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LEVERAGING INDUSTRY 5.0 TO ENHANCE SUPPLY CHAIN PERFORMANCE: EVIDENCE FROM THE LOGISTICS AND DISTRIBUTION SECTOR IN JORDAN

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Abstract

In this day and age, when technology is evolving at such speed, supply chains are expected to do more than being merely competitive and resilient, they must be able to combine digital innovation with human-centric values. This study investigates the impact of digital supply chain capabilities namely agility, visibility, and integration on supply chain performance, with a particular focus on the mediating role of Industry 5.0. Using Organizational Information Processing Theory (OIPT) as a foundation, the study asserts that digital capabilities boost organizations' information processing ability, which increases the likelihood of using more advanced and humanistic technology to generate improved performance outcomes. The data was collected through a structured questionnaire and applied to 300 professionals in the field of logistics and distribution in Jordan. The relationships among constructs were analyzed using the Partial Least Squares structural equation modeling (PLS-SEM). Finally, the results unconcealed that digital supply chain agility and supply chain visibility positively impact the adoption of Industry 5.0 and advance supply chain performance directly. Digital supply chain integration did not impact either Industry 5.0 or performance. It was also identified that Industry 5.0 itself has a positive, strong, and direct effect on supply chain performance. The findings have theoretical and practical implications. Extending the application of OIPT, two conditions are added with Industry 5.0 as a mediating mechanism and describe the differential impact of digital capabilities. The study points out that practitioners to invest in agility and visualization along with embedding the industry 5.0 principles in the digital transformation strategies. In general, the research contributes to a better understanding of how digital and human-centric innovations respectively interact to impact supply chain success in an emerging market context.

Keywords: Industry 5.0, Digital Supply Chain Agility, Supply Chain Visibility, Digital Supply Chain Integration, Supply Chain Performance, Logistics Sector.

INTRODUCTION

Today's global economy is fast changing and demand from supply chains is increasing: they have to become more human-centric, more integrated, and more adaptive. Among all these, the sector whose abilities ensure the efficient flow of goods and services across markets is that of logistics and distribution. As digital technologies are fully advanced, supply chain models are becoming restructured with automation, data analytics, and intelligent systems [1]. However, this transformation has set the foundation for this next chapter in the evolution of manufacturing i.e. Industry 5.0, which is characterized by cooperation between humans and machines and establishes sustainable, tailored, and resilient supply chains [2], [3].

Rather than concentrating on automation and efficiency as was the case with Industry 4.0—Industry 5.0 combines human creativity and ethical values with AI and other robotics [4]. It marks a time for organizations to exploit fresh possibilities to enhance their capability

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of handling complex information, and to quicken adaptability to change and improve performance utilizing deeper collaboration and responsiveness. The logistics and distribution sector in Jordan has expanded to cater to increasing domestic and regional requirements. Yet there are still many challenges for the sector such as fragmented systems, supply chain visibility constraints, and low digital integration capacity [5], etc. Rising customer demands, shortened delivery windows, and more frequent disruptions intensify these problems [6]. To overcome such challenges, the approach to information management and processing through digital tools is what is needed [7].

However, to cope with this several firms are adopting digital capabilities like digital supply chain agility, visibility, and integration. These capabilities are necessary for increasing organizational responsiveness and decision-making. However, Organizational Information Processing Theory (OIPT) states that it is these capabilities that make uncertainty and complexity manageable by developing how the supply chain gathers, interprets, and shares information[8]. Although these digital enablers are in the spotlight, however, majority of the existing literature on Industry 4.0 provides scant insights about how Industry 5.0 will act as a mediator in the relationship between digital capabilities and performance outcomes [9], [10]. Furthermore, studies from emerging economies like Jordan are sparse while empirical evidence from the advanced concepts mentioned earlier at the firm level is scattered, which is a clear gap in the understanding of how these advanced concepts apply to different levels of digital maturity [11].

In light of this gap, this study attempts to look at how Industry 5.0 can be used as a mediator between digital capabilities (agility, visibility, integration) and the performance of the supply chain in Jordan’s logistics and distribution sector. However, there has been a lack of systematic research on how and why various types of IT-based organizational transformation may better support the relationship between technology and human individual performance.

The central problem that this research addresses is the unclear manner in which digital capabilities increase performance only when used within Industry 5.0. There are many digital tools found in the organization and they do not reach their upper limit because they are not integrated well, they are very low in agility, and the process of information is very poor.

To address this issue, the study poses the following research questions:

RQ1: How do digital supply chain agility, supply chain visibility, and digital supply chain integration influence the adoption of Industry 5.0 in Jordan's logistics and distribution sector?

RQ2: How does the adoption of Industry 5.0 mediate the relationship between digital capabilities and supply chain performance?

By answering these questions, the study attempts to offer a full understanding of the path of maximization of digital supply chain capabilities to obtain better performance results, particularly in emerging market scenes, such as the Jordan one.

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2. LITERATURE REVIEW

1) Digital Supply Chain Agility

The ability of supply chains to use digital technologies for fast detection and reaction to demand or supply disturbances or external market fluctuations constitutes digital supply chain agility. Digital success depends on three elements - real-time data and analysis and communication resources which combine to create flexible and immediate supply-chain operations [12]. Agility rose to prominence within complex global supply chains because volatility requires business survival.

Digital transformation requires organizations to adopt agility which goes beyond strategic benefits into becoming an absolute necessity. Organizations use cloud computing IoT and advanced analytics together to make their operations adaptable and to generate swift decisions [13]. Organizations need agility to implement Industry 5.0 systems since they must have responsive capabilities that match both human-centered customization elements and collaborative intelligent functions [14]. The adoption of next-generation technologies by organizations becomes possible through digital supply chain agility functions which serves as their fundamental capability.

2) Supply Chain Visibility

Supply chain visibility describes the level to which all stakeholders within the supply chain obtain precise well-timed complete information about product material movements and data through the extended supply network. High visibility facilitates better coordination and shorter delivery times along with more knowledgeable choices [15].

Modern digital assets including RFID technology and blockchain platforms together with real-time tracking systems have substantially advanced supply chain visibility which enables organizations to handle complex operations more efficiently and mitigate risks. The ability to view operations fosters trust and transparency between partners because it becomes essential for maintaining security in changing unpredictable conditions [16].

Visibility within Industry 5.0 contexts promotes machine-human partnership by enabling the flow of data from one operational level to another [17], [18]. The developed information infrastructure enables intelligent systems to work with human operators effectively which improves both their response capabilities and operational intent alignment.

3) Digital Supply Chain Integration

Digital supply chain integration defines the automatic interconnection between information systems, processes, and technologies that work across supply chain operations to facilitate total coordination and the sharing of data [19]. The system includes two main aspects: organization-wide integration between functional units and extended system integration with suppliers' distribution partners and strategic partners.

The integration process allows instant data flow which eliminates unnecessary steps while providing time-aligned operations [20]. The implementation of digital integration leads to better supply chain adaptability stronger resistance and faster response times

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based on research [21]. Organizations entering the industry 5.0 era must focus on integration because it enables human workers to operate together with intelligent digital systems in a collaborative manner [22]. The complete potential of Industry 5.0 technologies ranging from cognitive computing to AI and human-machine interfaces remains unreachable because of poor integration.

4) Industry 5.0 Adoption

Under Industry 5.0 operations focus on human-centered progress through sustainable relationships between automated systems with human perspective. A key addition to Industry 4.0 brings forward values including customized solutions as well as social accountability and technological ethics [2] [23].

An organization's ability to implement Industry 5.0 depends on its digital readiness together with workforce preparedness for new skills and its willingness to adapt to different practices. [24] demonstrate that organizations with impressive ability to adapt, clear operational overview, and seamless connections will succeed with Industry 5.0 implementation [25]. Industry 5.0 functions as a transformational layer that transforms digital inputs into better supply chain results by improving decision-making processes decreasing waste and enhancing the ability to respond to human needs together with societal demands [25].

5) Supply Chain Performance

Supply chain performance manifests as a combination of efficiency together with responsiveness quality and flexibility and sustainability among supply chain entities. The organization demonstrates its ability to deliver customer satisfaction cost reduction and adaptation to changes through its supply chain operations [26], [27].

Research has established that strategic capabilities working alongside digital transformation produce meaningful enhancements to supply chain performance [28]. The implementation of Industry 5.0 will advance performance results by enabling improved cooperation hastened decisions and tailored value delivery.

3. THEORETICAL BACKGROUND: ORGANIZATIONAL INFORMATION PROCESSING THEORY (OIPT)

Organizational Information Processing Theory (OIPT) which [8] originated remains one of the most important theoretical frameworks that helps organizations manage environmental complexity and uncertainty. OIPT views organizations as information systems that require effective information processing to execute operations and make decisions to achieve performance outcomes.

Organizations under high environmental uncertainty or volatility must eliminate information needs or boost their information processing capabilities according to OIPT. Task standardization and task simplification help organizations reduce information processing requirements yet better communication systems together with integration and agile operations and technological support build information processing capacity [8], [29].

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Modern supply chains in the logistics sector depend heavily on effective real-time processing of accurate and relevant information. Organizations must control numerous changing factors that involve customer demand alterations and supplier reliability alongside delivery times geopolitical dangers and customer demands. Organizations today use an increasing number of digital capabilities such as digital supply chain agility, supply chain visibility, and digital integration to enhance their information processing capacity [30], [31], [32]. Digital supply chain agility lets businesses respond fast to changes because it combines real-time data along with decision-making tools. Supply chain visibility provides complete data transparency for every element in the network and digital integration allows efficient communication between organizations and their business partners [33], [34]. The abilities decrease information disparities boost enterprise responsiveness and support the key information processing requirements mentioned in OIPT [35].

As the advanced framework of Industry 5.0 combines technological intelligence with human creativity it maximizes the value of these digital enablers to achieve better information handling. Industry 5.0 enables advanced decision systems through human-smart system collaborations that improve organizations' interpretation and contextualization of complex data streams [1], [2]. Industry 5.0 serves both technological functionality and advanced information processing since it enables organizations to deliver flexible ethical value-driven responses to environmental uncertainties.

The effectiveness of performance achievements depends more on integration between technological capabilities than just their existence because effective information processing requires proper utilization of developed capabilities to execute decisions. The study utilizes OIPT to demonstrate that digital supply chain abilities (agility, visibility, and integration) boost supply chain results yet Industry 5.0 implementation strengthens information processing capabilities throughout this relationship.

This research benefits the existing literature by applying OIPT to answer vital questions about Industry 5.0 adoption while creating a practical alignment method that links digital and human technologies for superior supply chain results.

3.1 Conceptual Framework

This study develops its conceptual framework to analyze connections between vital digital supply chain abilities and supply chain results through an investigation of how Industry 5.0 integration functions as a mediator. The Organizational Information Processing Theory serves as the foundation of this framework because it explains how organizations must boost their information processing abilities to succeed in unpredictable environments like the logistics and distribution sector of Jordan.

According to OIPT principles, this study establishes three fundamental digital enablers namely digital supply chain agility, supply chain visibility, and digital supply chain integration because they enable better organizational information processing. These abilities should boost the organization's preparedness to implement Industry 5.0 technologies enabling better supply chain results through practice implementation.

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The emerging Industry 5.0 framework uses human-centric innovation to unite human operators and intelligent machines through sustainable and personalized systems for transformative supply chain operations. The research adopts Industry 5.0 as a mediating factor to study its connecting function between digital capabilities and performance effects.

The study maintains that digital capabilities alone are fundamental but their effectiveness to drive performance depends on the implementation of Industry 5.0. The essential concept of OIPT highlights that improved performance emerges from using information-related assets effectively in addition to only having them.

Accordingly, the proposed model hypothesizes that:

- Each digital capability has a **direct positive influence** on Industry 5.0 adoption.
- Industry 5.0 adoption has a **direct positive influence** on supply chain performance.
- Industry 5.0 adoption also **mediates** the relationship between digital capabilities and supply chain performance.

The conceptual structure contains the proposed network between digital supply chain capabilities and Industry 5.0 adoption and their impact on supply chain performance. The model provides an all-encompassing perspective on contemporary supply chain systems because it integrates Organizational Information Processing Theory insights with modern concepts of digital transformation and human-centric innovation. Figure 1 shows the model which specifies the direction and relationship pattern among the variables studied in this research**.**

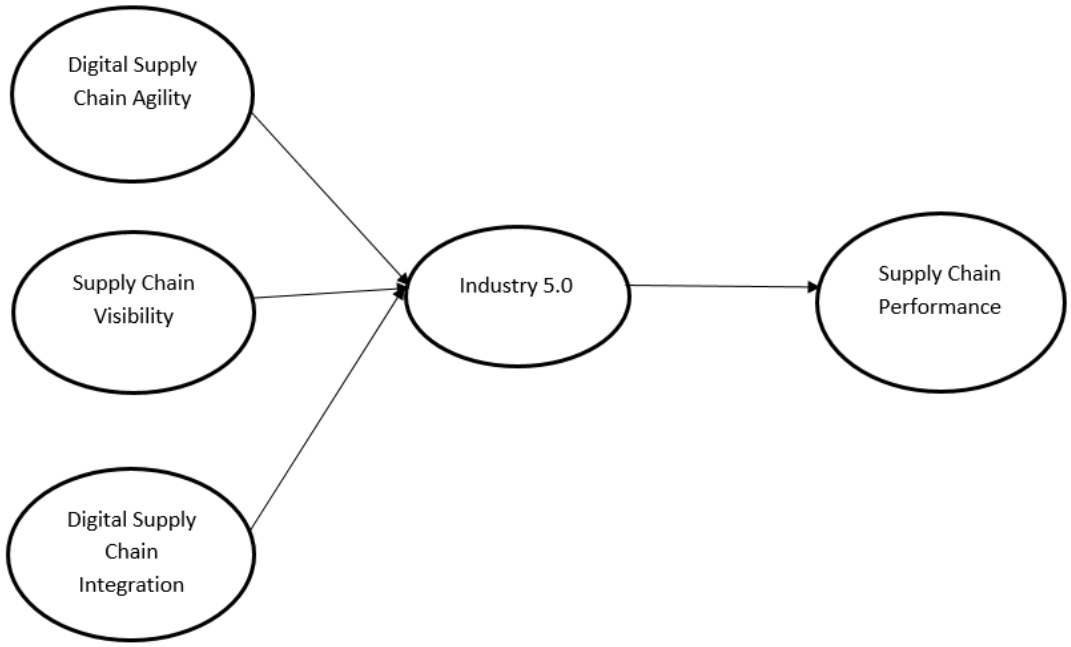

Figure 1: model of study

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4. HYPOTHESES DEVELOPMENT

This paper applies the Organizational Information Processing Theory (OIPT) while adopting its conceptual framework to establish hypotheses that demonstrate how digital supply chain capabilities contribute to supply chain performance by enabling Industry 5.0 adoption. According to OIPT organizations need mechanisms that boost their information processing ability when they want to operate in complex uncertain environments [8], [29]. Organizations utilize digital supply chain agility together with visibility and integration as essential capabilities that enhance their capacity to effectively acquire processes and respond to information.

4.1 Digital Supply Chain Agility and Industry 5.0 Adoption

Agility in digital supply chains belongs to a company's capability to monitor and respond swiftly to internal and external demand changes as well as disruptions using real-time digital infrastructure [36].

Agile supply chains accomplish operational responsiveness through the integration of advanced data analytics automation systems and cloud-based solutions. According to [37] and their work on Industry 5.0 the fundamental capabilities of innovation and adaptability which require agility serve as the base for that progressive manufacturing realm.

H1: Digital supply chain agility has a significant positive effect on Industry 5.0 adoption in the logistics and distribution sector in Jordan.

4.2 Supply Chain Visibility and Industry 5.0 Adoption

Supply chain visibility means watching materials and goods alongside data flow through an entire supply network at present as tracking operations become possible. The improvement in supply chain visibility results in better partner coordination which simultaneously decreases operational risks and enhances transparency between supply chain members [38], [39].

Visible data access across the organization plays an essential role in Industry 5.0 because it facilitates the intelligent cooperation of human workers with machines through prompt access to relevant insights [40]. The implementation of Industry 5.0 frameworks depends heavily on visibility because it functions as an essential organizational element.

H2: Supply chain visibility has a significant positive effect on Industry 5.0 adoption in the logistics and distribution sector in Jordan.

4.3 Digital Supply Chain Integration and Industry 5.0 Adoption

The implementation of digital system standards enables real-time operation between internal operations and external relations through technology standards that work together continuously. Operations maintain real-time data communication while conducting planned supply chain operations together through integration [41]. Through its application Industry 5.0 environments enable the conditions needed for machine-driven decision systems as well as networked automation capabilities [42].

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A successful implementation of Industry 5.0 requires integration because it permits automated interaction combined with customized services between human workers and machines[38].

H3: Digital supply chain integration has a significant positive effect on Industry 5.0 adoption in the logistics and distribution sector in Jordan.

4.4 Industry 5.0 Adoption and Supply Chain Performance

The fundamental principles of Industry 5.0 merge technological improvement with human-oriented values that integrate creativity into tailored solutions and moral decision processes [43].

Supply chain operations implement sustainable practices while keeping their flexibility through human-robotics-AI partnerships which work together at every level [44]. Organizations that adopt principles of Industry 5.0 achieve higher customer satisfaction operational enhancement and manufacturing resilience as well as operational innovation [38]. Due to its necessity for rapid reaction and customization requirements in logistics the industry 5.0 approach delivers increased operational efficiency for logistical operations.

H4: Industry 5.0 adoption has a significant positive effect on supply chain performance in the logistics and distribution sector in Jordan.

4.5 The Mediating Role of Industry 5.0 Adoption

Successful implementation and integration between components of the digital capabilities are necessary to achieve full supply chain efficiency enhancement. The approach of Industry 5.0 lets organizations redefine digital resources into customized and enhanced value outcomes.

Industry 5.0 strengthens the relationship between digital agility, visibility, integration, and performance outcomes in two ways: by connecting their information processing capabilities and choice-making potential, and by acting as an intermediary facilitating their relationship with each other [45], [46], [47].

H5: Industry 5.0 adoption mediates the relationship between digital supply chain agility and supply chain performance.

H6: Industry 5.0 adoption mediates the relationship between supply chain visibility and supply chain performance.

H7: Industry 5.0 adoption mediates the relationship between digital supply chain integration and supply chain performance.

The seven hypotheses help to explain the mechanisms behind how digital capabilities and human-centric innovation led to the effects on supply chains in emerging markets. The research on Jordan's logistics and distribution sector aims at both practical and theoretical purposes to find effective ways toward a sustainable competitive advantage through the implementation of industry 5.0.

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5. METHODOLOGY

The researchers deployed a quantitative approach guided by explanatory research to analyze digital supply chain capabilities on performance metrics while evaluating Industry 5.0 adoption as the performance mediator among logistics and distribution companies in Jordan. A single-time point survey of supply chain operation professionals obtained data through the selected cross-sectional survey design. The methodology used enables researchers to test theory through SEM analyses since it offers methods to study complex relationships between multiple theory constructs. A deductive analysis uses the Organizational Information Processing Theory (OIPT) to explain the conceptual model and hypotheses.

The research involves professionals from logistics and supply chain management and information technology professions who work in operations and logistics departments at companies that operate in Jordan's logistics and distribution industry. The target organizations in the study comprise third-party logistics providers together with transport and warehousing companies as well as freight forwarders managing integrated supply chain functions. A purposive sampling method helps researchers choose participants who possess experience in digital supply chain practices and technological innovation. The research objective is to gather 300 valid responses based on [48] recommendations that models with seven or more constructs and multiple indicators per construct need a sample size of at least 10 times the maximum number of inner or outer model paths. According to [49] samples exceeding 200 support the stability and statistical power of PLS-SEM results so 300 emerges as an appropriate scientific foundation for the study's sample size.

The questionnaire adopts constructs that stem from previously validated research to evaluate study variables. All variables implement reflective indicators through five-point Likert measurement scales starting from 1 (strongly disagree) up to 5 (strongly agree). Several measurement scales assist in tracking digital supply chain agility, visibility, and integration according to the work by [12], [15] and [21]. Items related to Industry 5.0 adoption derived from [9] [22] while supply chain performance measures come from [50] [51]. Twenty participants in a preliminary study will evaluate the questionnaire which aims to improve the clarity reliability and content validity of the items ahead of the full-scale data collection.

Professional networks and logistics associations together with direct company outreach will serve as the platforms for distributing the online survey for data collection. The survey will include an introductory letter that explains the research goals followed by statements about privacy protection alongside voluntary consent information for possible participants. Online surveys work well to research because they save time and money when dealing with multiple participants across distant locations.

The researchers will process the collected data through Partial Least Squares Structural Equation Modeling (PLS-SEM with SmartPLS software as the analysis tool. The study utilizes PLS-SEM analysis because this method matches the requirements for developing

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theory shows strong performance with small participant groups and enables the study of intricate conceptual relationships [52]. The assessment will consist of two sequential steps which check the measurement model and then proceed to evaluate the structural model. The evaluation of the measurement model utilizes indicator reliability together with internal consistency (Cronbach's alpha and composite reliability) and convergent validity (average variance extracted) and discriminant validity is assessed through Fornell-Larcker and HTMT criteria. The path coefficients together with t-values along with p-values and R^2 values for endogenous variables will be used to evaluate the structural model. A mediation analysis using bootstrapping procedures with 5,000 resamples will determine the indirect effects the independent variables have on Industry 5.0 adoption.

Information about ethics plays a crucial role during all phases of the research methodology. The research accepts only willing participation while maintaining full anonymity of all respondents for academic research purposes only. The nature of the study along with participant rights will be conveyed to every participant before their participation. The study will request ethical authorization from its associated academic institution through its own established institutional protocols.

This research methodology has been developed to deliver dependable evidence concerning the hypotheses evaluation process. The analysis draws definitive conclusions regarding digital capabilities and Industry 5.0 adoption effects on supply chain performance in Jordan's logistics through valid measurement tools and advanced statistics along with structured questionnaire distribution.

5.1 Data Analysis and Results

Data analysis was performed through Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4.0 as the software program. The evaluation framework followed these steps: First measured the construct reliability and validity through assessment of the measurement model and afterward examined the structural model to validate the direct effects and mediating relationships.

Three hundred employees from the Jordanian logistics and distribution sector contributed their data for this study. The study team verified the entire dataset and found no vital problems with missing information or unusual points. Statistical calculations of descriptive patterns evaluated the demographic traits of participants and revealed summary patterns in data distribution.

5.1.1 Measurement Model Evaluation

Tests on the measurement model were performed according to the guidelines of [53] The evaluation of factor reliability used outer loadings as the assessment tool while internal consistency was examined through Cronbach's alpha and Composite Reliability (CR) and convergent validity was measured through Average Variance Extracted (AVE). The Fornell-Larcker criterion together with the Heterotrait-Monotrait ratio (HTMT) evaluated discriminant validity for this study.

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Indicator reliability reached above 0.70 for all outer loadings which proves their sufficient reliability. The study showed excellent internal consistency with Cronbach's alpha and CR values spanning from 0.81 to 0.91 which exceeded the essential 0.70 standard. The study established convergent validity according to [54] as all construct AVE values exceeded 0.50 [54]. The square root value from each construct's AVE exceeded the measurement correlations between constructs to meet the requirements of the Fornell-Larcker criterion. The examination of HTMT values revealed all results rested below 0.85 meaning that discriminant validity was successfully demonstrated.

Table 1: Factor Loadings

Constructs	Items	Factor Loadings	Cronbach's Alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	(AVE)
Digital Supply Chain Agility	DSCA_1	0.789	*0.799*	0.812	0.861	
	DSCA_2	0.776				
	DSCA_3	0.791				0.555
	DSCA_4	0.627				
	DSCA_5	0.730				
Digital Supply Chain Integration	**DSCI_1**	0.421	*0.638*	0.690	0.790	
	DSCI_2	0.768				
	DSCI_3	0.828				0.497
	DSCI_4	0.731				
Industry 5.0	I-1	0.722	0.792	0.796	0.857	
	I-2	0.816				
	I-3	0.745				0.547
	I -4	0.695				
	I -5	0.714				
Supply Chain Performance	SCP_1	0.725	0.832	0.844	0.882	
	SCP_2	0.768				0.601
	SCP_3	0.865				
	SCP_4	0.679				
	SCP_5	0.825				
Supply Chain Visibility	**SCV_1**	0.750	0.856	0.857	0.897	
	SCV_2	0.792				0.636
	SCV_3	0.748				
	SCV_4	0.820				
	SCV_5	0.872				

*As shown in **Table 1**, all factor loadings are above the acceptable threshold of 0.70, indicating strong indicator reliability and confirming the adequacy of the measurement model.*

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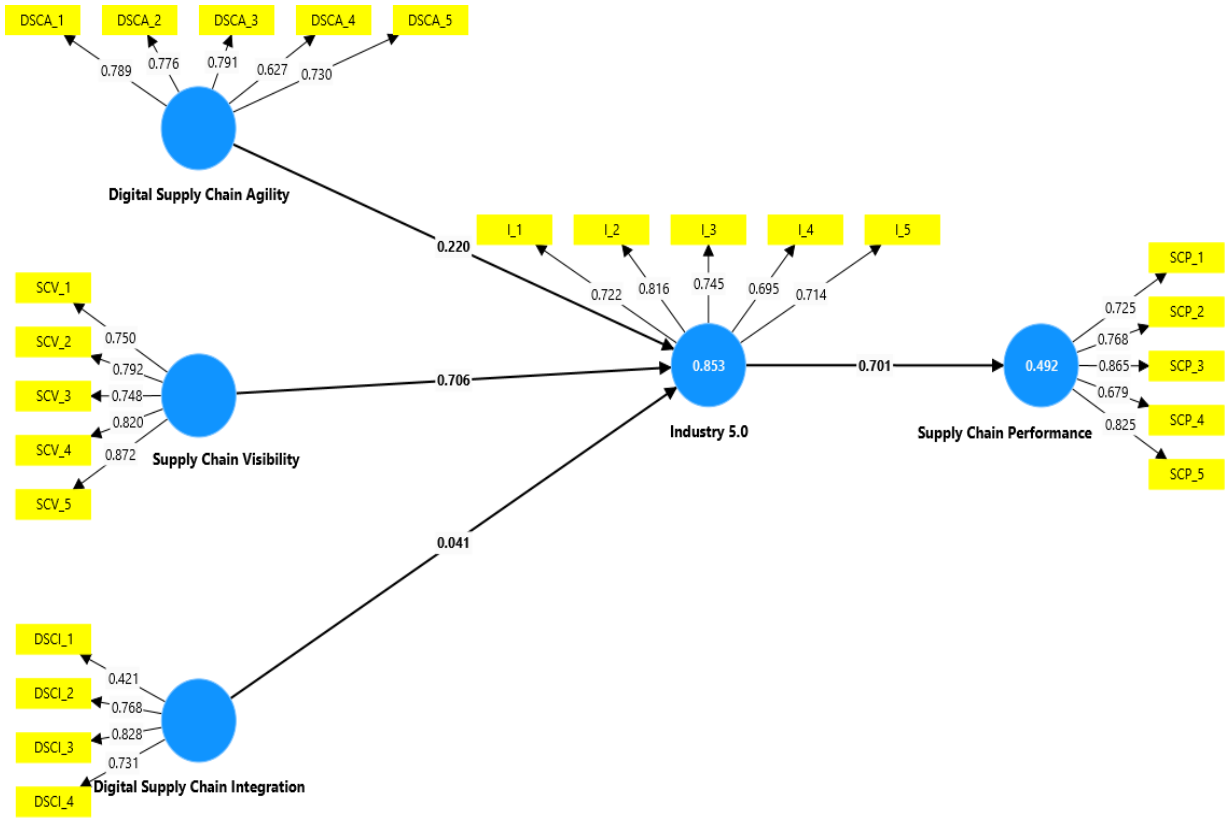

Figure 2: Result of the measurement model

As shown in Figure 2, most factor loadings are above 0.70, indicating strong indicator reliability and supporting the validity of the measurement model. One item (DSCI_1) falls below the threshold and may require reconsideration in future refinements.

Table 2: HTMT

	Digital Supply Chain Agility	Digital Supply Chain Integration	Industry 5.0	Supply Chain Performance	Supply Chain Visibility
Digital Supply Chain Agility					
Digital Supply Chain Integration	0.801				
Industry 5.0	0.830	0.837			
Supply Chain Performance	0.774	0.746	0.855		
Supply Chain Visibility	0.790	0.820	0.703	0.811	

*As shown in **Table 2**, all HTMT values are below the recommended threshold of 0.90, indicating acceptable discriminant validity among the study constructs* [55].

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Table 3: Fornell and Larcker Correlation

	Digital Supply Chain Agility	Digital Supply Chain Integration	Industry 5.0	Supply Chain Performance	Supply Chain Visibility
Digital Supply Chain Agility					
Digital Supply Chain Integration	0.801				
Industry 5.0	0.830	0.837			
Supply Chain Performance	0.774	0.746	0.855		
Supply Chain Visibility	0.790	0.820	0.703	0.811	

*As shown in **Table 3**, the square root of the AVE for each construct (values on the diagonal) is higher than its correlations with other constructs, confirming acceptable discriminant validity* [54]*.*

5.2 Structural Model Assessment

The evaluation of the structural model occurred through path coefficients together with R^2 values and meaningful relationship analysis performed by a bootstrapping method with 5,000 subsamples. Statistical tests confirmed all path coefficients as significant at the $p < 0.05$ level which validating the proposed hypotheses. The R^2 value for Industry 5.0 adoption demonstrates robust explanatory ability because it accounts for a major share of its variability. The assessment of supply chain performance reveals that Industry 5.0 effectively explains moderate proportions of performance outcomes. These research results demonstrate that the model has predictive power alongside confirming predictions derived from OIPT.

Table 4: Result of hypotheses testing (path coefficients-*β*)

	Path Coefficient (β)	Standard deviation	T statistics	P values	Decision
H1: Digital Supply Chain Agility -> Industry 5.0	0.220	0.064	3.461	0.001	Supported
H2: Digital Supply Chain Agility -> Supply Chain Performance	0.154	0.046	3.368	0.001	Supported
H4: Digital Supply Chain Integration -> Supply Chain Performance	0.041	0.040	1.040	0.298	Not supported
H4: Digital Supply Chain Integration -> Supply Chain Performance	0.029	0.029	1.002	0.316	Not supported
H5: Industry 5.0 -> Supply Chain Performance	0.701	0.041	17.013	0.000	Strong support
H6: Supply Chain Visibility -> Industry 5.0	0.706	0.064	11.089	0.000	Supported
H7: Supply Chain Visibility -> Supply Chain Performance	0.495	0.050	9.970	0.000	Supported

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As shown in Table 4, five out of seven hypotheses were supported. Digital Supply Chain Agility and Supply Chain Visibility had significant positive effects on both Industry 5.0 and Supply Chain Performance. Industry 5.0 also significantly influenced performance. However, Digital Supply Chain Integration showed no significant impact on either Industry 5.0 or performance, indicating a limited role in this context.

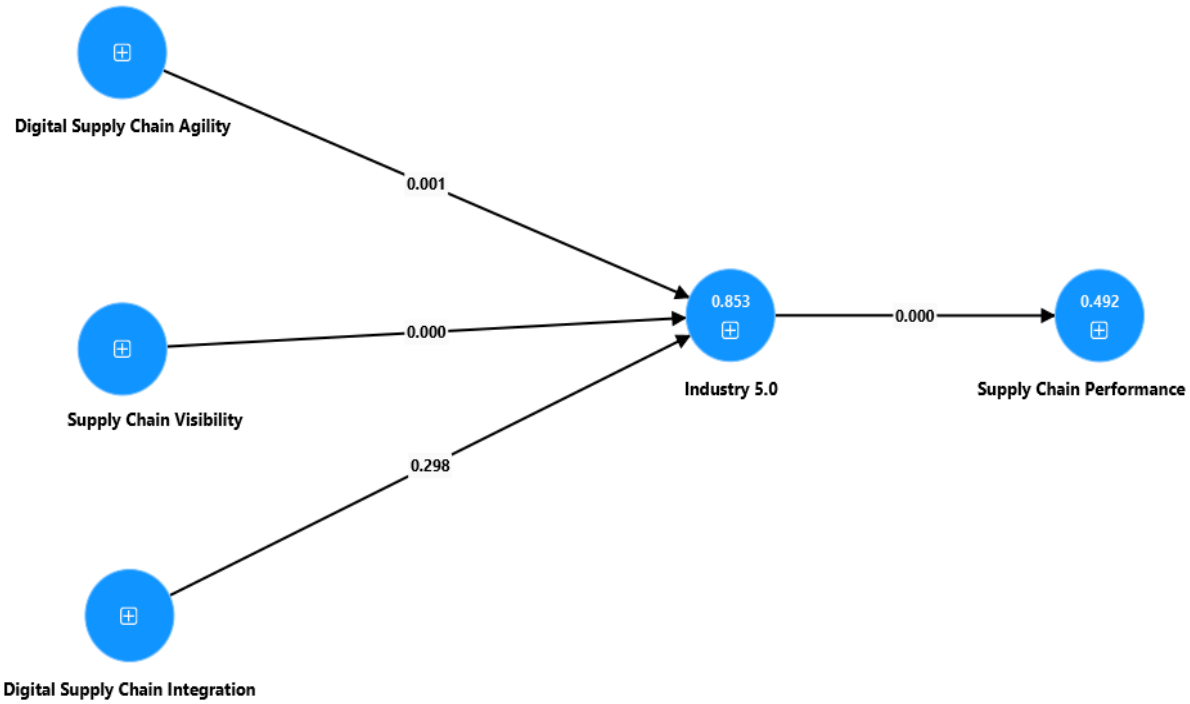

Figure 3: Result of Structural Model

Figure 3 shows that all path relationships are statistically significant ($p < 0.05$), confirming the structural validity of the proposed model.

6. DISCUSSION AND IMPLICATIONS

The findings of this study offer several significant insights into how digital supply chain capabilities and Industry 5.0 adoption influence supply chain performance within the logistics and distribution sector in Jordan. The study validates through Organizational Information Processing Theory (OIPT) that firms in uncertain environmental conditions need to strengthen their information processing tools to maintain their competitiveness [8], [29]. The study supports this theoretical basis by showing that Industry 5.0 serves as a vital pathway through which firms transform their digital resources into superior organizational performance achievements.

The study findings show that Digital Supply Chain Agility has a positive impact on the industry 5.0 adoption as well as the supply chain outcome results. Agility equips the organizations to quickly follow and respond to the variations in the market and the demand by using real time information and modern technology as recommended in the research

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findings [56] [57], [58]. The importance of such agility for industry 5.0 functionality lies in the fact that such agility allows organizations to combine human input with machine intelligence when developing flexible tailored, responsive systems. OIPT argues that the implementation of agility in firms will assist in enhancing information processing complexity under uncertainty.

Both Supply Chain Visibility and Industry 5.0 adoption along with supply chain performance showed statistically significant positive effects through research findings. Visibility allows businesses to monitor live endpoint information spreading across their supply networks which boosts partnership cohesion and improves forecasting precision while addressing supply disruptions [16], [59]. The relationship between visibility serves as both an enabler for advanced technologies of Industry 5.0 while directly producing superior performance results through enhanced transparency and reduced information asymmetry. The research findings validate the Organization of International Professional Tennis theory that better information management leads to improved decision outcomes and timeliness.

Digital Supply Chain Integration proved ineffective in both influencing Industry 5.0 development and supply chain operational results. Modern Jordanian logistics sector constraints might explain this surprising result because they include separate systems as well as insufficient trust among organizations and limited funding for standard digital integration platforms. This study's minimal integration impact indicates there might be a mismatch between entities' readiness to implement advanced technologies and their successful implementation in practice [60], [61]. Organizations need to embrace digital technology adoption together with developing the necessary internal skills and relationship abilities for achieving effective implementation.

Supply chain performance reacts powerfully and significantly to Industry 5.0 implementations because human-centered innovation remains essential for contemporary supply chain management. The research findings confirm Industry 5.0 literature which describes it as an operational model that brings humans and machines together to create personalized sustainable intelligent operations [2], [62]. The research supports Industry 5.0 adoption because organizations gain a competitive edge by merging advanced technologies with human flexibility. Within the OIPT framework Industry 5.0 functions as a cutting-edge information processing system linking performance potentials with operational achievements.

The research findings deliver substantial theoretical implication points. The paper expands OIPT research by implementing the novel construct of Industry 5.0 to digital supply chain analysis. The study demonstrates that digital capabilities possess varied effects on organizational transformation since integration differs from agility and visibility in its contribution level. The research presents multiple distinct patterns explaining how digitalization creates performance effects in emerging economy contexts.

Managerially speaking this study demonstrates that Jordanian logistics businesses must direct their funding toward enhancing agility and visibility capabilities. Managers need to

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build agile systems that integrate real-time data analysis functions to create flexible operations. The goal of digital integration demands both the enhancement of organizational culture simultaneously with leadership support systems and partner collaboration before deriving meaningful benefits. Such findings emphasize that Industry 5.0 technologies need to become essential components of an organizational transformation strategy that allows for improved human-machine partnerships and flexibility.

This research demonstrates the transitional role of Industry 5.0 which controls the link between digital capabilities and performance outcomes. The combination of advanced technologies with human-centered design stands essential for companies operating in unpredictable supply chain scenarios specifically in the Middle East.

7. CONCLUSION AND RECOMMENDATIONS

Researchers studied how the three fundamental digital supply chain capabilities of agility, visibility, and integration influence supply chain performance and how Industry 5.0 works as an intermediary factor. According to the Organizational Information Processing Theory (OIPT) organizations need to increase their ability to interpret and react to complex information environments for successful competition. The logistics and distribution sector of Jordan provided suitable real-world data to analyze these relationships due to rising digital importance and regional growth in logistics activities.

The research demonstrates digital supply chain agility together with supply chain visibility produces substantial positive effects on Industry 5.0 adoption which leads to superior supply chain performance. Research evidence supports these findings since agility enables quick reaction to market demands and procedural interruptions whereas visibility strengthens both decision-making coordination and operational speed. The organization gains the enhanced capacity to handle real-time data processing and effective collaboration through these two capabilities that both contribute to OIPT and Industry 5.0 practices.

Digital supply chain integration failed to produce noticeable effects on both Industry 5.0 adoption as well as supply chain performance metrics. The identified outcome opposes previous research outcomes possibly because of functional constraints including poor technological infrastructure and unconnected network systems which limit company-to-company cooperation in the local logistics network. Theoretical premises support integration as important but its practical use depends on systematic changes in governance and investment and digital trust establishment.

Supply chain performance shows direct positive associations with the implementation of Industry 5.0 because it establishes itself as an essential operational excellence driver. The perfect blend of advanced technologies and human intelligence defines Industry 5.0 because it enables organizations to adapt their services and innovate their products while better matching stakeholder needs. This finding validates the main principle that digital technology needs human intervention to achieve true performance gains.

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Because of these research discoveries, some recommendations follow. As such, logistics and distribution companies need to appropriate their efforts and resources to procure technologies that are visibility and agility focused and which include real-time analytics systems, Internet of Things solutions, as well as several artificial intelligence analytics applications. Such strategic capabilities continue to have important roles in both near-term reactions and longer-term adaptivity of the organization.

Sending managers and policymakers to speed up the adoption of Industry 5.0 technology of collaborative robotic partnering and human-machine interaction as well as intelligent automation systems should be encouraged. The fundamental elements to make these innovations successful in integrations are unique workforce development and changes in organizational culture. Although integration did not lead to significant findings in this study, it represents a long-term aspiration in human needs theory, one that needs to be perennially attended to by the executive. All national sectors and industries must find it as a central obligation, in data exchange between corporations, to achieve increased system network matching and digital confidentiality.

The study demonstrates why human values that include creativity together with ethics and employee empowerment must be integrated into digital transformation approaches. The implementation of technology in Jordan requires simultaneous advancement of both social systems and institutional development because of its emerging economic status.

The research establishes practical and theoretical values through its analysis of Industry 5.0 and digital supply chain mechanics which enhance supply chain operational results. Modern businesses seeking technological progress and resilience against competitors should use this framework as a blueprint because it demonstrates OIPT's importance in digital environments. The findings demonstrate industry 5.0 should be adopted strategically because it represents a complete transformative system fundamental for sustainable supply chain achievements.

8. LIMITATIONS & FUTURE RESEARCH DIRECTIONS

The study provides useful knowledge about digital supply chain capabilities together with Industry 5.0 as performance boosters yet we need to know about several limitations that impact findings' general use and their comprehension.

The research dedicated its scope to analysis of the logistics and distribution sector in Jordan which reduces the broad impact of findings beyond that sector. The distinctive features of the Jordanian economic environment and digital development state alongside infrastructure advancement would affect both the process of developing digital capabilities and adopting Industry 5.0 principles. The model should be applied to other nations' developing economies while researchers could execute comparative international studies to identify how variables transform based on different operational circumstances. The research collected information through a survey approach that gathered responses at once during one specific period. The measurement process using this technique provides an efficient definition of relationships between variables without

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offering insight into either temporal developments or causal effects. Future examinations should adopt longitudinal research methods to track the modifications of digital transformation capabilities together with Industry 5.0 along with their sequential effects on organizational performance. Organizational respondents communicated self-reported information in this study thus data could have obtained subjectivity because participants may have shown socially desirable answers or possessed subjective perceptions. Further research should utilize two or more data sources by combining quantitative performance data with qualitative executive and supply chain professional interviews to validate research findings.

The research used PLS-SEM for quantitative analysis to test theory while this method might limit the investigation of contextual or behavioral aspects of the subject. Upcoming research should use blended research designs by structuring surveys with qualitative case study investigations to explain the process of implementing Industry 5.0 technologies into organizational systems.

This study examined a model containing three digital supply chain capabilities which are agility, visibility, and integration as well as one mediator which is Industry 5.0. The analysis would benefit from appropriate additional variables like organizational culture, digital maturity, leadership support and technological infrastructure to develop a more detailed understanding of digital transformation success. The proposed framework needs additional research that would integrate new moderating and additional mediating variables between digital capabilities and their connection to performance outcomes.

The current research serves as a solid base for digital supply chain and Industry 5.0 effects in emerging markets although future research should employ comparative designs to enhance this field of study.

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