Vol. 08, No. 2 (2026) 735-748, doi: 10.24874/PES08.02.012

Proceedings on Engineering Sciences

www.pesjournal.net

STRENGTHENING GCC SUPPLY CHAINS THROUGH PRODUCTION LOCALIZATION: THE ROLES OF INFRASTRUCTURE AND LOCAL SUPPLIER DEVELOPMENT

Sohail Tariq[1]
Shahzad Ahmed Khan
Asad Javed
Fahad AlOtaibi
Junaid Zafar

Received 16.12.2025.
Revised 14.04.2026.
Accepted 06.05.2026.

Keywords:
Production localization,
Supply chain resilience,
Industrial infrastructure development,
Local supplier capability,
Supply chain resilience theory

A B S T R A C T

Driven by recent global supply chain disruptions, Gulf Cooperation Council (GCC) countries are placing greater emphasis on production localization as a key strategy for improving supply chain resilience. This study investigates the role of production localization in strengthening supply chain resilience, examining the mediating effect of industrial infrastructure development and the moderating impact of local supplier capability development. Using a comprehensive conceptual framework, this research highlights how investments in industrial facilities, logistics systems, and digital infrastructure, combined with skilled and capable local suppliers, enable GCC firms to respond flexibly and efficiently to disruptions. Data was collected through a cross-sectional survey from 325 individuals, managers of manufacturing firms and operating in four sectors: petro chemicals, electrical & electronics, FMCG, and logistics firms of GCC. Structural equation modelling was employed to test the influence of production localization on on supply chain resilience directly and indirectly. Grounded in Supply Chain Risk Management (SCRM) theory, the study proposes that production localization improves resilience by fostering robust industrial infrastructure, while the effectiveness of this relationship is contingent upon the capabilities of local suppliers. The findings offer both theoretical contributions by integrating localization, infrastructure, and supplier development into the supply chain resilience discourse, and practical implications for policymakers and managers aiming to enhance domestic production, optimize supply chain robustness, and promote economic self-reliance in the GCC region. Theoretically, it adds to the literature of supply chain resilience by incorporating production localization, industrial infrastructure development, and local supplier capability development into one integrated framework instead of splitting analyses that are prevalent in the current literature. The empirical study is context specific, offering empirical evidence of GCC, which is generally underrepresented in resilience research, though it is strategically important in global trade, energy markets, and industrial transformation, increasing the external validity and geographical applicability of resilience theory. The study stands out with a comprehensive framework that combines the localization of production, the development of industrial infrastructure, and the potential of the local suppliers. It proves that GCC supply chains can be resilient to a much greater extent by applying stringent empirical research methodology. The results are framed in terms of economic and geopolitical contexts unique to the GCC, which explains how strategic domesticized manufacturing, combined with specific infrastructure investment and the development of suppliers, can provide solid resilience gains.

© 2026 Published by Faculty of Engineering

[1] Corresponding author: Sohail Tariq
Email: sohailtariq1990@gmail.com

1. INTRODUCTION

The faster development of infrastructure and greater integration into global trade systems promoted by oil revenues have limited the region's capacity to ascend the value chain. The economies of the member states of the Gulf Cooperation Council, Saudi Arabia, the United Arab Emirates, Qatar, Kuwait, Oman, and Bahrain are traditionally characterized by overdependence on hydrocarbon revenues. The high level of import penetration into manufactured goods, and a strong structural susceptibility to external shocks to supplies has been observed consistently over the decades. Recent unrest of several types, including the COVID-19 pandemic and geopolitical tensions, as well as logistical bottlenecks, has shown the vulnerability of production systems that rely on imports and resulted in increased pressures on strategic localization to improve resilience and diversify the economic base. The national transformation programs like the Vision 2030 of Saudi Arabia and the Centennial 2071 of the United Arab Emirates define industrial development, advanced production, and the establishment of a domestic system of suppliers as an instrument to sustainable development and job creation. In the Gulf Cooperation Council (GCC) context, the localization of production takes on a salient role in strengthening supply chain resilience through reducing reliance on far-away or international suppliers to mitigate external shocks like geopolitical tensions, trade barriers, or pandemics (Ivanov & Dolgui, 2020).

The development of industrial infrastructure is a mediating element in this nexus, which reinforces the resilience of the localization-based supply chains by providing reliable logistics, production capacity, and technological assistance needed to deliver quick responses and recovery in times of disruptions

Supply chain resiliency and industrial upgrading suggests that the most effective localization strategies are those supported by a well-developed transport, digital, and energy infrastructure; intentional development of supplier capabilities; institutional coordination; and consistent policy frameworks (Christopher & Peck, 2004; Gereffi et al., 2005; Porter, 1998; World Bank, 2020; OECD, 2021a, 2021b). It has been observed in the context of emerging economies that the investments in logistic performance, industrial clustering, and the upgrading of suppliers significantly promote productivity, lower the cost of transaction, and strengthen the integration into the production networks, both globally and regionally (Baldwin, 2016; UNCTAD, 2020; World Economic Forum, 2021). In the GCC, strategic synchronization of infrastructure growth and national capacity development of suppliers is not only a policy of economic diversification but also a significant change towards robust, knowledge-based production systems that can withstand external shocks and can be sustained in their competitiveness in the long run.

The acceleration of geopolitical tensions, with trade wars, regional conflicts, sanctions, and strategic shifts forcing the operating environment of global supply chains, has significantly shifted the weaknesses in the production systems that are based on long and efficiency-focused international networks. The recent few disruptions have proven that when the economies are exposed to the global energy, trade, and logistics flows, the exposure to disruption in supply, cost volatility, and uncertainty in operations is increased, especially to the economies that are at the crossroads of global energy, trade, and logistics routes, like the Gulf Cooperation Council (GCC). Lack of a unified conceptualization of how localization relates to infrastructure preparedness and supplier capacity development during geopolitical uncertainty has led to localization policies that are not always consistent with the operational reality. This problem limits the capacity of firms and governments to develop locally based supply chains and also to be adaptive, robust, and resilient to persistent geopolitical uncertainty, and thus is the reason why an empirical study based on the context of the GCC is necessary. This paper aims to argue that production localization is more than just an increase in supply chain efficiency by synthesizing supply chain resilience theory that this process actually increases the survivability and adaptability of a business in unpredictable conditions. The dialectic between industrial infrastructure and supplier capabilities represents the transfer of the principles of resilience, redundancy, flexibility, and robustness, into operational praxis in the context of the GCC and thus creates a sustainable competitive advantage.

2. LITERATURE REVIEW

2.1 Impact of Production Localization on Supply Chain Resilience

Recently, the localization of production has become recognized in the scholarly community as a strategic tool used to strengthen the supply chain resilience. It has gained a lot of interest by decreasing the dependency on remote suppliers, enhancing responsiveness, and reducing the risk of global disruptions, including geopolitical tensions and pandemics (Kinkel, 2012; Ivanov & Dolgui, 2020; Gereffi, 2020; Urbaniak et al., 2025). Experience shows that localized production strengthens the coordination process, increases the velocity of the information flow, and simplifies the cooperation with local suppliers. Such abilities, in their turn, contribute to fast recovery and continuity during the state of uncertainty (Ponomarov & Holcomb, 2009; Scholten et al., 2014). However, the efficacy of the production localization depends on the complementary infrastructure of industries and the capacity of suppliers. With such conditions, localized networks are able to function effectively and flexibly (Ivanov, 2020; Tukamuhabwa et al., 2015). Altogether, production localization is not only a strategic operating decision but

also a source of resilience. Combined with the enabling infrastructure and suppliers with capacity, it improves the adaptive, absorptive, and restorative properties of supply chains.

***H₁**: Production localization has a positive effect on supply chain resilience*

2.2 Impact of Production Localization on Industrial Infrastructure Development

Localization of production has been found to have a strong impact on the development of industrial infrastructure by generating a high level of focused demand on the logistics network, energy system, and technological and industrial services, thus encouraging government and privately organized investment in supporting infrastructure (Kinkel, 2012; Lall, 2004). Empirical studies suggest that companies engaging in local production promote the growth and modernization of industrial clusters, transportation systems, and digital systems that subsequently increase the efficiency, reliability, and connectedness of local supply chains (Porter, 1990; Timmer et al., 2014). Earlier research additionally points out that the development of industrial infrastructure is a predetermining as well as an effect of localization since the performance of localized production is determined by the availability of facilities, pool of skilled labor, and well-integrated logistical networks (Aschauer, 1989; Calderón & Serven, 2010). The experience of the developing economies also indicates that long-term localization policies can enable long-term infrastructure development by generating uninterrupted demand among the governments and individual investors, thus strengthening the production capacity, technology use, and economic stability of the regions (Hausmann & Hidalgo, 2011; OECD, 2021a, 2021b). In general, the literature stresses the mutualistic nature of production localization, which promotes the growth of industrial infrastructure, and vice versa, which facilitates the formation of stronger and more flexible localized production networks.

***H₂:** Production localization has a positive effect on Industrial Infrastructure Development*

2.3 Impact of Local Supplier Capability Development on Supply chain resilience

Local supplier capability development is well known to be a key driver of supply-chain resilience. When suppliers are efficient, technologically savvy, and flexible, the whole network can be better able to absorb shocks and continue operations (Krause et al., 2007; Flynn et al., 2010). Studies show that training programs, joint problem-solving, process standardization, and knowledge transfer increase reliability, reduce lead time variability, and reinforce the relationships between focal firms and their supply partners (Cousins et al., 2008; Krause et al., 2009). Resilient supply chains depend on the maturity and capability of local suppliers particularly in emerging economies where domestic vendors are hampered by infrastructure, technology, and skills gaps (Handfield et al., 2002; Tukamuhabwa et al., 2015). In practice, capable suppliers allow for localized production and flexible logistics, leading to quicker recovery from disruptions, flexibility, and continuity of service levels even under uncertainty (Ivanov, 2020; Tang, 2006). Overall, the literature highlights the strategic and operational nature of building supplier capability to significantly enhance the absorptive, adaptive, and restorative capabilities of supply chains that are confronted with dynamic risks. Javed et al. (2025) analysed that inclusive leadership impacts numerous organizational outcomes.

***H3:** Local Supplier Capability Development has a positive effect on supply chain resilience*

2.4 Impact of Local Supplier Capability Development between Industrial Infrastructure Development and Supply Chain Resilience

The available literature is trending toward establishing the evolution of local supplier capabilities as a moderating variable between the provision of industrial infrastructure and the resilience of supply chains, arguing that physical resources alone are not capable of becoming resilient production systems unless they are supplemented by meaningful improvement in the competencies of suppliers and their relationship capabilities. Initial conceptual accounts in operation and supply-chain management have argued that resilience is generated at both hardening nodes, i.e., infrastructure, and flexible connections, i.e., supplier competencies, that together absorb, adapt, and recover when the system is disturbed (Christopher & Peck, 2004; Sheffi, 2005). Empirical research indicates that investments in infrastructure like transport networks and industrial belts reduce transaction costs and allow economies of scale, but these advantages are comprehensively attained when local suppliers are able to achieve stern quality, delivery, and innovation benchmarks, which reduces reliance on distant suppliers (Humphrey & Schmitz, 2002; Ketels, 2013). Studies on global value chains also show that initiatives to develop suppliers, including training of skills, adoption of new technology, and process reengineering, increase the integration of suppliers into the production network of the lead firms and their responsiveness to demand shocks and disruptions (Gereffi et al., 2005; Giuliani et al., 2005). Further, research in emerging and transition economies highlights the amplifying role of capability-building interventions in enhancing the absorptive capacity whereby suppliers have the ability to move to superior standards and work towards incremental innovation, which by extension reinforces overall supply-chain flexibility and resilience (Bessant et al., 2003; Humphrey & Memedovic, 2006). Such capability improvements can be triggered by infrastructure development that can provide the environment that promotes learning and co-

location, as shown in industrial clusters where knowledge spillovers locally and proximity can continue to upgrade suppliers (Porter, 1998; Feldman & Audretsch, 1999). On the other hand, without a purposeful capability building, the infrastructural enhancements run a risk of consolidating the production patterns of enclaves where the suppliers are on the periphery and cannot adapt to the shock, thus limiting the benefits of resilience investments (Pietrobelli & Rabellotti, 2011; OECD, 2017). Taken together, the literature highlights that local supplier development is not just a downstream beneficiary of infrastructure investments, but it is also a centralized mechanism that enhances the resilience impacts of infrastructure investments by facilitating localized networks to anticipate, respond to, and recover from disruptions in an increasingly uncertain global environment.

H_4: *Local Supplier Capability Development positively moderates the relationship between Production Localization and Supply Chain Resilience*

2.5 Impact of Industrial Infrastructure Development between Production Localization and Supply Chain Resilience

Industrial infrastructure development acts as a central mediator in the nexus between localization of manufacturing and supply-chain resilience, that the infrastructure does not only serve to maintain local development of manufacturing capacity, but it further increases significantly the ability of supply chains to mitigate and recover from shocks. The original theoretical provisions of the supply-chain literature hold that physical and organizational scaffolding of infrastructure alleviates transaction costs and creates links between localized systems of production with larger market networks such that firms internalize supply-chain activities that were earlier offshored or geographically distributed (Williamson, 1985; Gereffi, Humphrey, & Sturgeon, 2005). Empirical studies of manufacturing clusters have demonstrated that locating strategic investments in transport modalities, industrial parks, utilities, and logistics platforms lower barriers to entry by local producers, as well as encourage the formation of dense supplier networks, both of which produce greater responsiveness and flexibility (Porter, 1998; Ketels, 2013). Existing studies in emerging economies show that better infrastructure can enhance localized production in terms of reduced lead times, balanced input flows, and better inventory control, strengthening the resilience to external shocks, e.g., natural disasters or global economic shocks (World Bank, 2020; UNCTAD, 2020). Additionally, the literature regarding regional economic development highlights the fact that localized manufacturing is disproportionately advantaged by the infrastructure that supports digital connectivity and energy reliability as well as multimodal transport since such infrastructures aid in real-time coordination and reconfiguration of production activities in response to changes in demand conditions (Christopher & Peck, 2004; Sheffi, 2005; Bair & Gereffi, 2001). On the other hand, inadequate infrastructure may hinder the beneficial impact of localization by continuing to create bottlenecks and increasing the dependence of firms on their suppliers located at a distance, which contradicts the aim of resilience (Pietrobelli & Rabellotti, 2011; OECD, 2017). These lessons are further refined in the recent research on the topic of supply-chain risk management, which assumes that the development of infrastructure is a structural facilitator that amplifies the benefits of localized production by instilling the flexibility, redundancy, and connectivity of supply networks and consequently provides both proactive risk mitigation and responsive recovery capacity (Tukamuhabwa, 2015; Wieland & Wallenburg, 2013).

H_5: *Industrial Infrastructure Development positively mediates the relationship between Production Localization and Supply Chain Resilience.*

2.6 Supply Chain Resilience Theory

In the context of supply chain resilience theory, GCC localization of production is the redesign of the network across the main aspects of robustness, redundancy, flexibility, and recovery capacities. According to the resilience theory, systems that experience uncertainty within the environmental conditions need to acquire the ability to foresee, absorb, adjust to, and recover amidst the disruption. The extreme dependence on international upstream suppliers in the GCC region has affected robustness in the past as long as internationally spread supply chains increased the susceptibility to geopolitical shocks, logistical bottlenecks, and border constraints. Localization minimizes structural exposure, which involves the shortening of supply chains and locating production inside geographically proximate networks, which further enhances the resistance of the system to external disturbances (Figure 1). The impact of infrastructure investment on absorptive capacity is that this investment improves visibility and speed of coordination in addition to multimodal transport options, which all lead to greater adaptive flexibility in disruption. At the same time, the development of local suppliers brings in the relational redundancy and capability depth whereby, in case of shocks, there are several capable suppliers that can replace each other. The paper not only shows that localization reconfigures the supply network architecture in accordance with the resilience theory but also, instead of focusing on the enhancement of efficiency, the paper explains that adaptability, redundancy, and recovery speed become the keystones of long-term stability in the GCC production ecosystem.



Figure 1. Conceptual framework illustrating how production localization enhances GCC supply chain resilience through the mediating role of industrial infrastructure development and the moderating influence of local supplier capability development

3. RESEARCH METHODOLOGY

A quantitative research design was used to empirically test the relationships alleged as existing between the constructs and to test both measurement and structural characteristics of the conceptual model (Figure 2). A variance-based structural equation modeling strategy was used to support the predictive direction of the model, the existence of more than one latent construct, as well as the inclusion of mediating relationships.

3.1 Research Design and Approach

The survey design used was cross-sectional to collect primary data about the respondents who are representatives of the target population to the contextual framework of this study. The unit of analysis was the respondents at the organization level who had adequate knowledge in production practices, development of infrastructure, supplier capacity, and supply chain performance (Table 1). The creation of a structured questionnaire was based on the existing scales derived through the previous empirical studies, with the items then streamlined to ensure that the context was taken into consideration. All constructs were picked to be operationalized to represent latent variables and were measured on a five-item Likert scale of strongly disagree to strongly agree. Before the actual data collection, content validation of the instrument was conducted through expert review to guarantee the instrument was clear, relevant, and conceptualized.

3.2 Population and Sampling

The target population of the study was the senior managers, domain experts, and upper-level operational personnel working in logistical, supply-chain, manufacturing, and distribution logistics firms in GCC. The inclusion criteria were based on the fact that the respondents were directly involved in sourcing, procurement, and logistical activities and also involved in the performance appraisal cycles. The use of a strictly designed sampling framework that ensured the methodological soundness enabled the collection of primary data. The participants needed to have at least three years of professional experience and must have a significant role in making decisions concerning sustainability. Lastly, the dataset was subjected to a strict cleaning procedure, during which only those observations that fulfilled the following criteria of completeness, low response bias, and no statistical outliers were kept.

3.3 Measurement of Variables

All measurement items as a part of the methodological rigor were based on existing, peer-reviewed literature and validated instruments. Each construct was rated by the respondents on a five-point Likert-type scale anchored as 1=strongly disagree and 5=strongly agree. The localization of the production measure was evaluated based on the twelve-item measure developed by Al Mansoori and Ahmad (2023). The ten-item scale as articulated by Dubey et al. (2019) was the scale used to measure industrial infrastructure development and was used as a mediating variable. Krause et al. (2007) tested it using a ten-item scale of local supplier capability

development. Lastly, the operationalization of supply chain resilience was a dependent construct, using the instrument of eight items. Demographic data, namely age, gender, work experience, and education level, also went into the questionnaire. The respondents were assured of confidentiality and anonymity, as seen in the explanatory cover letter to the instrument that contained details of the purpose of the study.

Table 1. Variables Description and Role in the Research Model

Variables Name	Description	Role in Model
Production Localization	The strategic shift toward domestic manufacturing and sourcing of goods and services within GCC countries to reduce import dependence and strengthen regional value chains.	Independent Variable
Industrial Infrastructure Development	The development of transport networks, industrial zones, manufacturing facilities, logistics hubs, digital infrastructure, and energy systems that support domestic production capacity, operational efficiency, and regional connectivity within GCC supply chains.	Mediating Variable
Local Supplier Capability Development	The enhancement of local suppliers' technical skills, production capacity, quality standards, innovation capability, financial strength, and compliance with international benchmarks to support production localization	Moderating Variable
Supply Chain Resilience	The ability of GCC supply chains to anticipate, absorb, adapt to, and recover from disruptions while maintaining operational continuity, flexibility, and performance.	Dependent Variable

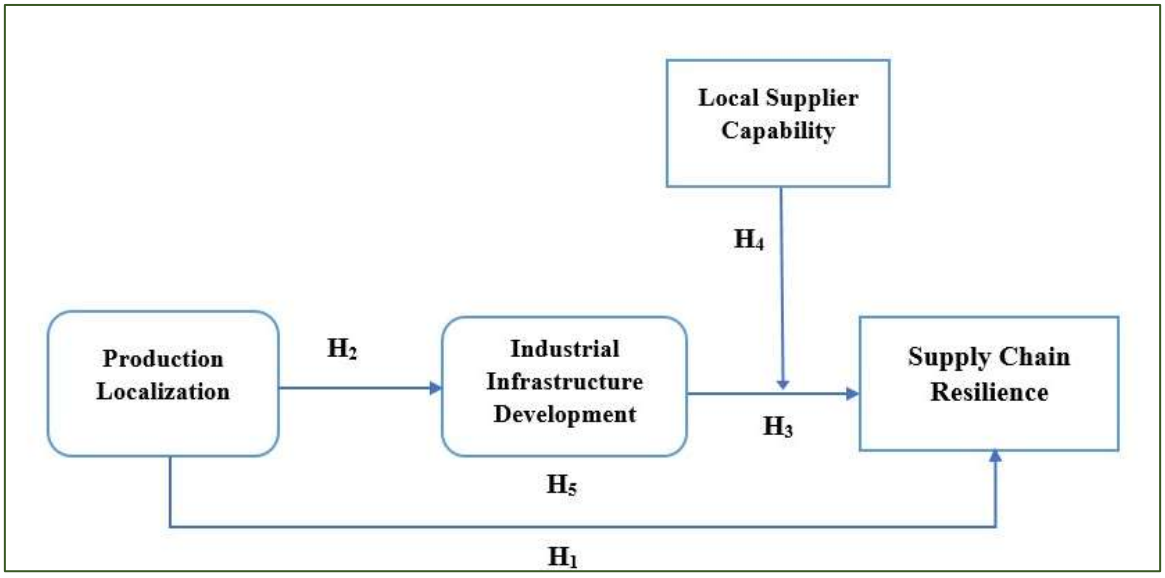


Figure 2. Proposed Research Model

3.4 Data Collection Procedure

Data collection was done through self-administered questionnaires electronically administered to the respondents who were eligible. They were not compelled to take part, and to avoid the social desirability bias, the participants were reassured that they were confidential. The respondents were made aware that the data that would be obtained would only be used in academic research. Procedural controls to minimize the common method variance were taken into consideration, such as accurate instructions, a psychological separation of predictor and criterion variables in the questionnaire, and anonymity. The questionnaire was reviewed strictly before being deployed to make sure that it is conceptually sound and contextual. Since the size of the available population was large, convenience sampling was used and 325 valid responses were obtained and used to make the analysis.

3.5 Measurement Model Assessment

Before considering the structural relationships, the measurement model was reviewed to determine reliability and validity as accurately as possible. Besides, composite reliability coefficients were used to evaluate internal consistency, thus ensuring that each construct was coherent enough (Table 2). Convergent validity was assessed through factor loadings and average variance extracted, and it was found that the indicators were able to capture the intended constructs sufficiently. Discriminant validity was established as per the set standards, and this ensured empirical differentiation among all constructs in the model (Table 3, 4). The structural relations were analyzed after the achievement of good levels of reliability and validity. This sequential method will ensure that the inferential analyses will be based on a solid foundation of measurement, hence maximizing the validity of the results that will be reached.

Table 2. Loadings, Composite Reliability and Average Variance Extracted

Construct	Item	Factor loading	Cronbach's α	(CR)	AVE
Industrial Infrastructure Development	IID1	0.551	0.922	0.935	0.592
	IID10	0.807			
	IID2	0.778			
	IID3	0.813			
	IID4	0.755			
	IID5	0.791			
	IID6	0.781			
	IID7	0.807			
	IID8	0.792			
	IID9	0.785			
Local Supplier Development	LS1	0.807	0.914	0.928	0.567
	LS10	0.654			
	LS2	0.772			
	LS3	0.782			
	LS4	0.723			
	LS5	0.827			
	LS6	0.840			
	LS7	0.779			
	LS8	0.658			
	LS9	0.655			
Production Localization	PL10	0.761	0.903	0.919	0.509
	PL11	0.656			
	PL12	0.697			
	PL2	0.664			
	PL3	0.705			
	PL4	0.678			
	PL5	0.680			
	PL6	0.732			
	PL7	0.754			
	PL8	0.752			
	PL9	0.755			
Supply Chain Resilience	SCR1	0.770	0.908	0.925	0.608
	SCR2	0.795			
	SCR3	0.716			
	SCR4	0.816			
	SCR5	0.778			
	SCR6	0.838			
	SCR7	0.796			
	SCR8	0.720			

Note. Cronbach's alpha and composite reliability values above 0.70 indicate internal consistency reliability. Average variance extracted (AVE) values above 0.50 indicate adequate convergent validity (Hair et al., 2022).

Table 3. Discriminant Validity (HTMT Ratio)

HTMT	Industrial Infrastructure Development	Local Supplier Development	Production Localization	Production Localization
Industrial Infrastructure Development				
Local Supplier Development	0.665			
Production Localization	0.700	0.551		
Supply Chain Resilience	0.647	0.684	0.579	0

Note. HTMT values below 0.85 (strict criterion) or 0.90 (liberal criterion) indicate adequate discriminant validity (Henseler et al., 2015).

Table 4. Discriminant Validity (Fornell - Larcker Criterion)

	Industrial Infrastructure Development	**Local Supplier Development**	**Production Localization**	**Production Localization**
Industrial Infrastructure Development	0.770			
Local Supplier Development	0.600	0.753		
Production Localization	0.649	0.494	0.713	
Supply Chain Resilience	0.603	0.632	0.527	0.780

Note. Discriminant validity is considered acceptable when the square root of the average variance extracted (AVE) for each construct is greater than its highest correlation with any other construct (Fornell & Larcker, 1981).

Table 5. Cross Loading

	IID	**LS**	**PL**	**SCR**
IID1	0.551	0.397	0.658	0.405
IID10	0.807	0.481	0.472	0.517
IID2	0.778	0.428	0.488	0.430
IID3	0.813	0.505	0.553	0.456
IID4	0.755	0.434	0.518	0.442
IID5	0.791	0.449	0.459	0.505
IID6	0.781	0.477	0.462	0.480
IID7	0.807	0.473	0.434	0.480
IID8	0.792	0.467	0.419	0.425
IID9	0.785	0.476	0.452	0.460
LS1	0.443	0.807	0.412	0.557
LS10	0.546	0.654	0.446	0.385
LS2	0.397	0.772	0.286	0.481
LS3	0.413	0.782	0.337	0.469
LS4	0.429	0.723	0.305	0.439
LS5	0.455	0.827	0.375	0.546
LS6	0.413	0.840	0.339	0.529
LS7	0.427	0.779	0.340	0.498
LS8	0.522	0.658	0.466	0.418
LS9	0.554	0.655	0.474	0.392
PL10	0.473	0.377	0.761	0.377
PL11	0.490	0.413	0.656	0.392
PL12	0.505	0.390	0.697	0.426
PL2	0.401	0.298	0.664	0.335
PL3	0.431	0.325	0.705	0.348
PL4	0.399	0.277	0.678	0.337
PL5	0.446	0.347	0.680	0.393
PL6	0.458	0.333	0.732	0.399
PL7	0.503	0.385	0.754	0.399
PL8	0.456	0.342	0.752	0.327
PL9	0.499	0.359	0.755	0.387
SCR1	0.494	0.478	0.400	0.770
SCR2	0.460	0.457	0.422	0.795
SCR3	0.318	0.396	0.377	0.716
SCR4	0.440	0.497	0.433	0.816
SCR5	0.482	0.509	0.415	0.778
SCR6	0.531	0.535	0.466	0.838
SCR7	0.429	0.514	0.350	0.796
SCR8	0.553	0.523	0.414	0.720

Note. Cross-loadings indicate adequate discriminant validity when each indicator loads higher on its associated construct than on all other constructs (Chin, 1998; Hair et al., 2019)

3.6 Structural Model Evaluation

The structural model was analyzed in line with the conceptual framework that proposed to test the direct impact of the localization of production on the supply chain resilience and the mediator roles of the industrial infrastructure development and the local supplier capability development. After ensuring that none of the predictor constructs were met with a multi collinearity problem as was indicated by acceptably high values of the variance inflation factor, the hypothesized relationships were evaluated through a bootstrapping process that had a large resample to obtain strong values of standard errors and confidence intervals. First, we evaluated the direct correlation between localization of production and the resilience of its supply chain. The path coefficient was verified on direction, magnitude, and statistical significance to determine whether localized production strategies have a direct positive impact on resilience outcomes. Then, the effect of localization of production on the development of industrial infrastructures was discussed in an attempt to establish whether there is any appreciable impact of localization projects on developing infrastructure capacity (Figure 3). The next correlation between the development of industrial infrastructure and the resilience of supply chains was then tested to ensure that it had the predictive strength in the model. The indirect impact of production localization on the resilience of the supply chain through the development of industrial infrastructure was calculated to explore the first mediating mechanism. Bootstrapped confidence intervals were used to evaluate the importance of this indirect path. The presence of mediation was considered by comparing the direct and indirect effects and thus finding out whether it was partial or complete mediation (Table 6). Similarly, the model also investigated how the development of industrial infrastructure impacts local supplier capability development and then how local supplier capability development impacts supply-chain resilience. The sequential mediation effect was observed by looking at the serial indirect pathway connecting production localization with supply-chain resilience by taking into consideration both the industrial infrastructure development and the development of local supplier capability. The methodological soundness of this multi-step indirect relationship was estimated with bootstrapping to ascertain the statistical significance. The model was measured in terms of the explanatory power of the coefficient of determination in the development of industrial infrastructure, local supplier capability development, and resilience in the supply chain. These values represented the percentage of variance explained by the antecedent constructs of the structural model. The effect-size measures were also obtained in order to determine the substantive contribution of the respective predictors to the endogenous variables (Figure 4). To ensure that the model has enough out-of-sample predictive power, the predictive relevance was evaluated on a blindfolding basis. All these analyses provided an in-depth evaluation of the structural relationships and confirmed the suggested theoretical model in the empirical environment of the research.

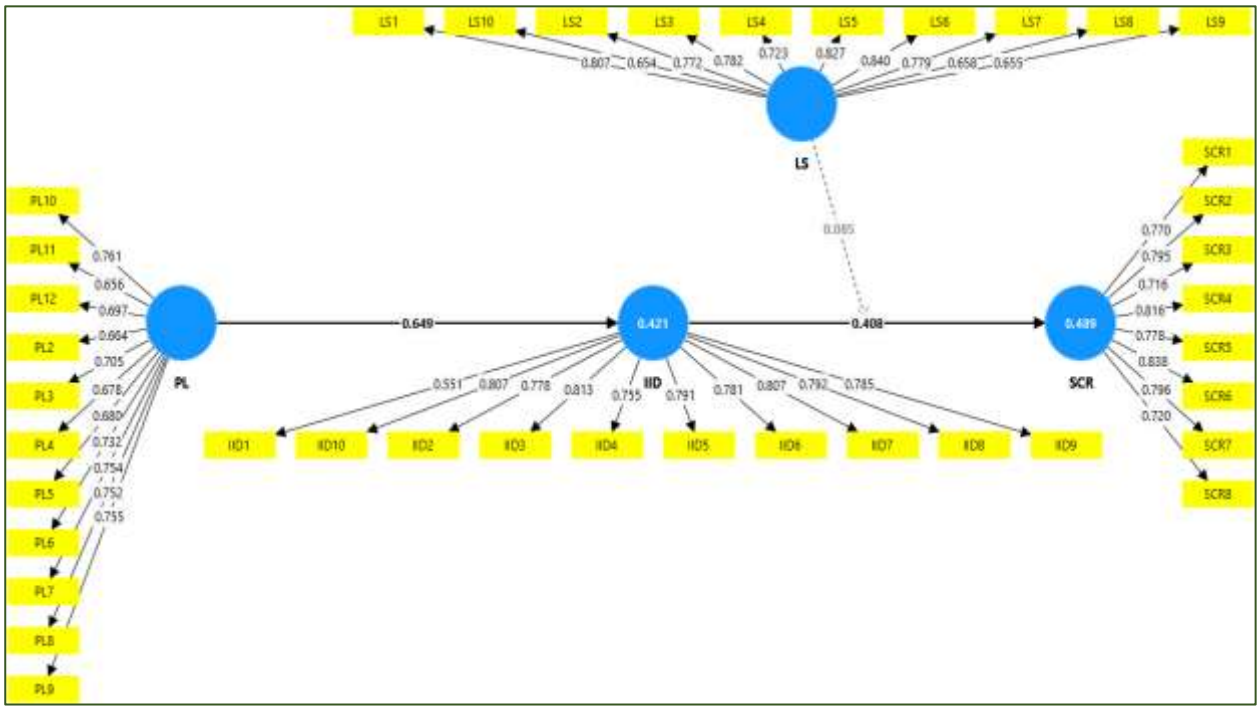


Figure 3. Measurement and structural model results with standardized estimates and explained variance (R^2)

Table 6. Structural Model Path Coefficients

Hypothesis	Path	β	t-value	p-value	CI (5%-95%)	Decision
H1	PL → SCR	0.265	4.891	0.000	0.177, 0.355	Supported
H2	PL → IID	0.649	14.930	0.000	0.576, 0.720	Supported
H3	IID → SCR	0.408	5.417	0.000	0.277, 0.528	Supported
H4	PL → IID → SCR	0.265	4.891	0.000	0.177, 0.355	Supported
H5	LS → IID → SCR	0.085	2.073	0.019	0.021, 0.154	Supported

Note. Path coefficients (β) were tested using bootstrapping with 5,000 subsamples. Paths are significant at *p*-value < 0.05 and *t*-value > 1.65. Confidence Intervals (CI) for path coefficients (β) were computed using bias-corrected bootstrapping with 5,000 subsamples. Paths were considered significant if the 95% CI did not include zero.

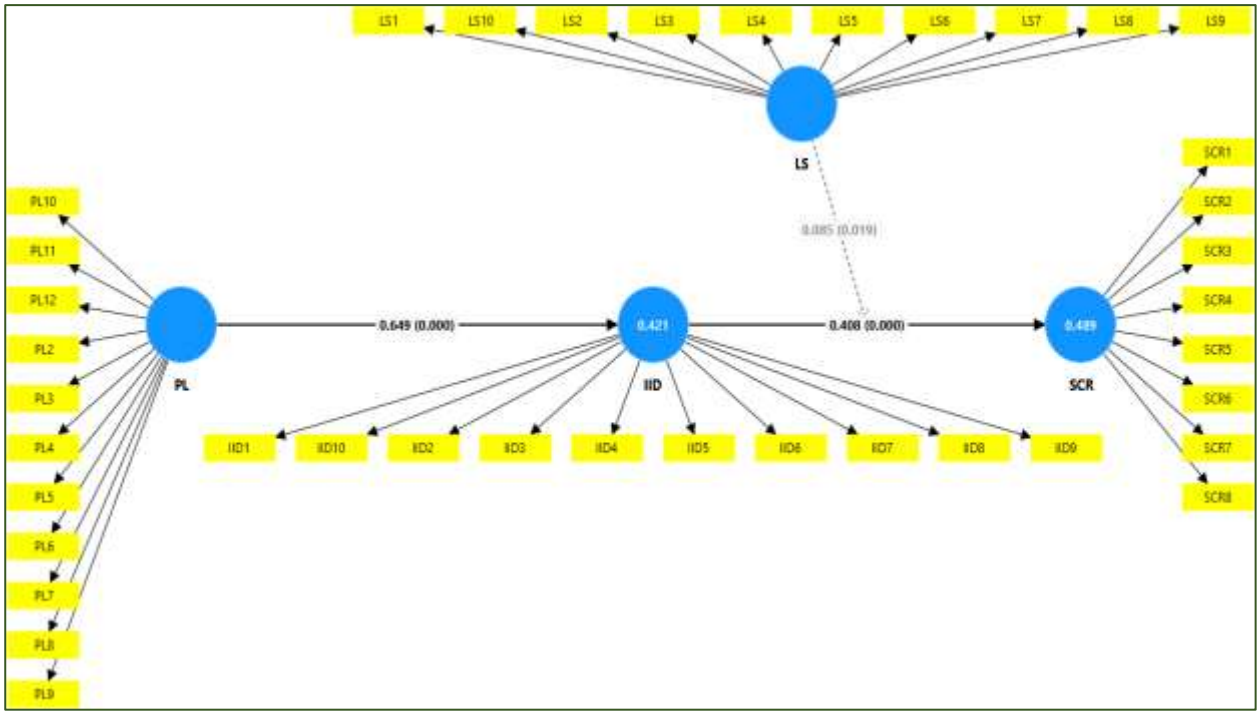


Figure 4. Structural and measurement model results obtained through PLS-SEM, showing standardized path coefficients with associated *p-values*, outer loadings, and R^2 values for endogenous constructs

4. RESULTS AND DISCUSSION

The results provide strong empirical evidence of the structural model connecting production localization, development of industrial infrastructure, development of the capability of local suppliers, and resilience of the supply chain. The measuring frame exhibited strong psychometric properties as all constructs have high internal consistency as manifested by composite reliability and Cronbach alpha values that are strictly above the recommended values (Table 2). Convergent validity was supported by satisfactory average variance extracted values, and all figures of factor loading were significant and statistically relevant. The rigor of discriminant validity was strictly checked using the HTMT ratios, the Fornell-Larcker criterion, and the cross-loading analysis, thus approving the fact that each construct represents a unique conceptual area (Tables 3, 4, and 5). These results are also sufficient to allow the structural inferences to be based on a good measurement base. The outputs of the structural model indicate the presence of a consistent, theoretically sound constellation of relations. Production localization has a strong and most significant impact on the development of industrial infrastructure (β 0.649, $p < 0.001$), which is the most significant direction in the model. This highlights the fact that localization strategies are not just simple modifications to operations but events that lead to a larger-scale transformation in industries. As companies generate more at home, a parallel development will be felt in terms of infrastructural capability, logistical networks, industrial equipment, and technological infrastructure that will be inescapable. The development of industrial infrastructure, in its turn, positively influences the resilience of the supply chain to an important extent (0.408, $p < 0.001$). This observation substantiates the fact that resilient supply chains are institutionally entrenched within the quality and complexity of the industrial environment that they serve. The improved infrastructure strengthens redundancy and flexibility, coordination, and speed of recovery, which enhances the ability of the system to withstand interference. The localization of production also has a positive direct impact on the supply chain's resilience (0.265, $p < 0.001$). The fact that this important direct relationship exists as well as the mediated effect is

evidence of partial mediation (Table 6). In this way, localization can bring about two aspects of resilience complementary to each other: by directly reducing external dependence and reducing supply chains and indirectly, by driving the development of infrastructure that, in turn, increases adaptive capacity. In addition, the model reveals a salient sequential process of local supplier capability development. The indirect route proves that infrastructural development positively influences the capabilities of suppliers, which subsequently leads to higher supply-chain resiliency. The fact that the size of this indirect effect is less than that of the primary infrastructure pathway does not make it non-statistically significant, but rather theoretically significant. This sequential mediation emphasizes the fact that resilience is not only dependent on physical or structural investments but also on relational and capability-based development of the supplier base. The model has a significant explanatory force, and it has significant robust variation in the case of industrial infrastructure development and supply-chain resilience. Effect-size tests confirm that the substantive effect of localization of production on infrastructure is strongly positive and that the substantive effect of the localization of production on the outcome of resiliency is moderate and strongly significant. Predictive relevance analysis also supports the strength of the model and its ability to elucidate resilience that is not random. On the whole, these findings strongly support the presented model and demonstrate that production localization is an effective strategic stimulant, infrastructure development of industries is an effective transmission process, and the development of local suppliers' capacity is a fortifier, which enhances the resilience. The results underline that resilience in the GCC environment is reached not with the independent policy actions but with the multi-level transformation of the production systems, infrastructure capacity, and supplier capabilities.

4.1 Theoretical and Practical Implications

The research has both theoretical and practical implications by enhancing the knowledge of how supply chains can be designed to resist the constant geopolitical and economic shocks, especially among the emergent and resource-dependent economies like the Gulf Cooperation Council (GCC). Theoretically, it adds to the literature of supply chain resilience by incorporating production localization, industrial infrastructure development, and local supplier capability development into one integrated framework instead of splitting analyses that are prevalent in the current literature. The empirical study is context specific, offering empirical evidence of GCC, which is generally underrepresented in resilience research, though it is strategically important in global trade, energy markets, and industrial transformation, increasing the external validity and geographical applicability of resilience theory. In a pragmatic sense, the findings present practical implications for policymakers given the fact that they explain how localization efforts can be balanced with infrastructure investment and supplier development efforts to generate meaningful resilience impacts as opposed to the appearance of compliance to geopolitical pressures. To industry leaders, the study guides strategic choices on sourcing, configuration of production, and development of suppliers in the environment of increased uncertainty and assists in designing both local embedded and multinationally competitive supply chains. The study, as a whole, is relevant to making industrial policy more informed and robust supply chain strategy in a period of long-term geopolitical instability.

4.2 Managerial and Policy Implications

The results of this paper give vital recommendations to managers and policymakers who are keen on enhancing supply-chain resilience in the GCC region by implementing strategic localization. The consequences of the research for managers are that localization of production should be sought not only as a strategy to lower costs but also as a means of resiliency in the medium and long term supported by a strong industrial base and local suppliers. This means that companies need to invest in contemporary logistics infrastructure, integrated digital supply-chain systems, and the creation of industrial clusters that result in better coordination, reduce dependence on suppliers that are far, and increase responsiveness in operations in times of disruption. It is also vital that the local supplier capabilities are developed in a way that is systematic through training, technology transfer, collaborative partnerships, and quality-management programs so that the domestic suppliers will be able to meet international standards of production and easily fit into the regional supply networks. From a policy perspective, governments across the GCC can play a key role by developing supportive industrial policies that can encourage local manufacturing, strengthen transportation and digital infrastructure, and develop inducements that companies should use to pursue supplier-development initiatives. The competitive local supply bases can also be further expedited through public investment in industrial zones, innovation ecosystems, and skill-development programs. Besides, regulatory frameworks, which support the cooperation of multinational companies and domestic suppliers, may support the knowledge transfer and the creation of sustainable production ecosystems. Overall, these coordinated managerial operations and policy interventions can help reduce the supply vulnerability of the external environment and foster expansion and long-term stability and competitiveness of GCC supply chains.

4.3 Limitations and Future Research

This study provides substantive information on the nexus of production localization, industrial infrastructure, supplier capacity development, and supply-chain resilience in the GCC context, it has a number of methodological limitations, which future academic

research should consider. First of all, the cross-sectional design only captures the perceptions of the stakeholders at one point in time, hence limiting causal inferences; furthermore, the use of self-reported survey data only creates the specter of subjectivity and partisanship. Secondly, the biased attention to specific industries and combining the results of the GCC member states together may hide sector-specific and nation-specific differences in industrial development, regulatory frameworks, and industry dynamics. Third, external macro-environmental variables, such as geopolitical risk, frequency of disruption, and digital transformation, were not captured, and ecosystem-level and network interdependences were not studied (resilience measurements were limited to the firm level). Fourth, a theoretical formulation of supplier capability as an unidimensional construct overlooks the latent sub-dimensions of supplier capability, and the study failed to probe trade-offs between resilience, cost, and efficiency. Future studies must hence follow longitudinal, multi-level designs, merge objective performance scales, make comparative sectoral and national studies, add environmental and situational moderators, explore the inner sub-dimensions of supplier strength, and explore more extensive network and ecosystem-wide processes. These methodological developments will provide a stronger piece of evidence, enhance theoretical knowledge, and create practical recommendations to further supply-chain resiliency development in the dynamic GCC industrial landscape.

5. CONCLUSION

This paper proves the fact that the fortification of local production, the building of industrial infrastructure, and the strengthening of suppliers are some of the decisive factors of supply-chain stability and responsiveness in the Gulf Cooperation Council (GCC). The findings emphasize that strategic investments, accompanied by concerted actions, can greatly increase the ability of firms to respond to disruptions and recover much faster; however, the analysis also clarifies the complexity of the issue of how the policy directives can be translated into concrete resilience performances. This study emphasizes the importance of aligning long-term planning, rational resource distribution, and holistic capacity development to strengthen the regional supply chains through the presentation of the empirical evidence in a variety of industrial sectors. Such results provide useful insights to the executives and policymakers aiming to find a balance between growth, stability, and flexibility in the framework of rapidly changing economic settings.

Acknowledgment: The authors would like to express their warmest thanks to all managers of manufacturing companies, logistics and supply chain professionals of the FMCG, electrical and electronics, process and machinery departments of GCC who were so kind to take part in this study. Their precious time, real-life experiences, and frank answers played a key role in completing this study. Another group of people that the authors acknowledge and who helped them at the stage of data collection and initial analysis are the departmental colleagues and research assistants. Special credits are given to Lincoln University College, University of Buraimi and the University of Malaysia Terengganu, who helped in this collaborative research work. The reviewers also appreciate the anonymous reviewers whose constructive feedback helped the authors in making this manuscript much better.

Conflict of Interest: The authors state that they do not know of any competing financial interests or personal relationships that might have manifested themselves in the work that is reported in this paper. This study was not funded by any other organization or agency to carry out this study. The study was performed without connection, and the authors have no interest in any organization or entities, financial or non-financial, in the topic or material to be covered in this manuscript.

References:

Al Mansoori, M. A., & Ahmad, A. N. A. (2023). Proposing a predictive model for assessing the influence of employee empowerment on organizational performance. International Journal of Sustainable Construction Engineering and Technology, 14(3), 12–20. https://doi.org/10.30880/ijscet.2023.14.03.002

Aschauer, D. A. (1989). Is public expenditure productive? *Journal of Monetary Economics, 23*(2), 177–200. https://doi.org/10.1016/0304-3932(89)90047-0

Bair, J., & Gereffi, G. (2001). Local clusters in global chains: The causes and consequences of export dynamism in Torreon's blue jeans industry. *World Development, 29*(11), 1885–1903. https://doi.org/10.1016/S0305-750X(01)00071-0

Baldwin, R. (2016). *The great convergence: Information technology and the new globalization.* Harvard University Press.

Bessant, J., Kaplinsky, R., & Lamming, R. (2003). Putting supply chain learning into practice. International Journal of Operations & Production Management, 23(2), 167–184. https://doi.org/10.1108/01443570310458470

Calderón, C., & Servén, L. (2010). Infrastructure and economic development in Sub-Saharan Africa. *Journal of African Economies, 19*(Suppl_1), i13–i87. https://doi.org/10.1093/jae/ejq010

Christopher, M., & Peck, H. (2004). Building the resilient supply chain. *International Journal of Logistics Management, 15*(2), 1–14. https://doi.org/10.1108/09574090410700275

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295–336). Lawrence Erlbaum Associates.

Cousins, P. D., Lawson, B., & Squire, B. (2008). Performance measurement in strategic buyer–supplier relationships. *International Journal of Operations & Production Management, 28*(3), 238–258. https://doi.org/10.1108/01443570810852494

Dubey, R., Gunasekaran, A., Childe, S. J., Papadopoulos, T., Blome, C., & Luo, Z. (2019). Antecedents of resilient supply chains: An empirical study. *IEEE Transactions on Engineering Management, 66*(1), 8–19. https://doi.org/10.1109/TEM.2018.2813046

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50. https://doi.org/10.2307/3151312

Feldman, M. P., & Audretsch, D. B. (1999). Innovation in cities: Science-based diversity, specialization and localized competition. *European Economic Review, 43*(2), 409–429. https://doi.org/10.1016/S0014-2921(98)00074-0

Flynn, B. B., Huo, B., & Zhao, X. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. *Journal of Operations Management, 28*(1), 58–71. https://doi.org/10.1016/j.jom.2009.07.001

Gereffi, G. (2020). What does the COVID-19 pandemic teach us about global value chains? The case of medical supplies. *Journal of International Business Policy, 3*(3), 287–301. https://doi.org/10.1057/s42214-020-00062-w

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy, 12*(1), 78–104. https://doi.org/10.1080/09692290500049805

Giuliani, E., Pietrobelli, C., & Rabellotti, R. (2005). Upgrading in global value chains: Lessons from Latin American clusters. *World Development, 33*(4), 549–573. https://doi.org/10.1016/j.worlddev.2004.10.002

Handfield, R. B., Walton, S. V., Sroufe, R., & Melnyk, S. A. (2002). Applying environmental criteria to supplier assessment: A study in the automotive industry. *Journal of Supply Chain Management, 38*(3), 18–28. https://doi.org/10.1111/j.1745-493X.2002.tb00130

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.).

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review, 31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science, 43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

Hausmann, R., & Hidalgo, C. A. (2011). The network structure of economic output. Journal of Economic Growth, 16(4), 309–342. https://doi.org/10.1007/s10887-011-9071-4

Humphrey, J., & Memedovic, O. (2006). *Global value chains in the agrifood sector*. Retrieved from https://www.unido.org/resources-publications

Humphrey, J., & Schmitz, H. (2002). How does insertion in global value chains affect upgrading in industrial clusters? *Regional Studies, 36*(9), 1017–1027. https://doi.org/10.1080/0034340022000022198

Ivanov, D. (2020). Viable supply chain model: Integrating resilience and adaptability under disruption. *International Journal of Production Research, 58*(10), 2904–2915. https://doi.org/10.1080/00207543.2020.1714469

Ivanov, D., & Dolgui, A. (2020). Viability of intertwined supply networks: Extending the supply chain resilience angles towards survivability. *International Journal of Production Research, 58*(10), 2904–2915. https://doi.org/10.1080/00207543.2020.1750727

Javed, A., Ibrahim, M. Y., Ngah, A. H., Zafar, M. J., Hammad, M., Khan, A. Z., & Mir, F. (2025). Impact of inclusive leadership on project success-with mediating role of organizational commitment and top management support as moderator: A systematic literature review. *Multidisciplinary Reviews, 8*(8), 2025250-2025250. https://doi.org/10.3390/multi8080250

Ketels, C. (2013). Recent research on competitiveness and clusters: What's next? *Cambridge Journal of Regions, Economy and Society, 6*(2), 185–189. https://doi.org/10.1093/cjres/rst002

Kinkel, S. (2012). Trends in production relocation and backshoring activities: Changing patterns in the course of the global economic crisis. *International Journal of Operations & Production Management, 32*(6), 696–720. https://doi.org/10.1108/01443571211238820

Krause, D. R., Handfield, R. B., & Tyler, B. B. (2007). The relationships between supplier development, commitment, social capital accumulation and performance improvement. *Journal of Operations Management, 25*(2), 528–545. https://doi.org/10.1016/j.jom.2006.05.007

Krause, D. R., Vachon, S., & Klassen, R. D. (2009). Special topic forum on sustainable supply chain management. *Journal of Supply Chain Management, 45(*4), 18–25. https://doi.org/10.1111/j.1745-493X.2009.03162

Lall, S. (2004). Reinventing industrial strategy: The role of government policy in building industrial competitiveness. UNU-WIDER Working Paper. Retrieved from https://www.wider.unu.edu/publication/reinventing-industrial-strategy

OECD. (2017). Enhancing the contributions of SMEs in a global and digitalised economy. OECD Publishing. https://doi.org/10.1787/9789264275683

OECD. (2021a). Global value chains: Efficiency and risks in the context of COVID-19. Retrieved from https://www.oecd.org/trade/topics/global-value-chains

OECD. (2021b). Global value chains: Efficiency and resilience. OECD Publishing. Retrieved from https://www.oecd.org/trade/topics/global-value-chains

Pietrobelli, C., & Rabellotti, R. (2011). *Global value chains, development, and emerging economies.* Cambridge University Press. https://doi.org/10.1017/CBO9780511974241

Ponomarov, S. Y., & Holcomb, M. C. (2009). Understanding the concept of supply chain resilience. *International Journal of Logistics Management, 20*(1), 124–143. https://doi.org/10.1108/09574090910954873

Porter, M., E. (1990). The competitive advantage of nations. *Harvard Business Review, 68*(2), 73-93.

Porter, M. E. (1998). Clusters and the new economics of competition. *Harvard Business Review, 76*(6), 77–90. Retrieved from https://hbr.org/1998/11/clusters-and-the-new-economics-of-competition

Scholten, K., Scott, P. S., & Fynes, B. (2014). Mitigation processes—Antecedents for building supply chain resilience. *Supply Chain Management: An International Journal, 19*(2), 211–228. https://doi.org/10.1108/SCM-10-2013-0386

Sheffi, Y. (2005). *The resilient enterprise: Overcoming vulnerability for competitive advantage.* MIT Press.

Tang, C. S. (2006). Robust strategies for mitigating supply chain disruptions. *International Journal of Logistics: Research and Applications, 9*(1), 33–45. https://doi.org/10.1080/13675560500405584

Timmer, M. P., Erumban, A. A., Los, B., Stehrer, R., & de Vries, G. J. (2014). Slicing up global value chains. *Journal of Economic Perspectives, 28*(2), 99–118. https://doi.org/10.1257/jep.28.2.99

Tukamuhabwa, B. R., Stevenson, M., Busby, J., & Zorzini, M. (2015). Supply chain resilience: Definition, review, and theoretical foundations. *International Journal of Production Research, 53*(18), 5592–5623. https://doi.org/10.1080/00207543.2015.1037934

Urbaniak, M., Zimon, D., & Lysenko-Ryba, K. (2025). Expectations towards suppliers in terms of ensuring and enhancing product and process quality. *International Journal for Quality Research, 19*(2), 689–696. https://doi.org/10.24874/IJQR19.02-22

Wieland, A., & Wallenburg, C. M. (2013). The influence of relational competencies on supply chain resilience. *International Journal of Physical Distribution & Logistics Management, 43*(4), 300–320. https://doi.org/10.1108/IJPDLM-08-2012-0243

Williamson, O. E. (1985). The economic institutions of capitalism. Firms, markets, relational contracting. In Das Summa Summarum des Management: Die 25 wichtigsten Werke für Strategie, Führung und Veränderung (pp. 61-75). Wiesbaden: Gabler.

World Bank (2020). Trading for development in the age of global value chains. World Bank. https://doi.org/10.1596/978-1-4648-1457-0

World Economic Forum (2021). Shaping the future of global value chains. Retrieved from https://www.weforum.org/reports/shaping-the-future-of-global-value-chains

UNCTAD (2020). World investment report 2020: International production beyond the pandemic. United Nations. Retrieved from https://unctad.org/webflyer/world-investment-report-2020

Sohail Tariq
Lincoln University College
Malaysia
sohailtariq1990@gmail.com
ORCID 0009-0001-0222-2294

Shahzad Ahmed Khan
Buraimi University,
Oman
shahzad@uob.edu.om
ORCID 0000-0001-9193-3217

Asad Javed
University Malaysia Terengganu
Malaysia
engrasad.raja@gmail.com
ORCID 0009-0005-2591-1745

Fahad Al Otaibi
Lincoln University College
Malaysia
fahadj.phdscholar@lincoln.edu.my
ORCID 0009-0005-0391-3184

Junaid Zafar
University Malaysia Terengganu
Malaysia
nch7900@gmail.com
ORCID 0009-0008-1660-215X