it a fundamental building block of the country's economic structure (*Jordan Chamber of Industry*, 2024). Additionally, it forms 94% of total exports in Jordan, highlighting its strategic significance in world trade (*Jordan Chamber of Industry*, 2024). Nonetheless, outdated infrastructure, limited human capital, and inefficient practices are issues that hinder its ability to adopt advanced technologies such as AI and BDAC. Highlighting these issues is necessary to show the potential of this sector and guarantee long-term economic resilience and growth.

The Jordan Chamber of Industry (JCI) has introduced the "Jordanian Industrial Index (JII)," a pioneering metric designed to periodically evaluate the performance of the industrial sector. This index, locally and regionally unique, integrates several sub-indicators pertinent to various aspects of industry. Such sub-indicators are scientifically weighted and then categorized to reflect industrial performance accurately. Meanwhile, a qualitative questionnaire is developed to gain insights into industrial sub-sectors, each of the ten sub-sectors is weighted based on their performance over the past decade. The development of the JII followed a methodical approach outlined in the "Handbook on Constructing Composite Indicators," using the best practices and methodologies, including Laspeyre's methodology for calculation, with 2016 set as the base year. The benefits of using JII, such as the evaluation of industrial performance regularly, recognizing potential within sectors, comparing historical performance data, and tracing fluctuations over time, with results demonstrated both quarterly and annually for the general index and certain sub-sectors (*Jordan Chamber of Industry*, 2024).

In the 2024 distribution of the Jordanian Industry Index, the Engineering, Electrical, and Information Technology Industries contributed the largest share at 33%, as shown in Figure 1.2. The Food, Catering, and Agricultural Industries ranked second with 17%, followed by the Construction Industries at 15% and the Wood and Furniture Industries at 12%. The Leather and Textile Industries accounted for 6%, while the Chemical and Cosmetic Industries and Packaging, Paper, Cardboard, and Office Supplies each contributed 5%. The Plastic and Rubber Industries held 4%, whereas the Therapeutic Industries and Medical Supplies and the Mining Industries had smaller shares, each at 1%, completing the industrial distribution landscape (*Industrial Sub-Sectors in Jordan*, 2024).

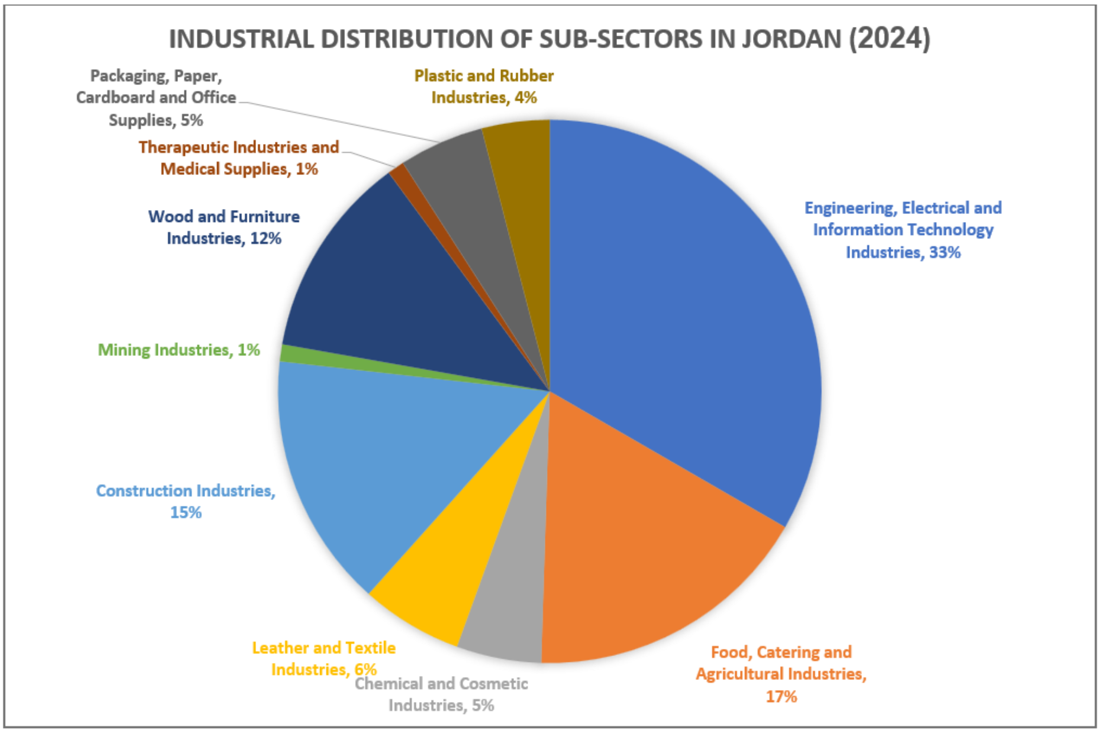

Figure 1.2 Distribution Industrial of Sub-Sectors in Jordan (2024)

Despite the existing potential of Jordan's manufacturing sector to enhance supply chain performance through methodologies such as Lean Six Sigma, Total Quality Management (TQM), and Just-In-Time (JIT), these strategies have not been particularly used. These methodologies aim to refine delivery timelines, reduce costs, and increase operational efficiency critical elements for sustaining competitiveness in international markets (Alomari et al., 2020). In addition, the integration of advanced technologies including blockchain and AI profoundly improve supply chain transparency, traceability, and security. It has competitive benefits for Jordanian manufacturers (Al-Jaroodi & Mohamed, 2019).

Extensive research is needed to highlight the crucial role of supply chain integration and effective management practices in enhancing supply chain performance. Notably, supply chain integration is proven to strengthen export performance and enhance environmental sustainability. They positively influence financial outcomes (Jum'a et al., 2021). Yet, the role of AI and BDA in optimizing supply chain performance within Jordan's manufacturing sector has been considerably neglected.

This study addresses these deficiencies by proposing a novel framework that examines the interactions between AI, BDAC, adaptive capabilities, and pivotal supply chain moderators such as information sharing and data-driven culture. This research aims to offer practical insights into how these emerging technologies accelerate supply chain resilience and supply chain performance, as a result, securing a durable competitive boundary for Jordanian manufacturers.

1.2 Research Problem Statement

Global markets are rapidly becoming more complex and volatile highlighting the significance of efficient supply chain management which is a key area of interest for many organizations. Supply chain performance is defined as the ability of the supply chain to meet the needs of consumers effectively and also reduce costs and control disruptions (Gunasekaran et al., 2004; Ivanov & Dolgui, 2021). Globalization, technological changes, and the COVID-19 pandemic are factors highlighting the importance of supply chain performance in economic progress (World Bank, 2023). These challenges have reflected shortcomings in the area of supply chains, and the need for improving dependability, flexibility, and resiliency as a core aspects of supply chain performance (Lee et al., 2024; Sarkis, 2020).

In response, organizations worldwide are increasingly adopting advanced technologies such as AI, BDAC, and the Internet of Things (IoT) in supply chain management. These technologies support trend analysis, process monitoring, and resource optimization, enabling firms to develop more flexible and efficient supply chains. Such adaptation assists in handling complex information flows, mitigating production risks, and enhancing robustness and operational integrity during crises (Bahrami & Shokouhyar, 2022a; Cui et al., 2023). For example, AI enables accurate and timely production planning, while IoT supports inventory and risk management (Kumari et al., 2024). However, in regions with limited resources such as Jordan, the adoption and integration of these technologies remain challenging, which hinders the sustainability of SCP performance (Abu Allan et al., 2018; Al-Khatib & Al-ghanem, 2022).

In Jordan, the manufacturing sector plays a pivotal role in ensuring economic stability and growth. This sector significantly contributes to GDP and creates employment opportunities (*Jordan Chamber of Industry*, 2024). It has been instrumental in enhancing industrial development, improving technological adoption, and accelerating export performance. Besides global challenges, local factors in Jordan make the situation more complex for improving supply chain performance. Factors such as high energy costs, limited access to financing, outdated infrastructure, and logistical inefficiencies decrease profit margins and disrupt supply chain performance (*JSF - Jordan Strategy Forum*, 2022). External factors, such as fluctuating global energy prices, geopolitical instability in the Middle East, and the consequences of the COVID-19 pandemic, aggravated these issues, therefore, reducing the sector's resilience and limiting its global competitiveness (Abu Allan et al., 2018; World Bank, 2023).

Jordan's manufacturing sector has been less competitive over the past few years. According to the Jordan Industrial Competitiveness Report (2022), after a period of rapid growth between 2000 and 2008, its growth speed became sharply slow between 2009 and 2019. The manufacturing value added (MVA) per capita failed to keep up with the population growth. This sector was unable to meet domestic and foreign demand for manufactured goods. Moreover, Jordan's production structure is concentrated on low and medium-low-technology sectors, therefore, the manufacturing sector is unable to compete with global high-tech industries that are growing rapidly. This lack of diversification and technological advancement led the Jordanian manufacturing sector to vulnerability and declining competitiveness on the global stage.

In the 2000s, Jordan experienced three distinct periods in manufacturing value added: rapid manufacturing growth between 2000 and 2008 with an annual increase of 10.2%, outpacing GDP growth and ranking highest among leading countries; a significant reduction between 2008 and 2019 to a growth rate of 1.8% per year; and a decline between 2019 and 2020. This decline raised concerns about whether this situation was temporary due to COVID-19 or indicative of major issues. To evaluate Jordan's level of industrialization and the place manufacturing obtained in its economy, it is necessary to examine the share of manufacturing value added in domestic GDP, as depicted in Figure 1.3, bear in mind that manufacturing value added addresses the manufacturing sector and excludes other industrial sectors, including mining, construction, and public utilities.

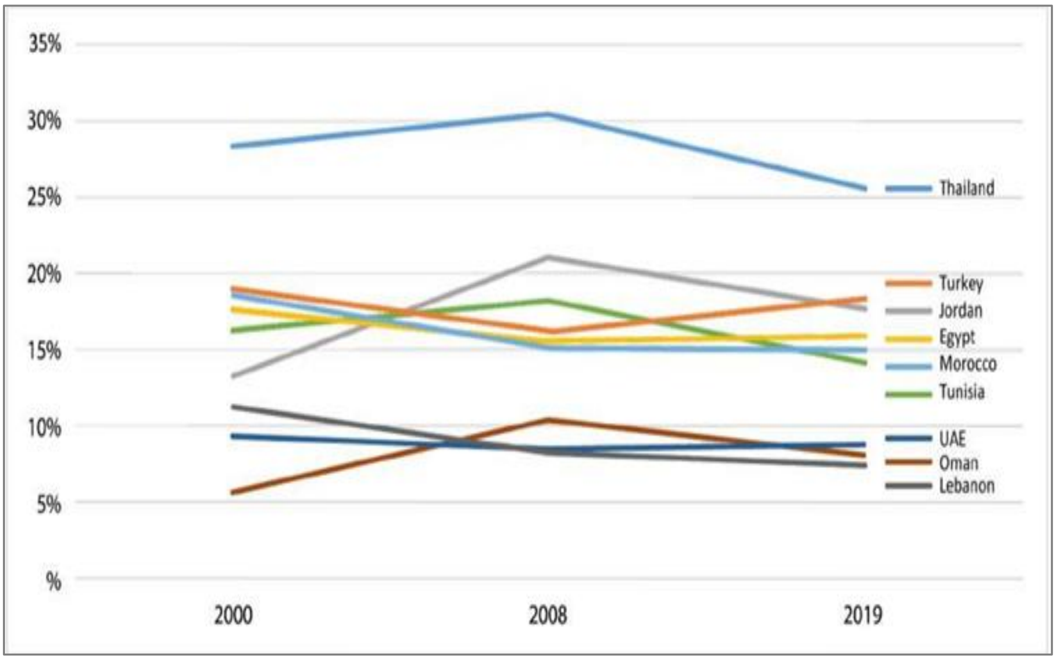

Figure 1.3 Manufacturing value added as a % of GDP for Jordan and selected benchmarks

Source: World Bank 2023a, WDI, constant USD 2015

Despite these obstacles, the sector demonstrates resilience. For instance, GDP from manufacturing in Jordan increased from JOD 1,325 million in Q1 2024 to JOD 1,458 million in Q2 2024, indicating recovery momentum. However, by early 2025, output eased to around JOD 1,368 million, reflecting short-term fluctuations but still maintaining an upward long-term trajectory for the industrial sector. (Tradingeconomics.Com| The Hashemite Kingdom of Jordan Department of Statistics, 2024) (see Figure 1.4). To sustain this upward trajectory, strategic interventions are needed. The government's Economic Modernisation Vision (EMV) emphasizes technological innovation and digital adoption (e.g., AI and BDAC) as essential tools for enhancing productivity, optimizing resource allocation, and strengthening supply chains (JSF - Jordan Strategy Forum, 2022).

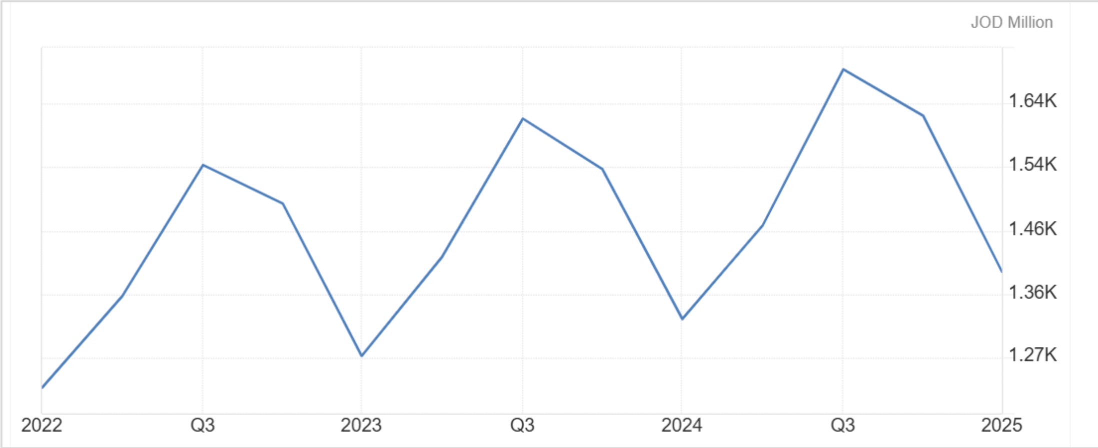

Figure 1.4 The Manufacturing Growth in Jordan

Despite SCP's importance for economic growth, research on this topic remains underdeveloped, particularly in Jordan. Many studies focus on defining and measuring SCP but provide limited insights into strategies for resilience and adaptability in turbulent contexts (Arora et al., 2016; Shishodia et al., 2023). Others fail to explain why some organizations succeed in disruption while others fail under similar conditions (Bukola et al., 2023; Dubey et al., 2021; Yi et al., 2011). This gap underscores the need for more empirical research to develop implementable solutions that help organizations remain efficient and competitive under critical situations. Additionally, despite the growing importance of supply chain performance in developing countries, there is a lack of empirical studies on effectively cultivating it in Jordan's manufacturing sector. This study aims to bridge this gap by examining untapped resources and organizational capabilities of the manufacturing sector in Jordan using AI and BDA to enhance supply chain performance in terms of efficiency and resilience. Previous research found that supply chain performance is strongly linked to an organization's ability to leverage internal resources and advanced technologies, such as AI and BDA, to mitigate disruptions and maintain operations. While AI enables predictive analytics and real-time decision-making, BDA supports comprehensive data integration and optimization, necessary for controlling supply chain uncertainties (Belhadi et al., 2022; Roscoe et al., 2022). Moreover, the integration of these technologies fosters innovation and enhances agility, key components for sustaining efficient supply chain performance under unpleasant conditions (Linkov et al., 2022; Sarkis, 2020). This study aims to provide practical insights into how AI and BDAC can transform supply chain management in companies based in Jordan.

AI capabilities are significant for improving supply chain performance, particularly in unfavorable conditions concerning factors such as efficiency, resilience, and adaptability. AI's predictive analytics, resource allocation optimization, and real-time decision-making support help companies mitigate disruptions and maintain operational stability (Bag et al., 2023; Ivanov & Dolgui, 2021a). Nonetheless, there is a lack of quantitative studies in the existing literature to confirm the link between AI capabilities and supply chain performance (Sarkis, 2020; Shashi et al., 2020a). Such a gap in research underscores the need for empirical investigations to present concrete evidence on how AI technologies can be leveraged to develop supply chain outcomes, especially in contexts with uncertainty and rapid change. Addressing this gap will not only improve theoretical understanding but also offer practical insights to companies aiming to strengthen their supply chain performance using advanced technological solutions.

BDAC is used for enhancing supply chain performance by providing companies with data-driven decision-making, predictive insights, and operational optimization as capabilities that have an essential role in improving supply chain efficiency, agility, and resilience, particularly in dynamic and uncertain contexts (Dube et al., 2021; Wamba et al., 2020). Nonetheless, there is no evidence to prove the link between BDAC and supply chain performance. While some studies insist on the transformative impact of BDAC in increasing supply chain outcomes, the findings of other studies have shown an inconsistent or non-significant impact (Kache & Seuring, 2017; Mikalef et al., 2020). Therefore, further empirical research is needed to explore how BDAC can be effectively leveraged to optimize supply chain processes and also address issues such as disruptions, demand variability, and resource constraints. It is essential to understand these dynamics for developing both theoretical insights and practical strategies in supply chain management, particularly in improving economies where BDAC adoption may encounter obstacles (Bag et al., 2023; Ivanov & Dolgui, 2021).

AI capabilities and BDAC have significant potential to improve supply chain performance by enabling advanced data-driven decision-making, predictive analytics, and operational optimization. Nonetheless, these technologies may be effective partially due to the lack of contingency factors that support their application. To address this gap, this study introduces data-driven culture and information sharing as moderating factors to show how they improve the relationship between AI capabilities, BDAC, and supply chain performance. A data-driven culture paves the way for decision-making processes, ensuring that AI and BDAC outputs are used effectively, while information sharing elevates transparency and collaboration across the supply chain, promoting the integration of these technologies (Dubey et al., 2021; Shashi et al., 2020). By examining these moderating effects, the study aims to provide deeper insights into the way AI capabilities and BDAC are optimized to maximize efficiency, agility, and resilience in dynamic and uncertain supply chain environments (Ivanov & Dolgui, 2021; Mikalef et al., 2020). By offering practical implications, this study improves supply chain performance.

The term adaptive capability refers to the ability of a company to respond effectively to changes, disruptions, and uncertainties in the supply chain environment. Such capabilities that are crucial for enhancing supply chain performance remain underexplored in research, especially concerning advanced technologies such as AI capabilities and BDAC. These capabilities pave the way for organizations to adjust quickly to dynamic market conditions, optimize operations, and also improve resilience against disruptions (Dubey et al., 2021 ; Ivanov & Dolgui 2021) . Although prior studies have recognized the potential of adaptive capabilities to enhance supply chain agility, efficiency, and long-term sustainability (Shashi et al., 2020; Bag et al., 2023), empirical research integrating AI and BDAC into supply chain performance is rare. Therefore, this study aims to examine the relationships between adaptive capabilities and advanced technologies, to give practical insights to companies attempting to promote supply chain operations, in particular, in turbulent environments. Moreover, having a digitally integrated manufacturing sector necessitates robust adaptive capabilities to react to rapidly changing environments and global market dynamics and as a result, equips companies with reconfiguring resources and processes for operational resilience and efficiency (Leończuk et al., 2018).

Supply chain performance is highly dependent on supply chain resilience as a factor that equips organizations to adjust to disruptions and sustain operational efficiency. This factor encompasses both proactive strategies, including risk management and anticipative planning, as well as reactive capabilities such as creativity, flexibility, and responsiveness to unexpected issues (Chowdhury & Quaddus, 2017; Christopher & Peck, 2004; Soni et al., 2014). By promoting resilience, organizations can control the negative impacts of disruptions, maintain performance, and build long-term competitive advantages (Ivanov & Dolgui, 2022; Ponomarov &

Holcomb, 2009). This study examines the effect of supply chain resilience on supply chain performance, by considering risk management practices and adaptive capabilities as mechanisms to improve resilience. organization must understand the links to optimize supply chain operations, maintain stability, and sustain efficiency in turbulent environments (Dubey et al., 2023a; Shashi et al., 2020a).

Seamless information sharing promotes features, including collaboration, visibility, and agility across supply chains, while a strong data-driven culture integrates data insights into strategic decision-making, ensuring the perfect exercise of BDAC and AI (Barratt & Oke, 2007; Dubey et al., 2019). These factors create an ecosystem conducive to achieving the objectives of the economic modernization vision by increasing supply chain resilience and supply chain performance. However, it is necessary to investigate how AI and BDAC influence adaptive capabilities and how information sharing and data-driven culture moderate these effects in manufacturing sectors based in Jordan (Al-Ghwayeen & Abdallah, 2018; Al-Khatib & Al-ghanem, 2022). To align the manufacturing sector in Jordan with the economic modernization vision, it is necessary to address these gaps. Technologies such as predictive analytics and AI-driven maintenance systems can decrease operational costs, increase export competitiveness, and elevate decision-making processes in real time (Cui et al., 2019; Ivchenko & Kupin, 2019). Thus, while global research emphasizes the transformative role of AI and BDAC in strengthening supply chain resilience and performance, the Jordanian manufacturing sector remains constrained by resource limitations, traditional organizational structures, and slow digital adoption. Despite contributing significantly to GDP and employment, the sector faces declining competitiveness, infrastructural challenges, and vulnerability to regional and global disruptions. These realities underscore the urgency of investigating how AI capabilities, BDAC, adaptive capabilities, and contextual enablers such as information sharing and data-driven culture can be leveraged to enhance supply chain resilience and performance in Jordan. This study is therefore situated in the current industrial and economic context of Jordan, responding directly to the challenges identified by recent government and industry reports.

This research aims to develop and validate a novel model of supply chain performance grounded in the frameworks of Dynamic Capabilities Theory (DCT) and Organizational Information Processing Theory (OIPT) in Jordan’s manufacturing sector. The study investigates how AI capabilities, BDAC, and adaptive capabilities as strategic resources enhance supply chain performance in Jordan’s turbulent context (Bag et al., 2022; Dubey, Bryde, et al., 2021b; Ivanov & Dolgui, 2022). Contrary to previous research limited to certain disruptions, this study selects a holistic approach to strengthen internal capabilities, enabling Jordanian manufacturing sectors to adapt to diverse and unpredictable issues effectively (Mikalef et al., 2019b; Shashi et al., 2020a). This study develops a comprehensive framework adapted to the complexities of the local and global contexts of the supply chain. By applying and then validating it in Jordan’s manufacturing sectors, this approach not only promotes theoretical understanding but also offers practical insights for Jordanian manufacturers seeking to elevate supply chain performance and remain competitive in the market (Bag et al., 2022; Belhadi et al., 2022; Chowdhury & Quaddus, 2017).

In summary, this study addresses three interrelated core problems: (1) the limited adoption and integration of advanced technologies such as AI and BDAC in Jordan’s manufacturing sector, (2) persistent gaps in supply chain resilience and performance due to disruptions and inefficiencies, and (3) infrastructural and organizational constraints that hinder digital transformation. These challenges are particularly acute in Jordan, where industries remain in the early stages of Industry 4.0 adoption and face heightened vulnerability to global and regional uncertainties. To address these issues, the study leverages Dynamic Capabilities Theory (DCT) to explain how AI and BDAC can help firms sense, seize, and reconfigure resources for resilience, and Organizational Information Processing Theory (OIPT) to highlight how information sharing and data-driven culture improve decision-making under uncertainty. This alignment ensures that the research problems, objectives, and theoretical foundations are tightly connected, thereby providing both empirical and practical insights into how Jordanian manufacturers can enhance supply chain resilience and performance.

Despite the growing body of literature on digital transformation and supply chain management, several theoretical gaps remain. First, most prior studies on AI and BDAC are conducted in developed economies, leaving emerging markets like Jordan underrepresented, despite their unique institutional and infrastructural challenges (Mikalef et al., 2020; Dubey et al., 2021). Second, while the dynamic capabilities perspective emphasizes sensing, seizing, and reconfiguring resources, limited research has empirically validated adaptive capabilities as a mediating mechanism through which AI and BDAC enhance SCRes and SCP (Belhadi et al., 2021). Third, although scholars have highlighted the importance of contextual enablers such as data-driven culture and information sharing, their moderating effects remain underexplored, especially in volatile environments (Gupta & George, 2016; Brandon-Jones et al., 2014). Finally, few studies have attempted to integrate DCT and OIPT to jointly capture how technological resources, adaptive processes, and information flows interact to drive resilience and performance. Addressing these theoretical gaps, this study advances a more comprehensive framework that deepens scholarly understanding while offering practical insights for Jordanian manufacturers.

1.3 Research Objectives (RO)

Based on the preceding discussion, the present study aims to investigate the influence of Artificial Intelligence (AI) Capabilities and Big Data Analytics Capabilities (BDAC) on Adaptive Capabilities (AC), Supply Chain Resilience (SCRes), and Supply Chain Performance (SCP). Additionally, the study examines the moderating roles of Data-Driven Culture (DDC) and Information Sharing (IS) in strengthening these relationships, Accordingly, a number of research objectives are articulated:

RO1. To examine the effect of Artificial Intelligence Capabilities on Adaptive Capabilities.

RO2. To investigate the impact of Big Data Analytics Capabilities on Adaptive Capabilities.

RO3. To examine the effect of Adaptive Capabilities on Supply Chain Resilience.

RO4. To investigate the impact of Adaptive Capabilities on Supply Chain Performance.

RO5. To investigate the moderating effect of Data-Driven Culture on the relationship between Artificial Intelligence Capabilities, Big Data Analytics Capabilities and Adaptive Capabilities.

RO6. To investigate the moderating effect of Information Sharing on the relationship between Adaptive Capabilities and Supply Chain Resilience.

RO7. To investigate the moderating effect of Information Sharing on the relationship between Adaptive Capabilities and Supply Chain Performance.

RO8. To determine whether Adaptive Capabilities serve as a mediator in the relationship between Artificial Intelligence Capabilities and Big Data Analytics Capabilities, and Supply Chain Resilience.

RO9. To determine whether Adaptive Capabilities serves as a mediator in the relationship between Artificial Intelligence Capabilities and Big Data Analytics Capabilities, and Supply Chain Performance.

RO10. To examine the impact of Supply Chain Resilience on Supply Chain Performance.

RO11. To investigate the extent to which Data-Driven Culture moderates the indirect relationship between Artificial Intelligence Capabilities and Big Data Analytics Capabilities, and Supply Chain Resilience via Adaptive Capabilities.

RO12. To investigate the extent to which Data-Driven Culture moderates the indirect relationship between Artificial Intelligence Capabilities and Big Data Analytics Capabilities, and Supply Chain Performance via Adaptive Capabilities.

RO13. To investigate the extent to which Information Sharing moderates the indirect relationship between Artificial Intelligence Capabilities and Big Data Analytics Capabilities, and Supply Chain Resilience via Adaptive Capabilities.

RO14. To investigate the extent to which Information Sharing moderates the indirect relationship between Artificial Intelligence Capabilities and Big Data Analytics Capabilities, and Supply Chain Performance via Adaptive Capabilities.

1.4 Research Questions (RQ)

Aligned with the research objectives, the following research questions are formulated to guide the study in addressing the identified problem:

RQ1. What is the effect of Artificial Intelligence Capabilities on Adaptive Capabilities?

RQ2. How do Big Data Analytics Capabilities affect Adaptive Capabilities?

RQ3. What effect do Adaptive Capabilities have on Supply Chain Resilience?

RQ4. How do Adaptive Capabilities impact Supply Chain Performance?

RQ5. To what extent does Data-Driven Culture moderate the relationship between Artificial Intelligence Capabilities, Big Data Analytics Capabilities, and Adaptive Capabilities?

RQ6. To what extent does Information Sharing moderate the relationship between Adaptive Capabilities, and Supply Chain Resilience?

RQ7. To what extent does Information Sharing moderate the relationship between Adaptive Capabilities, and Supply Chain Performance?

RQ8. Do Adaptive Capabilities mediate the relationship between Artificial Intelligence Capabilities, Big Data Analytics Capabilities and Supply Chain Resilience?

RQ9. Do Adaptive Capabilities mediate the relationship between Artificial Intelligence Capabilities, Big Data Analytics Capabilities and Supply Chain Performance?

RQ10. What impact does Supply Chain Resilience have on Supply Chain Performance?

RQ11. To what extent does Data-Driven Culture moderate the indirect relationship between Artificial Intelligence Capabilities and Big Data Analytics Capabilities, and Supply Chain Resilience via Adaptive Capabilities?

RQ12. To what extent does Data-Driven Culture moderate the indirect relationship between Artificial Intelligence Capabilities and Big Data Analytics Capabilities, and Supply Chain Performance via Adaptive Capabilities?

RQ13. To what extent does Information Sharing moderate the indirect relationship between Artificial Intelligence Capabilities and Big Data

Analytics Capabilities, and Supply Chain Resilience via Adaptive Capabilities?

RQ14. To what extent does Information Sharing moderate the indirect relationship between Artificial Intelligence Capabilities and Big Data Analytics Capabilities, and Supply Chain Performance via Adaptive Capabilities?

1.5 Significance of the Study

This study provides significant insights into the factors affecting the performance of supply chains in Jordan's manufacturing sector. Understanding the complexities of supply chain management is important, considering the crucial role manufacturing has in the economic development of the country. It aims to fill a significant gap in the existing literature by investigating the effects of various factors such as digital platforms, network dynamics, adaptive capacities, and knowledge sharing on supply chain performance. By doing this, the study enhances both scholarly discussions and practical implementations for businesses active in this industry. The findings could suggest manufacturers in Jordan actionable strategies to enhance their supply chain performance, optimize resource utilization, and consequently, improve competitiveness in domestic and global markets. In addition, this study by sharing knowledge gives new attitudes to the possibility of collaboration and innovation in supply chain management among manufacturers.

Moreover, aligned with the financial policies of Jordan to achieve economic diversification and promote industrial development, the findings of this study provide valuable information to policymakers, industry associations, and other stakeholders by showing the key factors that influence the efficiency and adaptability of supply chain