TRANSFORMATIVE SUPPLY CHAIN DRIVERS DURING COVID-19: A CUSTOMER PERSPECTIVE

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Abstract: This study aims to analyze key driving factors for Transformative Supply Chain (TSC), including technical skills, trust and services availability. Data was collected from 189 customers sampled across different regions in Jordan and analyzed using Structural Equation Modeling (SEM). The findings revealed that technical skills and service availability are significant drivers for a TSC, whereas trust influence on TSC was not supported by the findings. The research has important implications for supply chain logistics managers. It recommends that simple, flexible and clear design should be considered in TSC implementation as these factors play a vital role in enhancing customer experience and patronage. Additionally, service availability for all customers anywhere seems an important mechanism that could ensure the sustainability of TSC services during the Coronavirus pandemic.

Keywords: transformative supply chain, e-supply chain, supply chain drivers.

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Introduction

COVID-19 is being felt globally across manufacturing and operations in ways that challenge companies' abilities to develop effective response mechanisms. The crisis has caused a global catastrophe and negatively impacted human lives, economic activities, industry processes and all types of business (Dolgui et al., 2020; Golan et al., 2020; Ivanov & Dolgui, 2020). Many affected regions are located at the center of global trade and manufacturing supply chain networks. This affected the availability of goods and services, as companies had to build strategic inventories to meet demand fluctuations during the pandemic (Mollenkopf et al., 2021). To meet such a challenge, improving the resilience of the supply chain network has become a strategic concern for business companies. Exploring how global suppliers and manufacturers handle different operations will help and support all businesses to structure their responses. The need has arisen for companies to re-think their means to ensure supply chain flexibility in crises. Various studies have suggested approaches for tackling supply chain challenges during crises like COVID-19. At the heart of these efforts comes the implementation of a TSC approach.
TSC is an approach that describes the ability of supply chains to provide, supply and distribute goods to customers effectively through e-commerce platforms and other

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smart technologies (Ivanov, 2020). The global trend towards digitization combined with the continuous digital disruption caused by the never-ending development of technology makes this approach necessary for more effective and responsive supply chain activities. However, digital change does not occur by accident. Instead, it requires heavy investment across the organization as the disruptive potential of change, especially for more mature stages of digital transformation, extends beyond technologies (Halpern et al.,2021). Many driving forces seem significant when it comes to the digitization of business activities in general and supply chain practices in particular. These forces need in-depth analysis and consideration, which is the focus of this paper.

Another reason for investigating supply chains during the pandemic situation is the effect of lockdowns on social interactions and economic activities as people are restricted from buying and selling as usual. Considering the foregoing, there is a need to evaluate how the integration of technology, innovation and supply chain can help ensure the continuity of supply (services and goods), particularly regarding the restrictions that come with the lockdown.

The aspects and drivers of TSC to be investigated in this paper are technical skills, trust and service availability from the customer perspective. Few studies have explored TSC application from the pandemic perspective within the context of less developed countries. The COVID-19 situation is primarily explored from a developed countries' perspective (Mollenkopf et al., 2021). The present study argues that the importance of TSC is expected to increase as businesses in different industries are starting to realize the need for a transformational change in supply chain practices. The speed of digital business improvement and the emergence of new digital business models on the global level call for more concern towards a TSC model. This, however, should be a research-based and systematic transformation. Accordingly, an in-depth analysis of the driving forces towards TSC seems critical.

Towards this end, this paper seeks to contribute to knowledge and understanding of the TSC drivers during Covid-19 from customer perspectives. Specifically, the paper aims to critically examine TSC as an interventional mechanism for the effective provision of goods and services to customers during the lockdown situation.

Literature Review and Hypotheses Development

With the widespread COVID-19 pandemic and the increasing business pressure from customers, government and society, TSC supported with the technological revolution, is sought to provide a more effective logistics service that can address challenges and meet customer demands. The conventional supply chain denotes a network of facilities that focuses on processing and converting raw materials into semi-processed or end-products, as well as distributing the products to end-customers (Alsmairat & Sayda m, 2015). The advent of e-commerce platforms has introduced a new dimension for production, sales, and purchase processes, whereby customers expect the integration of IT systems, flexible productions and automated manufacturing in receiving their services and goods. Similarly, Ageron et al. (2020)

asserted that digitalization is a new phenomenon that has influenced multiple aspects of life across the globe, characterized by the dynamic, intricate, and competitive business setting. They added that organizations should benefit from the huge number of internet users who actively subscribe to online purchases. The amalgamation of digital technologies and the supply chain process is called digital or transformative supply chain (TSC) (Mollenkopf et al., 2021). Technology growth, decreasing the cost of IT services and broadband internet connection create preconditions for buying things through the online platform or from the web sales portal of selected suitable stores (Kersan-Skabic, 2021).

Ageron et al. (2020) defined TSC as adopting innovative technologies and reliance on IT systems to provide all supply chain and logistics activities to ensure the continuity of providing services and products, thus enhancing customer service and sustainable performance of the organization. Agrawal and Narain (2018) depicted that TSC is not a choice but an imperative for all businesses across all industries involving production, distribution, transportation and logistics activities. Besides, the transformative process, which facilitates many companies in adhering to profound changes in marketing, production and logistics, has generated rapid responses from customers during the pandemic due to the speed of receiving, managing and delivering customer orders effectively. Lopes de Sousa Jabbour et al. (2020) claimed that effective management of the TSC process could benefit from the exponential growth in e-commerce and the growing number of users, signifying the enhanced logistics, order fulfillment, information flow and customer service management. As IT systems are crucial for suppliers, manufacturers, distributors, and retailers, higher skills, flexibility, better strategies and improved agility are necessary (Alsmairat & Aldakhil, 2021; Gupta et al., 2016; Aljuraid & Alsmairat,2021).

Early studies regarding TSC have provided some insights relating to digital supply chain adoption and industry 4.0 (Garay-Rondero et al.,2020), COVID-19 and supply chain resilience (Ivanov,2020), COVID-19 disruption and the role of digital technologies (Hald and Coslugeanu, 2021). Gupta et al. (2016) highlight the importance of disaster relief management, while Hohenstein et al. (2015) recommend companies improve their understanding of risk management and resiliency issues in their supply chain to develop appropriate mitigation actions. Other contributions have focused on the supply side, including the network and global mobility effects of the crisis (Sun et al., 2020, Abu-Rayash and Dincer, 2020). In the same line, Ostrom et al. (2015) emphasized the important roles of enhanced processes, transformative services, innovation, technology and social media channels during the pandemic. Kelly and Marchese (2015) state that the integrated supply chain and the level of a dynamic, complex and flexible supply chain require more attention to information technology and its role in value chain creation. Digital services provide opportunities to enhance customer experiences by offering more convenience and greater levels of personalization (Mwesiumo et al., 2021).

Many recent scholars have debated TSC and have discussed related factors in the organization's context. Halpern et al. (2021) mentioned and explained two main factors that influence digital adoption and change, including organizational readiness and innovation. Nevertheless, Valsamidis (2020) addressed many inclusive factors related to human factors, customer attitudes, technological infrastructure and mobility. Lately, Yang and Zhang (2021) have investigated more variables to be included innovation, technological intelligence and supply chain cooperation. Kozma (2017) pointed out that management concepts used in supply chain management positively impact the effectiveness and efficiency of the entire supply chain. It is worth highlighting the organizational, technological and cooperation areas, which are the ones where the most significant progress can be observed.

By reviewing the available studies relating to TSC and digitization aspects relating to the supply chain, it is observed that studies focusing on customer perspective and the possible behavioral impacts of the crisis are still limited in the literature. Additionally, the disruptive nature of digital technology provides a logical justification to conduct more studies continuously.

Hence, it is necessary to examine the factors that drive the adoption of TSC from the stance of customers to create a new integrated paradigm of TSC. This can help customers to enjoy a transformed supply chain. This paper proposes three driving forces that may influence a TSC: technical skills, trust and availability of services. The selection of these factors is based on a review of the previous studies in addition to the researchers' knowledge of the study context and customers' main attributes in this context.

Technical skills refer to a customer's knowledge to effectively apply electronic applications (e-app) or any relevant digital technology (Hennig-Thurau, 2004). Al-adaileh et al. (2016) emphasized the significant differences among customers who use technologies and e-apps in their daily lives and business based on their education level, age, as well as knowledge. In the contexts of digitalization and TSC, Perla et al. (2018) found that technical skills were crucial in influencing both TSC and the intention of customers in adopting TSC. Therefore, TSC, similar to other digital services, demands technical skills for effective deployment. Since TSC implementation involves improving customer skills, orientation and practices (Gupta et al., 2016), enhanced self-efficacy and optimism of customers lead to a positive attitude towards TSC. Therefore, the following is proposed:

H1. Technical skills have a direct significant effect on transformative supply chain.

In the digital era, a contract between customers and sellers occurs via the Internet, which significantly increases the importance of trust in digital services (Pietrzak and Takala,2021). Trust is defined as the extent to which supply chain partners perceive each other as credible and benevolent (Doney & Cannon, 1997). Supply chain management is built on the foundation of trust and commitment. According to Salam (2017), trust has a crucial role in adaptive organizational forms mainly because it minimizes conflict and cost, facilitates the work process and promotes effective response to crises. Besides, trust is a crucial enabler of supply chain collaboration

(Fawcett et al., 2012) related to positive yields, such as effective programs and policies (Shea et al., 2014). Hence, trust is also imminent for digital enhancement as it ascertains customer predisposition to embrace technology (Ferreira et al., 2014). Moreover, digital transformation can be only realized by customers who willingly embrace it. Pérez-Morote et al. (2020) reported that a high level of trust in different e-apps promotes higher use and vice versa. Accordingly, trust is a motivator for TSC as it influences the relationship between two parties. This study depicts that the extent to which customers adopt TSC heavily depends on their trust towards TSC. Lokuge et al. (2019) asserted that lack of customer trust had failed many ideas that could have yielded new services and goods. Hence, the second hypothesis is proposed as follows:

H2. Trust has a direct significant effect on transformative supply chain.

Furthermore, service availability promotes digital change and adoption (Halpern et al., 2021), as evidenced by the growing involvement of digital services and innovation. Its primary goal is to integrate new technologies into varying solutions, to enhance the adoption of new technologies and ideas. Notably, service availability is defined as the probability that e-services, e-apps and techniques are functioning for all customers anywhere and anytime (Lim & Thiran, 2010). Kryvinska and Strauss (2013) asserted that the availability of e-service and e-apps could be selected or even substituted by others when one fails. This sustains not only the high availability but also guarantees the quality of service expected by users. Ivanov and Dolgui (2020) claimed that services must be made available to all customers. Likewise, TSC has become indisputably imminent during the COVID-19 pandemic as numerous companies have rapidly enhanced their supply-demand allocations. Hence, the third hypothesis has been framed as follows:

H3. Services availability has a direct significant effect on transformative supply chain.

Past studies had associated the adoption of digital transformation based on gender (e.g. Carter et al., 2003) and small and medium-sized enterprises (Gill, 2018; Perryman et al., 2016). As females outperformed males in education attainment (Figlio et al., 2019), it denotes that females can also exceed males in future competencies. Hence, the following two hypotheses are proposed:

H4. Gender has a direct significant effect on transformative supply chain.

H5. Education level has a direct significant effect on transformative supply chain.

To test the proposed hypotheses, the following research model is proposed (figure 1):

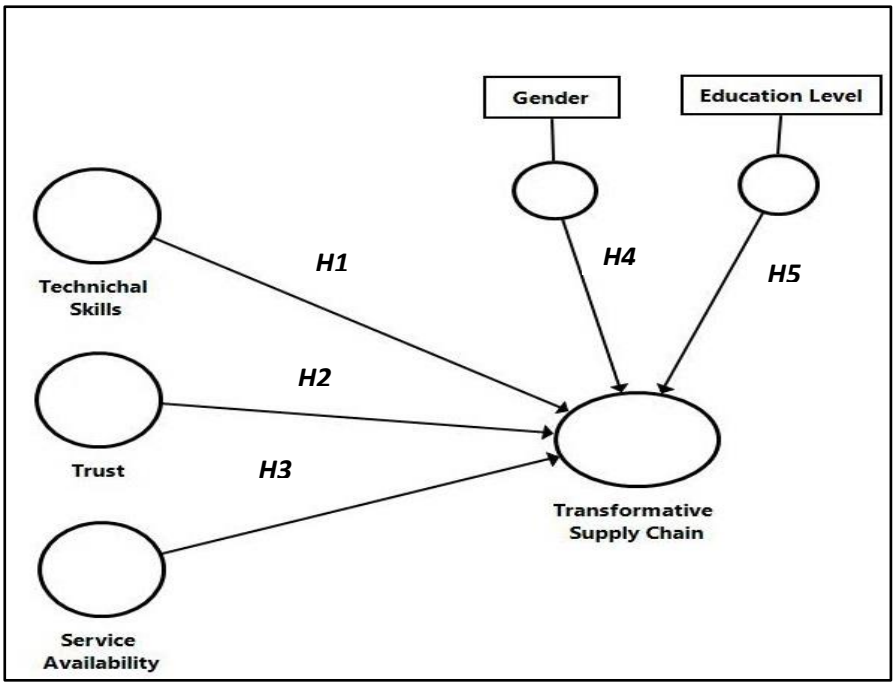

Figure 1: Research Model

Methodology

This study applied the survey approach. The sample includes customers from varying regions across Jordan selected via a convenient sampling approach. The survey was the main empirical research tool, and it was used mainly to collect quantitative data from the research sample. The questionnaires items were developed to collect data on each research indicator in line with specific research objectives. The questionnaire was in the form of a Likert scale where respondents evaluated different statements about independent and dependent variables. A scale of 1-5 was used. The questionnaires were administered by the researcher to all the respondents. The data were assessed using partial least square structural equation modelling (PLS-SEM). The total respondents of 189 met the minimum criterion of 100 samples to enable PLS-SEM execution and the 80% statistical power prescribed by Hair et al. (2019). Essentially, the methods employed in this study were to determine the relative significance of factors that explain variation in TSC.

Table 1. Sample Characteristics

Personal Information		Frequency	Percentage %
Gender	male	91	48.2
	female	98	51.8
Education level	high school or less	21	11.1
	diploma	113	59.9
	Bachelor or high	55	29.0
Total		189	100%

Only 189 usable samples were obtained among the questionnaires distributed because some of the forms have missing data. Out of the 189 respondents, 51.8% (98) were male, and 48.2% (91) were female. An overwhelming number of the respondents were in the education level diploma (59.9%) and bachelor or high (29%), and high school or less (11.1%).

Measurement model assessment

The measurement model is assessed to determine the validity of the outcomes in the SEM approach (Henseler et al., 2016) by examining discriminant validity, internal consistency reliability and convergent validity. Convergent validity is determined by evaluating the value of average variance extracted (AVE), which should exceed 0.5 to be acceptable. Next, the loading for every measure for its related construct should exceed 0.7 for acceptable indicator reliability. Table 1 tabulates the results of Cronbach's alpha, composite reliability (CR) and AVE. Notably, all loadings exceeded the threshold of 0.7 ($p < .001$) (see Table 2), while CR, Alpha, and AVE values exceeded the thresholds of 0.7, 0.7, and 0.5, respectively. The internal consistency reliability of the constructs was sufficient based on CR and Cronbach α approaches.

Table 2. Alpha, CR and AVE

Construct	Cronbach's alpha	CR	AVE
Transformative supply chain	0.905	0.924	0.603
Technical skills	0.828	0.865	0.521
Trust	0.877	0.910	0.670
Services availability	0.886	0.916	0.685

Table 3 Discriminant validity

Construct	TSC	TS	T	SA
Transformative supply chain (TSC)	0.777			
Technical skills (TS)	0.704	0.722		
Trust(T)	0.710	0.707	0.818	
Services availability (SA)	0.736	0.721	0.722	0.828

Discriminant validity refers to how every construct differs from others embedded in the model (Hair et al., 2019). It is vital to determine discriminant validity because it ascertains the distinctiveness of each construct and represents a scenario that is absent in other model constructs. Discriminant validity is commonly assessed using Fornell–Larcker criterion, whereby the square root of AVE for every construct should exceed its highest correlation with other constructs. Nonetheless, Hair et al. (2019) suggested the superior approach of heterotrait-monotrait (HTMT) to check discriminant validity in PLS-SEM. Henseler et al. (2015), who introduced the HTMT approach, stated that HTMT values below 0.90 denote constructs with similar concepts, whereas HTMT values below 0.85 signify constructs with dissimilar concepts.

As shown in Table 3, discriminant validity for all constructs is acceptable. As additional checks, cross-loadings confirm that each indicator has its highest loading value with the construct to which it is assigned, while the Fornell-Larcker criterion confirms that the square root of the AVE of each construct is higher than its highest correlation with any other construct.

Findings and Discussion

Path analysis and bootstrapping methods were conducted to examine the impact of the independent variables (technical skills, trust, & services availability) on the dependent variable (TSC). Figure 2 and Table 3 tabulates the results, followed by their description and interpretation.

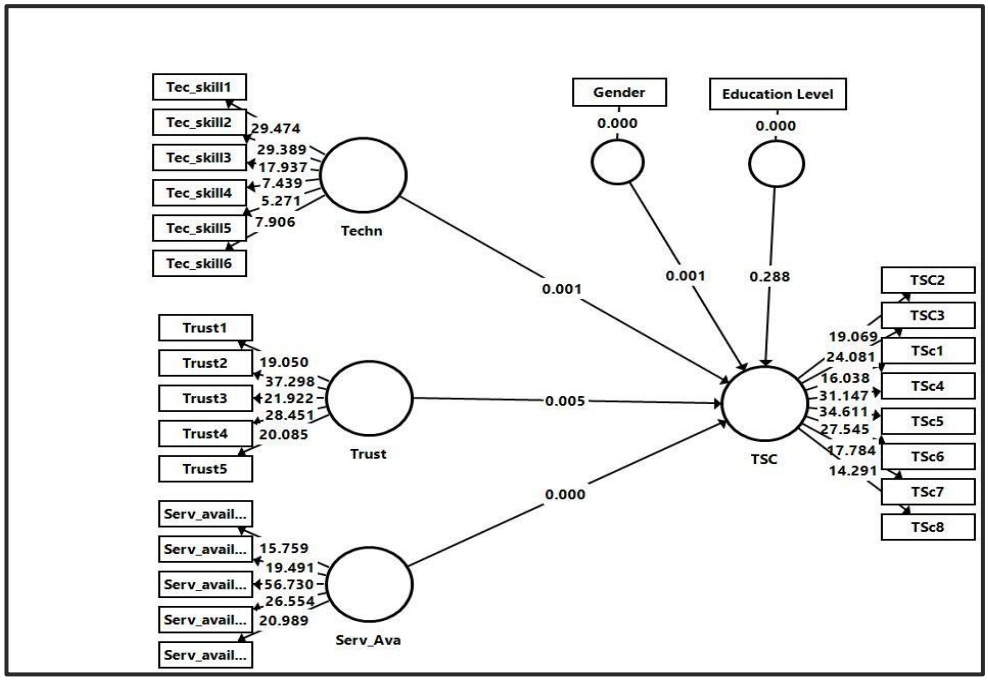

Figure2. Path Analysis Model

Table 4. Research Hypothesis Results

	Original sample	Sample mean	T statistics	P value	Hypothesis result
Technical skills >> Transformative supply chain	0.255	0.271	2.876	0.004	Accepted
Trust >> Transformative supply chain	0.275	0.265	3.177	0.002	Accepted
services availability >> Transformative supply chain	0.353	0.354	5.051	0.000	Accepted
Control Variable					
Gender	0.138	0.137	3.695	0.000	Accepted
Education Level	-0.037	-0.037	1.049	0.295	Rejected
R2= 0.635 Adjusted R2= 0.629					

The significance of the path coefficients is shown in Table 4 and Fig. 2. Referring to Table 4, the values of t-statistics and the absolute values of path coefficients ranged between 2.876-5.051 and 0.255-0.353, respectively. The dependent variable scored adjusted R^2 = 0.629, indicating approximate model fit and acceptable variation explained by the study model. The hypotheses were tested by evaluating the significance of path coefficients in the structural model, which illustrates the causal relationships among the variables (see Figure 2). For H1, an increased level

of technical skills displayed a significantly positive relationship with TSC (path coefficient = 0.255 & $p \leq .05$).

As for H2, trust exhibited a positive relationship with TSC (path coefficient = 0.275 & $p \leq .05$). In light of H3, services availability significantly correlated with TSC (path coefficient = 0.353 & $p \leq .05$). Next, H4 is also supported as gender was positively associated with TSC (path coefficient = 0.138 & $p \leq .05$). In the final hypothesis, education level had an insignificantly negative link with TSC (path coefficient was insignificant and negative at −0.037 with $p = .295$).

The analysis presented in this paper has sought to provide a more nuanced understanding of a major challenge currently facing the business industry, namely, increasing customer trust and confidence in the adoption of TSC. In turn, the the present research has also sought to build on the growing body of academic research concerning the TSC and innovation adoption demand and customer behavioral impacts during the COVID-19 crisis.

The study outcomes shed light on both the theory and practice of public procurement management and innovation. The TSC has been touted as an 'engine' for driving innovation in an economy (Edler & Georghiou, 2007; Alsmairat & Aldakhil, 2021), especially during pandemic lockdown scenarios with rising demand for services and goods. The TSC is an effective way to promote innovation, which enhances business growth via digital services. Hence, it is crucial to promote the deployment of TSC due to the vast benefits it offers. Upon reckoning the significance of TSC in promoting continuous support to customers during the pandemic lockdown, this study had looked into the key drivers of TSC from the stance of customers and their intention towards TSC. Apparently, technical skills positively impacted TSC, which in turn positively increased customers' dependency on TSC. These results indicate the importance of technical skills acquired by customers to be able to adapt and use TSC.

The technology-based nature of TSC, especially during the pandemic, requires technical awareness and high-level technical skills among customers. Notably, the level of customers' technical skills is a critical indicator for TSC adoption and performance(Alhawamdeh & Alsmairat,2019). This result is supported by several studies (Klimova et al., 2020; Perla et al., 2018; Al-adaileh et al., 2016; Al-adaileh, 2009). Next, this study registers evidence on the effect of service availability via various e-apps on TSC, especially during the pandemic lockdown. In this situation, customers believe that the availability of these services is a prerequisite for a continuous flow of basic materials and life sustenance.

Furthermore, the impact of trust as a key driver of TSC is verified in this study. Prior studies have not tested this relationship empirically but proposed a significant correlation between adoption of new technology/application and trust (e.g. Pérez-Morote et al., 2020). For instance, Pérez-Morote et al. (2020) reported that the higher the level of trust in different e-apps is the higher the use of these services and vice versa.

The conceptual model proposed in this study has been informed and driven by a sound and extensive review of the available studies from the different global contexts. Accordingly, the study outcomes should also be relevant and useful within the context of global supply chain settings in other countries. The globalized nature of supply chain practices, in addition to the availability of advanced digital technologies to all businesses all over the world, could justify this argument.

Eventually, the findings of this study have important managerial implications. The fundamental evidence is that the level of technical skills, customer trust in digital services and the availability of services for all customers should be considered to enable smooth TSC adoption and strategic orientation in any organization. Supply chain managers and practitioners should pay attention to avoiding the static view of managing their supply chain to rely more on technological capabilities and practices. This is significant, particularly now, once the digital service recognises its potential strategic role. Senior and supply chain managers must recognize the great role of digital technology in transforming supply chain activities and relationships as a key organizational resource that can improve organizational efficiency and competitiveness. Due to the rapid and highly influential impact of digital technologies, the extended nature of supply chain practices from local to regional to global alternatives is calling for more concern from supply chain practitioners.

Conclusion and Limitations

The findings of the current study, in conclusion, this research aims to contribute to the existing literature by examining various drivers of TSC. The analysis outcomes confirm the importance of technical skills, trust and services availability, and the moderation impact of gender. In light of these outcomes, this study confirms that it is high time for the implementation of digital services within companies to strengthen their businesses' collaboration and the flow of their supply chain activities. Apart from addressing technical skills for customers, the level of trust and high firms' capabilities to provide their services anywhere may also trigger important innovations that may maximise benefits for supply chain partners. The findings of this study have several practical implications for decision-makers who are invited to consider the outcomes of this study to develop a responsive and sustainable supply chain strategy. As a successful supply chain depends on real collaboration and partnership, supply chain managers must work collaboratively with their customers to improve their skills and knowledge. Additionally, they should build and maintain trust-based relationships with their customers. All efforts should also be combined with the development of reliable technology infrastructure and platforms to ensure that their services are available and accessible.

Despite the insightful outcomes reported in this study, and considering the strong and continuing trend towards the digital transformation of business operations, several setbacks could be noted and might be addressed in future endeavours. First, since only a single setting was employed in this study, future studies may look into other varying contexts, such as the Western hemisphere that is dissimilar from the

Middle East region. Second, despite the adequate explanation for the variation of TSC drivers provided in this study, future research wok may assess other critical factors in light of TSC adoption. This study, for example, omitted intrinsic motivation among customers upon examining TSC. Future research could adopt a more holistic view by combining organizational, customer-related and environmental driving forces that could shape the future use of TSC to be more effective and responsive. Furthermore, the survey applied in this study disregarded several demographic aspects, such as customer age, work experience and position held at the workplace. Lastly, it would be interesting to assess if customer willingness had an impact on TSC.

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TRANSFORMACYJNE CZYNNIKI NAPĘDZAJĄCE ŁAŃCUCH DOSTAW PODCZAS COVID-19: PERSPEKTYWA KLIENTA

Streszczenie: Niniejsze badanie ma na celu analizę kluczowych czynników napędzających transformacyjny łańcuch dostaw (TSC), w tym umiejętności technicznych, zaufania i dostępności usług. Dane zebrano od 189 klientów z różnych regionów Jordanii objętych próbą i przeanalizowano za pomocą modelowania równań strukturalnych (SEM). Ustalenia ujawniły, że umiejętności techniczne i dostępność usług są istotnymi czynnikami wpływającymi na TSC, podczas gdy wpływ zaufania na TSC nie został poparty tymi ustaleniami. Badania mają ważne implikacje dla menedżerów logistyki łańcucha dostaw. Zaleca, aby we wdrażaniu TSC uwzględnić prosty, elastyczny i przejrzysty projekt, ponieważ czynniki te odgrywają kluczową rolę w zwiększaniu doświadczenia klienta i patronatu. Ponadto dostępność usług dla wszystkich klientów w dowolnym miejscu wydaje się ważnym mechanizmem, który może zapewnić trwałość usług TSC podczas pandemii koronawirusa.

Słowa kluczowe: transformacyjny łańcuch dostaw, e-łańcuch dostaw, sterowniki łańcucha dostaw.

COVID-19 期间的变革性供应链驱动因素：客户视角

摘要：本研究旨在分析变革性供应链 (TSC) **的关**键驱动因素，包括技术技能、信任和服务可用性。从约旦不同地区采样的 189 **位客**户收集数据，并使用结构方程模型 (SEM) 进行分析。调查结果显示，技术技能和服务可用性是 TSC **的重要**驱动因素，而调查结果不支持对 TSC **的信任影响**。该研究对供应链物流经理具有重要意义。它建议在 TSC 实施中应考虑简单、灵活和清晰的设计，因为这些因素在增强客户体验和惠顾方面起着至关重要的作用。此外，为任何地方的所有客户提供服务似乎是一种重要机制，可以确保在冠状病毒大流行期间 TSC **服**务的可持续性

关键词：变革性供应链，电子供应链，供应链驱动因素