THE ROLE OF DIGITALIZATION AND AI USE IN MANAGING UNCERTAIN SUPPLY CHAIN MANAGEMENT IN WAR ZONES & CONFLICT AREAS

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Abstract

The study investigates the impact of uncertain supply chain management (SCM), artificial intelligence (AI), and digitalization on enhancing digital efficacy and improving operational performance within the Kingdom of Saudi Arabia (KSA) in war zones. Data was collected from a sample of 300 students and faculty members from the fields of International Relations and Computer Sciences. The results indicate significant relationships between these factors, with SCM strongly influencing AI adoption (β = 0.582, p < 0.001) and digital tools at the workplace (β = 0.743, p < 0.001). Additionally, digital tools were found to significantly enhance digital efficacy (β = 0.421, p < 0.001), which, in turn, improved operational performance (β = 0.659, p < 0.001). The study highlights the importance of integrating AI and digitalization strategies in SCM to boost efficiency and effectiveness in challenging environments. These findings contribute to understanding how digital transformation can be leveraged in conflict-affected areas to optimize humanitarian operations and resource management.

Keywords; *Supply chain management,Artificial Intelligence, Digitalization, Digital Efficacy Operational Performance.*

1. Introduction

In humanitarian operations, the practices of digitalization and artificial intelligence are significant, particularly in armed conflicts. In the last couple of years, the application of a particular technology has shifted the ways humanitarian responses are implemented, creating new possibilities for 'doing good' better. For instance, AI has revolutionized the handling and analysis of large volumes of data at a real-time basis; thus, identifying zones of conflicts, tracking refugees, or organizing the placement of resources and services (Schneider, Jimenez, & Kyriazi, 2023). This capability is very important especially in conflict condition where the environment is dynamic and may require some immediate action.

Besides data analysis, AI has improved the logistics through tools such as drones and satellite imagery, which are crucial when assessing areas that are unreachable or is deemed unsafe. These technologies assist in the on-sight monitoring and evaluation without compromising the lives of humanitarian workers, while offering valuable information about the extent of destructions and requirements of the distressed groups (Cortright, Fairhurst, & Wall, 2017). For instance, when the crisis was happening in Syria, drones powered by artificial intelligence were employed to collect data about the situation on the ground, improving the ways of assessing the needs of recipients while avoiding danger to the lives of humanitarian workers.

In addition, the coordination between different humanitarian actors has been enhanced through digitalization. AI systems can help organizations to forecast more effectively, organize inventory, and avoid the presence of aid where it is not required (Jauhar et al.,, 2024). They also help optimize the response while reducing cost and time in the provision of humanitarian assistance, thereby increasing the effectiveness of those services or products provided.

Additionally, artificial intelligence and digital technology contributed to better cooperation across international organizations, making crisis responses more cohesive. These technologies provide a uniform framework for exchange of information, ensuring that everyone in the industry understands what is expected of them. This is especially important in war-torn places, where collaboration can save the lives of those devastated by violence (Chui, & Francisco., 2017).

The integration of AI and digitalization in humanitarian operations is thus a game-changer, providing tools that enhance both the speed and accuracy of responses. As technology continues to evolve, its

role in humanitarian work will likely expand, offering even greater potential to protect and assist vulnerable populations during armed conflicts (Cortright, Fairhurst, & Wall, 2017; Jauhar et al., 2024).
Albeit the progress accomplished in the area of digitalization and AI, which has improved operational conditions and organizational responses in humanitarian situations during armed conflicts, there are also significant challenges and limitations. Some of the concerns unique to utilizing AI and digital tools in conflict areas include data protection, accuracy of the AI predictions, and proper application of AI systems that are autonomous in environments that involve people in distress. Moreover, there is a problem of the divide between the digital haves and have nots as well as the absence of infrastructure in conflict-prone regions that may hamper the deployment of these technologies. However, it is important that the challenges be met to the bureau's maximum potential to enhance the use of AI and digitalization in the assessment of humanitarian response during armed conflicts. Based on the above discussion following are the research questions for the current study;

- *Is there any relationship exist between Supply Chain Management and Digitalization at work place for humanitarian work in war zones and conflict areas?*
- *Is there any relationship exist between Supply Chain Management and application of AI at work place for humanitarian work in war zones and conflict areas?*
- *Does application of Digitalization policy at work place enhance organizational digital Efficacy for humanitarian work in war zones and conflict areas?*
- *Does application of AI at work place enhance organizational digital Efficacy for humanitarian work in war zones and conflict areas?*
- *Is organization Operational performance for SCM in war zone is effected by organizational digital Efficacy approach?*

The present research is important as it aims at providing the much-needed answers to vital questions related to digitalization and artificial intelligence (AI) in humanitarian operations during armed conflicts, with reference to Saudi Arabia. The analysis of potential ethical issues arising from application of AI in humanitarian activities will result in proposing guidelines and standards, which will minimize the negative impact of AI on people's rights and liberties. Examining the consequences of the attempt to understand the effect of digital divide will shed light on issues of minorities in conflict areas to access AI and digital technologies as a means of taking the necessary steps towards improvement of core digital rights and equality. The suggestions for the implementation of AI and other digital technologies in humanitarian processes will give specific advice to the policymakers and donors, humanitarian organizations, and technology creators, helping them improve cooperation and efficiency in the use of resources during crises.
Therefore, this study will add to the existing literature base of the use of AI and digital technologies in humanitarian contexts, providing a synthesis that can help scholars in formulating and promoting future work and discussions. Since the study helps in increasing the efficiency of humanitarian interventions, it supports the following United Nations SDGs 9-industry innovation and infrastructure as well as SDG 16-peace justice and strong institutions.
Altogether, this topic implies future possibilities to enhance the humanitarian response actions in the contexts of conflicts, which can lead to the saving of lives, minimizing suffering, and strengthening the vulnerability of populations.

2. LITERATURE REVIEW

2.1. Relationship between supply chain management and Digitalization at Workplace

It has been found that SCM and digitalization in the course of work have a valuable connection as business organizations continue to look for ways to improve their operations. Digitization, which can be described as the integration of digital technology across the SCM, has become an integral part of SCM due innovation in tools for efficiency in data collection, analysis and decision making. Current trends inclusive of IoT, block chain and analytics form the key pillars of this revolution providing value earnings and enhanced chain of supply (Bag et al., 2023) with improved transparency, accuracy as well as Coordination.
Digitalization has a positive impact on supply chain management since supply chain activities can be improving out of sight and under control. For instance, through IoT devices, retailers and warehouse

can monitor inventory levels and movement which can enhance demand estimations and proper distribution (Reaidy et al., 2015). This real-time data assists the organizations in making quick decisions since they can easily notice changes in demand or any supply disruptions, this will help them reduce any delays and ultimately helps to decrease operation costs (Zhao et al., 2021). Further, there is an increased efficiency in the management of data through the use of the blocks in recording the transactions hence improving the traceability of the commodities in the chain (Wu et al., 2019).

Furthermore, technologies like AI and ML play a role in effective supply chain management by supporting predictive analysis of the operations' efficiency. AI algorithms are helpful in analysing big data to detect patterns and trends to enable the organisations make right decisions on stock management, sourcing and distribution (Younis, Sundarakani,&Alsharairi, 2022). Machine learning models can take the benefits of its component supply chain by learning from the previous data and can enhance more and more performance (Sharma, et al., 2022).

In summary, digitalization has a profound impact on supply chain management by improving visibility, accuracy, and efficiency. The use of advanced technologies such as IoT, blockchain, AI, and collaborative platforms transforms traditional supply chain processes, leading to more agile and responsive supply chain operations.

2.2. Relationship between supply chain management and AI at Workplace

Artificial Intelligence (AI) integration in Supply Chain Management (SCM) has also transformed the structure and functioning of workplaces through improvement on their operational conduciveness through efficiency, accuracy, and decision making. Technologies such as machine learning, predictive analytics, and automation have turn into synonymous to change that has swept over the operation of conventional supply chains to create more flexible supply chain systems (Sharma, et al., 2022).

AI improves SCM because it offers sophisticated instruments for analyzing general information and suggested supply chain strategies. Big data can be of several types including numeric, text, graphics, and multimedia and the machine learning algorithms can process the data in its raw form along with the required pre-processing from different resources such as sale transactions, stocks, and trends on the market (Younis, Sundarakani, &Alsharairi, 2022). For instance, decision-making supported by AI in predictive analysis can make better demand prediction to avoid situations of stockout or overstocking (stock management) by organizations. This capability enhances the effectiveness of decisions made by organizations, the supply chain activities, and leaves no room for the accumulation of unsold inventory or stock-outs that disappoint the customers.

In addition, AI in automation helps in lowering down supply chain complexities and number of operations that involve human interference. Application of robotic process automation (RPA) and intelligent automation tools will assist greatly where there is often low-ticket, repetitive and clerical work like order processing, data entry and inventory control (Kankaew, 2023). These make it easier for the organization to have streamlined operations, and more importantly, it is possible for human workers to concentrate on value addition rather than repetitive tasks hence leading to improved productivity.

In addition, AI enhances decision-making when it comes to supply chain management since it incurs multiple analytical tools (Sharma Et al., 2023). AI systems enable the consideration of large amounts of data and the determination of patterns that may not be noticed when using a conventional approach. This capability assists in decision making since it provides managers with data to work with in the supply chain decision making process especially in procurement, logistics as well as supplier relationships (Younas et al., 2022).

In summary, the relationship between supply chain management and AI at the workplace is characterized by enhanced data analysis, automation, visibility, and decision-making. The integration of AI technologies into SCM processes results in more efficient, responsive, and effective supply chain operations, ultimately leading to improved performance and competitiveness.

2.3. Relationship between Digitalization at Workplace and Digital Efficacy

Digitalization at workplace and digital efficacy are correlated, and analyze how the technological changes affect the performances of organizations and their employees effectively (Selimović, et al., 2021). In concept, the digitization can be described as the process of incorporating digital technologies in various elements of working activities; these may include, but not limited to, communication media, information sharing, and working practices. It is believed that such change should identify critical

areas in the organization that can benefit from increased efficiency and effectiveness (Chatterjee et al., 2023). While digital efficiency refers to the capability of persons and institutions towards the competent use of technology and the Internet in the accomplishment of goals and the competent performance of tasks.

The aspect of digital technology promotes digital efficiency through enhancing working tools and or platforms among workers. For example, in the use of cloud computing, groupware, and data analytics, employees' productivity of tasks is improved (Maran et al., 2022). These technologies allow an employee to work remotely; share information with co-workers and make sound decisions based on real time information, all of which enhance their efficiency of performing work related activities (Chatterjee et al., 2023).

Furthermore, it creates such a culture where skills that are associated with the use of the digital technologies are constantly enhanced and advanced. It is also clearly seen that as digitalization increases digital efficacy increases which in turn has a positive impact on organizational performances. When employees are provided with digital technologies then there is an effectiveness in handling the operations with minimizing the wastage in the process and increasing total productivity (Maran et al., 2022). The organizations that effectively harness the value of information technology and help the employees transform to digital workers usually enjoy greater levels of output and competitiveness (Vuori et al., 2019).

In summary, digitalization at the workplace enhances digital efficacy by providing advanced tools, promoting continuous skill development, and improving overall operational effectiveness. As organizations continue to embrace digital transformation, the alignment of digital technologies with employee capabilities is crucial for achieving superior performance and maintaining a competitive edge.

2.4. Relationship between AI at Workplace and Digital Efficacy

The integration of AI at the workplace and workplace digital effectiveness plays a critical role in establishing how AI technologies affect workers' performance. Machine learning, natural language processing, and automation tools collectively under the umbrella term called AI (Sharma er al., 2022; Younas et al., 2022), enable digital efficacy to be boosted by improving work flows, decision making, and productivity. Digital efficiency then means the ability of people and companies to apply digital devices and technologies to bring about intended goal states and personally or organizationally complete operations effectively.

The adoption of AI in the workplace increase digital productivity as it assists with the tasks that are tedious and time-consuming hence freeing employees to work on the more important tasks. For instance, it can be seen that activity automation tools facilitated using artificial intelligence can execute usual clerk level operations such as data input and report preparation, thus saving time and effort of the employees (Vuori, et al., 2019). This also leads to efficiency where some of the routine tasks that employees performed in the past are now automated hence sparing the employees time to focus on other tasks such as decision making and strategy (Davenport &Ronanki, 2018).

In addition, AI improves the digital effectiveness concerning the readiness of progressive data analysis that could help to provide more adequate decisions. AI also plays a role in digital efficacy especially in matters touching on personalization or customization of the many workplace uses (Maran, et al., 2022). Integration of AI in the work setting implies that technologies can be customized to adopt to the users' preference and/or disability, thereby making the software tools and interfaces used in organizations more natural and easy to interact with (Younas et al., 2022). For instance, the use of artificial intelligence in recommendation systems can help recommend specific information, tools or resources that a user found relevant based on the user's activity thus enhancing the user capability to perform activities relevant and efficiently (Sharma et al., 2022).

In summary, the integration of AI at the workplace significantly boosts digital efficacy by automating routine tasks, enhancing decision-making capabilities through advanced analytics, and personalizing digital tools to meet individual needs. As organizations increasingly adopt AI technologies, understanding and leveraging their potential can lead to improved productivity, better decision-making, and a more effective use of digital resources.

2.5. Relationship between Digital Efficacy and Operational Performance

The relationship between digital efficacy and operational performance is increasingly significant as organizations continue to integrate digital technologies into their operations. Thus, there is a positive relationship between the degree of using digital technologies or tools effectively and the operational performance, which becomes more important as more organizations implement digitization in their daily operations. Digital efficiency can be described as the work output of a computer-based or digitally supported process (Maran et al., 2023), for example, its capacity to reduce costs, increase speed, ingenuity, or fulfil other intended aims. This concept includes how effectively various facets of operation are supported by digital technologies and how efficiently and effectively information is being processed and used to great effect (Younas et al., 2022).

Organizational digital productivity influences operational productivity based on the ability of organizations to increase technical advantages. For instance, proper digital technologies can help to reduce paperwork, time consumption in resource allocation or support real-time analytical data with the corresponding impact on decision-making procedures and business organization's performance (Jauhar et al., 2024). All these improvements can result in increased cost efficiency, improved production and an understanding of the overall performance. The findings presented in the literature indicate that when digital efficacy is higher, competitive advantage and operational efficiency increase as well because digital technologies enable firms to respond to changes in the market as well as the customers' needs more rapidly (Ulfert-Blank et al., 2022). However, the integration of digital initiatives with specific process targets enhances performance indicators even more because organizations use digital resources to accomplish strategic objectives (Maran et al., 2022).

Consequently, it could be posited that digital efficacy is an important driver of operational performance. In implementing the digital tools and techniques in organizations, it is evident that the organizations operational effectiveness can be enhanced hence identifying the crucially of digital skills in attaining outstanding organizational operations (see fig 1).

Hypothesis Statement

H1; *There is a significant relationship between Supply Chain Management and Digitalization at the workplace for humanitarian work in war zones and conflict areas.*

H2; *There is a significant relationship between Supply Chain Management and the application of Artificial Intelligence (AI) at the workplace for humanitarian work in war zones and conflict areas.*

H3;*The application of Digitalization policies at the workplace significantly enhances organizational digital efficacy for humanitarian work in war zones and conflict areas.*

H4;*The application of AI at the workplace significantly enhances organizational digital efficacy for humanitarian work in war zones and conflict areas.*

H5; *Organizational digital efficacy significantly affects the operational performance of Supply Chain Management in war zones and conflict areas.*

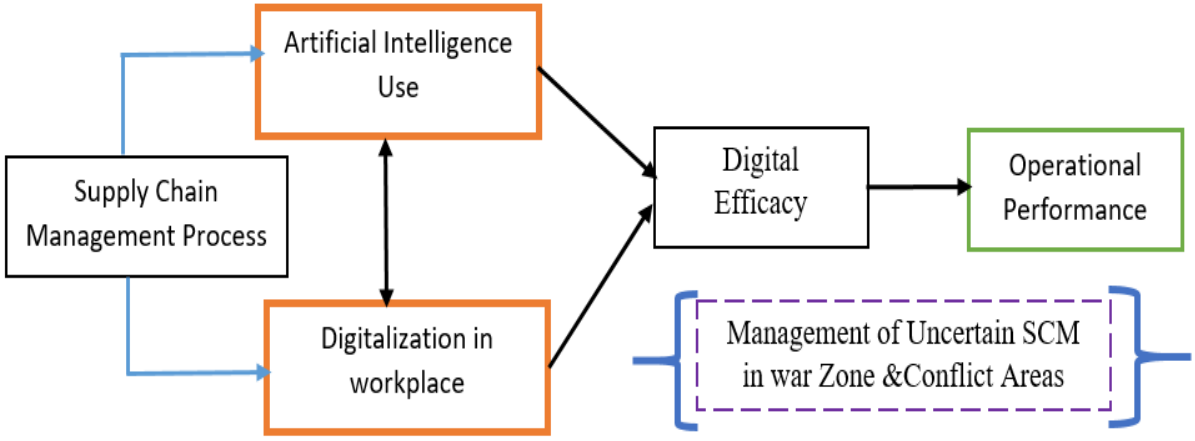

Fig.1. Conceptual Framework for Uncertain Supply Chain Management in War Zones

3. Research Methodology

The type of research methodology adopted in this study is quantitative research design to analyze the correlation between SCM, digitalization, AI in the humanitarian work in the war zones and conflict areas with organizational digital effectiveness and operational effectiveness. Thus, the purpose of the study is to evaluate the effects of digitalization and AI, as applied to SCM, in such crucial environments.

3.1. Sample and Sampling Technique

A sample of 300 respondents is employed and all respondents are selected from higher education institution targeting students and faculty in the social sciences and computer sciences. The sample size is decided from the item to response ratio formula given by Hair et al. (2012) where the minimum number of responses should be ten times the number of survey items. This is important in order to make sure that the sample size is sufficient enough to be able to produce accurate and reliable results.

3.2. Data Collection

Data is collected using a structured questionnaire, designed to assess the following constructs: Suppliers Management, digitization, AI use, business digital readiness, overall efficiency and effectiveness. The questionnaire contains items from the existing instruments (e. g., Aral & Weill, 2007) and self-developed items used in this study. To further validate the items, exploratory Factor analysis (EFA) and confirmatory factor analysis (CFA) were performed on the items in order to reassure on the reliability and validity of the items.

3.3. Questionnaire Development

The questionnaire is designed using items that are derived from theories and models that are aligned with SCM, digitization, Artificial Intelligence, and Digitization Effectiveness. The theoretical framework that guided the development of the items included previous studies on knowledge sharing, here, prior studies, including (Ratnasari et al., 2024) composed the theoretical background of the study. Novel products were developed based on an assessment of the literature. As a result of EDA the initial draft of the questionnaire was taken through a process of refinement of the items in an effort to enhance the clarity as well as the relevance of the questions that were included in the questionnaire. To further validate the constructs, CFA was also carried out.

3.4. Data Analysis

The collected data is analyzed using SmartPLS, a software tool for Partial Least Squares Structural Equation Modeling (PLS-SEM). SmartPLS allows for the evaluation of complex relationships between latent variables and provides insights into the structural model's validity and reliability (Hair et al., 2012). PLS-SEM is particularly suitable for this research due to its ability to handle formative and reflective constructs and its flexibility with small to medium sample sizes.

4. RESULT AND DISCUSSIONS

Table1

Convergent validity and composite reliability testing

Variable	Item/s	Loading	CR	AVE
Supply Chain Management	How do you perceive the impact of Saudi Arabia's digital tools on improving the efficiency of supply chain management in humanitarian operations within war zones?	0.726	0.820	0.575
	To what extent do you believe Saudi Arabia’s AI applications contribute to optimizing logistics and resource distribution in conflict areas?	0.823		
	How effective do you find Saudi Arabia’s digital platforms in enhancing coordination between various humanitarian agencies operating in war zones?	0.820		
	In your opinion, how crucial is Saudi Arabia’s digitalization for making data-driven supply chain decisions during humanitarian crises?	0.796		
	How do you rate the role of Saudi Arabia’s digitalization in improving the tracking and	0.604		

	management of resources in conflict-affected areas?			
Digitalization at Work place	How do you perceive the effectiveness of Saudi Arabia's digital technologies in streamlining humanitarian operations in war zones?	0.617	0.842	0.623
	To what extent do you believe Saudi Arabia's digital tools have increased the speed and accuracy of information processing in humanitarian aid efforts?	0.895		
	How do you assess the impact of Saudi Arabia's digital communication platforms on coordination with field teams in conflict areas?	0.878		
	In your experience, how significant is the role of Saudi Arabia's digitalization in managing data and resources for humanitarian missions in war zones?	0.850		
	How well do you think Saudi Arabia's digital tools are integrated into your organization's operations for humanitarian work in conflict zones?	0.662		
Artificial Intelligence at workplace	How effective is Saudi Arabia's AI in predicting and responding to humanitarian needs in war zones, according to your perspective?	0.656	0.785	0.534
	How do you perceive the role of Saudi Arabia's AI in analyzing large datasets to improve decision-making in humanitarian operations?	0.704		
	In your view, how has Saudi Arabia's AI contributed to optimizing the allocation and distribution of aid in conflict-affected areas?	0.659		
	How crucial is Saudi Arabia's AI technology for monitoring and evaluating the impact of humanitarian interventions in war zones?	0.838		
	To what extent do you believe that Saudi Arabia's AI has improved the accuracy of needs assessments in conflict zones?	0.779		
Organizational Digital Efficacy	How would you rate the effectiveness of Saudi Arabia's digital tools in managing and deploying resources for humanitarian work in war zones?	0.804	0.732	0.546
	To what extent do Saudi Arabia's digital technologies enhance operational efficiency and effectiveness in humanitarian efforts?	0.767		
	How well do you think Saudi Arabia's digital tools align with your organization's goals to improve humanitarian aid delivery in conflict areas?	0.746		
	In your opinion, how has the integration of Saudi Arabia's digital solutions affected the overall performance of humanitarian operations?	0.624		
Operational Performance	How do you evaluate the impact of Saudi Arabia's digital and AI technologies on the efficiency of humanitarian operations in conflict zones?	0.828	0.874	0.640
	To what extent has Saudi Arabia's digitalization led to improvements in response times during humanitarian crises?	0.879		
	How significant is the role of Saudi Arabia's AI and digital tools in achieving humanitarian objectives in war zones?	0.901		
	How do you assess the improvements in operational	0.892		

	success rates attributed to the adoption of Saudi Arabia's digital and AI technologies?	
	How do you evaluate the impact of Saudi Arabia's digital and AI technologies on the efficiency of humanitarian operations in conflict zones?	0.369

The data in the table (1) provides insights into the measurement model's validity and reliability, specifically focusing on supply chain management, digitalization, artificial intelligence, organizational digital efficacy, and operational performance within the context of Saudi Arabia's role in humanitarian operations in war zones.

The supply chain management construct demonstrates a high level of internal consistency with a Composite Reliability (CR) of 0.820, surpassing the 0.70 threshold recommended for reliability (Hair et al., 2014). The Average Variance Extracted (AVE) of 0.575 indicates adequate convergent validity, suggesting that the items collectively capture the underlying concept effectively (Fornell&Larcker, 1981).

The construct for digitalization in the workplace shows strong reliability, as indicated by a composite reliability (CR) score of 0.842. This means the items used to measure the construct are consistent and reliable. The average variance extracted (AVE) is 0.623, which is above the required threshold of 0.50, signifying good convergent validity (Fornell&Larcker, 1981).

For artificial intelligence (AI), the CR score is 0.785, which, though slightly lower than other constructs, still meets acceptable reliability standards (Considine, Botti, & Thomas, 2005). The AVE for AI is 0.534, marginally above the threshold, indicating a reasonable degree of variance explained by the construct. Item loadings range from 0.656 to 0.838, supporting AI's effectiveness in monitoring and improving humanitarian efforts (Hair et al., 2014).

Operational performance demonstrates the highest reliability, with a CR of 0.874, indicating excellent consistency (Nunnally& Bernstein, 1994). The AVE of 0.640 further strengthens convergent validity, confirming that the items effectively measure operational performance. Item loadings vary from 0.369 to 0.901, with most items showing strong correlations, although one may require further assessment (Hair et al., 2014).

In summary, the measurement model shows strong reliability and validity, making it a solid framework for analyzing the role of Saudi Arabia in improving humanitarian efforts through digitalization and AI technologies.

Table 2 FornellLarcker Method.

	AIW	DEF	DTW	OPR	SCM
AIW	0.731				
DEF	0.546	0.739			
DTW	0.689	0.726	0.789		
OPR	0.683	0.659	0.764	0.800	
SCM	0.582	0.711	0.743	0.745	0.758

***SCM**= Supply Chain Management, **OPR**= Operational Performance, **DTW**= Digitalization at Workplace, **DEF**= Digital Efficacy, **AIW**= AI at workplace*

The Fornell-Larcker criterion is a common method used to evaluate the discriminant validity of constructs within a structural equation model. Discriminant validity ensures that each construct is distinct and not overly correlated with other constructs in the model. According to the Fornell-Larcker criterion, a construct should share more variance with its own indicators than with other constructs in the model. This is assessed by comparing the square root of the Average Variance Extracted (AVE) for each construct against the correlation values between that construct and others.

The values from the above table indicate AVE values for all variables;

- AI at Workplace (AIW): 0.731
- Digital Efficacy (DEF): 0.739
- Digitalization at Workplace (DTW): 0.789
- Operational Performance (OPR): 0.800
- Supply Chain Management (SCM): 0.758

Results from table (2) indicate the Analysis of Discriminant Validity and findings depict that Digitalization at Workplace (DTW): The square root of AVE for DTW (0.789) is higher than its correlations with AIW, DEF, OPR, and SCM (0.689, 0.726, 0.764, and 0.743), further confirming the discriminant validity.**Operational Performance (OPR):** The square root of AVE for OPR (0.800) exceeds the correlations with AIW, DEF, DTW, and SCM (0.683, 0.659, 0.764, and 0.745), demonstrating strong discriminant validity.**Supply Chain Management (SCM):** The square root of AVE for SCM (0.758) is higher than its correlations with AIW, DEF, DTW, and OPR (0.582, 0.711, 0.743, and 0.745), confirming that SCM is distinct from the other constructs.TheFornell-Larcker analysis indicates that each construct in the model possesses strong discriminant validity. The square root of the AVE for each construct is higher than the correlations between that construct and all others, implying that the constructs are well-differentiated from one another. This ensures that each construct uniquely contributes to the model, without significant overlap with other constructs (Fornell&Larcker, 1981).

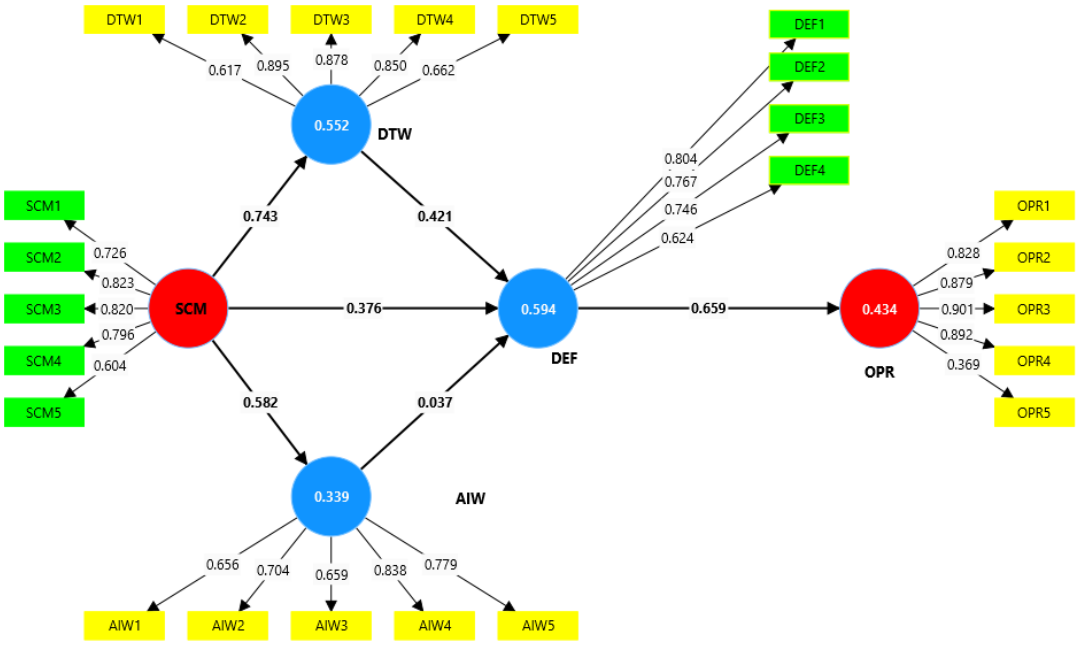

Fig.2. Structural Model Analysis

Table3 Path Coefficient for testing Hypothesis

Path Coefficient.	Beta	T statistics	P values
AIW -> DEF	0.037	0.614	0.539
DEF -> OPR	0.659	10.917	0.000
DTW -> DEF	0.421	5.446	0.000
SCM -> AIW	0.582	9.011	0.000
SCM -> DEF	0.376	6.475	0.000
SCM -> DTW	0.743	14.376	0.000
SCM -> AIW -> DEF -> OPR	0.014	0.607	0.544
AIW -> DEF -> OPR	0.024	0.618	0.536
SCM -> DTW -> DEF	0.313	4.729	0.000
DTW -> DEF -> OPR	0.278	4.297	0.000
SCM -> AIW -> DEF	0.021	0.615	0.539
SCM -> DEF -> OPR	0.248	5.552	0.000
SCM -> DTW -> DEF -> OPR	0.206	3.698	0.000

The table (3) presents the path coefficients, beta values, T-statistics, and P-values for testing various hypotheses in the structural model. The first six statements indicate direct relationships between the constructs, providing insights into how one variable directly influences another.

This path shows a weak positive relationship between AI at the Workplace (AIW) and Digital Efficacy (DEF). However, the T-statistic is low, and the P-value is not significant ($p > 0.05$), indicating that this relationship is not statistically significant. This suggests that AI technologies at the workplace may not strongly influence the perceived digital efficacy in this context.

There is a strong and significant positive relationship between Digital Efficacy (DEF) and Operational Performance (OPR), as indicated by the high beta value (0.659) and significant T-statistic (10.917, $p < 0.001$). This implies that increased digital efficacy within the organization leads to a notable improvement in operational performance, particularly in humanitarian operations in conflict zones.

The relationship between Digitalization at Workplace (DTW) and Digital Efficacy (DEF) is significant and positive, with a beta value of 0.421. The high T-statistic (5.446) and significant P-value ($p < 0.001$) suggest that digitalization efforts at the workplace significantly enhance the organization's digital efficacy.

The path from Supply Chain Management (SCM) to AI at the Workplace (AIW) is strong and significant, with a beta value of 0.582. The T-statistic (9.011) and P-value ($p < 0.001$) indicate that effective supply chain management is strongly associated with the successful implementation and utilization of AI technologies in the workplace.

Supply Chain Management (SCM) also has a significant positive impact on Digital Efficacy (DEF), as reflected by the beta value of 0.376 and significant T-statistic (6.475, $p < 0.001$). This suggests that robust supply chain management practices enhance the organization's digital capabilities and efficacy.

The relationship between Supply Chain Management (SCM) and Digitalization at the Workplace (DTW) is the strongest among the direct relationships, with a beta value of 0.743. The extremely high T-statistic (14.376) and significant P-value ($p < 0.001$) indicate that effective supply chain management significantly drives digitalization efforts within the workplace, especially in the context of humanitarian work in war zones.The table reflects a series of mediated pathways examining the influence of various factors on operational performance (OPR). The pathways involving AI at the Workplace (AIW) as a mediator (i.e., SCM -> AIW -> DEF -> OPR and AIW -> DEF -> OPR) are not significant, as indicated by their low beta values (0.014 and 0.024, respectively) and non-significant p-values (> 0.05). This suggests that AIW does not significantly mediate the relationship between Supply Chain Management (SCM) and Operational Performance (OPR) through Digital Efficacy (DEF). In contrast, the pathways involving Digitalization at the Workplace (DTW) show significant mediation effects. Specifically, SCM -> DTW -> DEF and DTW -> DEF -> OPR have substantial beta values (0.313 and 0.278) with highly significant p-values ($p < 0.001$), indicating that digitalization strongly enhances digital efficacy, which in turn improves operational performance. Additionally, the direct pathway from SCM -> DEF -> OPR and the fully mediated pathway SCM -> DTW -> DEF -> OPR are both significant, further emphasizing the pivotal role of digitalization in enhancing supply chain management’s impact on operational outcomes.

These findings highlight the critical role of supply chain management in influencing both AI implementation and digitalization at the workplace, which, in turn, enhance digital efficacy and operational performance. The significant relationships underscore the importance of integrating advanced technologies like AI and digital tools into supply chain processes to improve overall organizational effectiveness in challenging environments such as war zones.

5. Discussion

The identified path relationships provide comprehension of the strength of the OPR regarding various aspects of humanitarian operations in conflict settings with particular focus on SCM, DTW, DEF, and AIW.

First, the low beta value of WORK-AI and the non-significant p-value of AIW fail to support the first hypothesized relationship that let AI technologies at workplace affect the perceived digital efficacy. This result supports the notion advocated by (Sharma et al., 2019) that AI could enhance organisation digital competence by auto- mated tasks and quality decisions. This area may lack a good or strong relationship in this direction due to some obstacles that occur while applying AI in some sensitive fields like war theatres, where flexibility of AI may compromise.

On the other hand the positive and significant correlation between DEF and OPR with high Beta value and significant T-statistic suggests that the role of digital in improving the operational performance is important. This view is in line with the study of (Maran et al., 2019) who inferred that the dear digital

efficacy in organizations with efficiency issues are more effective towards the use of digital media and positively change the organization's perception towards the growing need for dealing with dynamic and complex situations including humanitarian missions in conflict areas.

Thus, the strong positive correlation between DTW and DEF indicates the importance of organizations to adopt technology for enhancement of an organization digital competence. With regards to this, the current study corroborates (Selimović, Pilav-Velić, &Krndžija, 2021; Chatterjee et al., 2023) study in the context of, where it was ascertained that the base idea of digitalization aids in the improvement of an organization's control of information, resources, and work-flows and a corresponding improvement of overarching organizational digital proficiency.

These results imply that since the concerned SCM and AIW indices are high and significant, sound supply chain management is associated with the use of the AI systems at the workplace. This finding supports the claim made by (Jauhar, et al., 2024;Bag et al., 2023) where they argue that efficiency of practices on SCM stays crucial to supply chain networks enhanced by technologies like AI to improve identified estimates in SCM and resource utilization in SCM and communication between various network participants.

Likewise, the coefficients estimate of SCM suggesting a highly significant and positive probability demonstrates that a proper implementation of supply chain management will enhance an organization's digital enabling factor. This relationship points at how SCM and digital capability are complementary whereby for SCM data has to be accurate, information has to be timely and resources have to be utilized efficiently and all this are supported by digital technologies (Wu et al., 2019;Chui,& Francisco, 2017;Younas et al., 2022; Sharma Et al., 2022).

Lastly, it has the closest link to DTW lending credence to the idea that having proper supply chain management makes a huge difference in boosting digitalization at the workplace. This finding aligns itself with(Sharma et al., 2022) study that established that SCM is a major advocate of the digital transformation within any company and especially within complex and delicate industries like the humanitarian operations during a war. Therefore SCM has a very crucial role in defining the strategic elements of DTW as enabler of digital technologies in supply chain operations with the overall goal of enhancing the operational performance in the chain.

In total, these path relationships emphasizing on the basic role of digitalisation and digital effectiveness while bolstering the operational performance, responding to the problematic setting of humanitarian actions in conflict zones.

6. Conclusion and Recommendations

6.1. Conclusion

While exploring the relationship within humanitarian operation in conflict areas with the use AIW, SCM, DTW, DEF, and OPR have shown positive correlation. The research establishes that AI technology has a very weak first-order correlation with perceived digital efficacy; nevertheless, sound supply chain management and organization's digitalization enhance the digital capacity of an organization, hence POS performance.

The study confirms that operative digital effectiveness in operational achievement is important, meaning that organizations that have a high technological skill level do have the ability to plan and manage the humanitarian operations in a high-risk environment. However, what stands out clearly is that SCM is core to the digitalization and AI integration into organizations for process enhancement indicating that right SCM standards are critical in putting in place sophisticated technologies.

6.2. Recommendations

1. Hence organizations that are involved in humanitarian operations, must put in place sufficient measures and provide appropriate ways of improving their human resource's digital skills. It is thus about time that organizations seeking to enhance their capacity in an organization through the use of digital tools and AI technologies.

2. As SCM is in line with digitalization and AI integration, the organizations should give much importance to the creation and improvement of their supply chain. Applying information technology solutions in supply chain management targeting the conflict affected regions may challenge like efficient utilization of resources and synergy may be resolved.

3. However, when looking at it in context it appears that there is no direct relationship between AI usage and higher digital efficiency, which may enhance the process of decision-making, AI has its

advantages. The big data and the humanitarian needs for organizations in the war zones have to be forecasted better the organizations should strive to enhance the current use of AI.

4. There is need for organizations to continue with their strategy on digitization most especially on the supply chain. For this reason, the integration of IT resources and technology in SCM enhances the capacity of an organization to deal with emergencies among other gains.

5. However, this different consideration has brought this author to conclude that there is still need to carry out further studies that explore the challenges and barriers of AI use in humanitarian organizations mainly because the level of digital efficacy, which AI has been found, in this case, hardly correlated with its effectiveness. Subsequent researches should therefore seek to establish some of the aspects that might have an undesirable impact to the use of AI on raising digital efficiency and identifying ways of addressing them.

6. This means that for industries that seek to tap on the full advantage of digital tools and artificial intelligence, then they ought to involve technology experts and specialists. For better outcomes that can help humanitarian organizations obtain applicable solutions for doing their work in conflict zones, it is possible to collaborate with tech firms and AI professionals.

By adopting these suggestions, the organizations will enhance their digital competence, enhance the efficiency of supply chain management and in extension enhance their operational effectiveness in the delivery of humanitarian aid in conflict regions.

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APPENDIX

Variable	Question	Response Options
1. Supply Chain Management (SCM)	How do you perceive the impact of Saudi Arabia's digital tools on improving the efficiency of supply chain management in humanitarian operations within war zones?	Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree
	To what extent do you believe Saudi Arabia's AI applications contribute to optimizing logistics and resource distribution in conflict areas?	Not at All, Slightly, Moderately, Very Much, Extremely
	How effective do you find Saudi Arabia's digital platforms in enhancing coordination between various humanitarian agencies operating in war zones?	Not Effective, Slightly Effective, Moderately Effective, Very Effective, Extremely Effective
	In your opinion, how crucial is Saudi Arabia's digitalization for making data-driven supply chain decisions during humanitarian crises?	Not Crucial, Slightly Crucial, Moderately Crucial, Very Crucial, Extremely Crucial
	How do you rate the role of Saudi Arabia's digitalization in improving the tracking and management of resources in conflict-affected areas?	Very Poor, Poor, Fair, Good, Excellent

Variable	Question	Response Options
Digitalization	How do you perceive the effectiveness of Saudi Arabia's digital technologies in streamlining humanitarian operations in war zones?	Very Ineffective, Ineffective, Neutral, Effective, Very Effective
	To what extent do you believe Saudi Arabia's digital tools have increased the speed and	Not At All, Slightly, Moderately, Very Much, Extremely

	accuracy of information processing in humanitarian aid efforts?	
	How do you assess the impact of Saudi Arabia's digital communication platforms on coordination with field teams in conflict areas?	Very Low Impact, Low Impact, Moderate Impact, High Impact, Very High Impact
	In your experience, how significant is the role of Saudi Arabia's digitalization in managing data and resources for humanitarian missions in war zones?	Not Significant, Slightly Significant, Moderately Significant, Very Significant, Extremely Significant
	How well do you think Saudi Arabia's digital tools are integrated into your organization's operations for humanitarian work in conflict zones?	Very Poorly, Poorly, Neutral, Well, Very Well

| **3.**

Variable	Question	Response Options
Artificial Intelligence (AI)	How effective is Saudi Arabia's AI in predicting and responding to humanitarian needs in war zones, according to your perspective?	Not Effective, Slightly Effective, Moderately Effective, Very Effective, Extremely Effective
	How do you perceive the role of Saudi Arabia's AI in analyzing large datasets to improve decision-making in humanitarian operations?	Not Important, Slightly Important, Moderately Important, Very Important, Extremely Important
	In your view, how has Saudi Arabia's AI contributed to optimizing the allocation and distribution of aid in conflict-affected areas?	Not At All, Slightly, Moderately, Very Much, Extremely
	How crucial is Saudi Arabia's AI technology for monitoring and evaluating the impact of humanitarian interventions in war zones?	Not Crucial, Slightly Crucial, Moderately Crucial, Very Crucial, Extremely Crucial
	To what extent do you believe that Saudi Arabia's AI has improved the accuracy of needs assessments in conflict zones?	Not At All, Slightly, Moderately, Very Much, Extremely

| **4.**

Variable	Question	Response Options
Organizational Digital Efficacy	How would you rate the effectiveness of Saudi Arabia's digital tools in managing and deploying resources for humanitarian work in war zones?	Very Ineffective, Ineffective, Neutral, Effective, Very Effective
	To what extent do Saudi Arabia's digital technologies enhance operational efficiency and effectiveness in your organization's humanitarian efforts?	Not At All, Slightly, Moderately, Very Much, Extremely
	How well do you think Saudi Arabia's digital tools align with your organization's goals to improve humanitarian aid delivery in conflict areas?	Very Poorly, Poorly, Neutral, Well, Very Well
	In your opinion, how has the integration of Saudi Arabia's digital solutions impacted the overall performance of your organization's humanitarian operations?	Very Negative Impact, Negative Impact, Neutral, Positive Impact, Very Positive Impact
	How effectively does your organization utilize Saudi Arabia's digital strategies to enhance its performance in delivering aid in war zones?	Very Ineffectively, Ineffectively, Neutral, Effectively, Very Effectively

Variable	Question	Response Options
Operational Performance	How do you evaluate the impact of Saudi Arabia's digital and AI technologies on the efficiency of your organization's humanitarian operations in conflict zones?	Very Ineffective, Ineffective, Neutral, Effective, Very Effective
	To what extent has Saudi Arabia's digitalization led to improvements in response times during humanitarian crises?	Not At All, Slightly, Moderately, Very Much, Extremely
	How significant is the role of Saudi Arabia's AI and digital tools in achieving your organization's humanitarian objectives in war zones?	Not Significant, Slightly Significant, Moderately Significant, Very Significant, Extremely Significant
	How do you assess the improvements in operational success rates attributed to the adoption of Saudi Arabia's digital and AI technologies in your organization?	Very Low Improvement, Low Improvement, Moderate Improvement, High Improvement, Very High Improvement