

Determinants of Firm Resilience in Global Value Chains: The Role of Firm- and Network-Level Factors

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Abstract

The recent global disruptions revealed the fragility of the modern global value chains (GVCs). These disruptions presented the necessity to explore resilience of firms operating in GVCs. To meet this need, the lense of complementarities from the ecosystem theory can serve as the extension of the GVCs with the structural context of ecosystems ensuring resilience. Therefore, the aim of this study is to investigate determining factors of resilience of firms operating in GVCs in the perspective of complementarities. The synthetic literature review and content analysis was adopted for the purpose of the research, which allowed to identify two groups of determining factors of resilience of firms operating in GVCs, namely firm- and network-level factors, and explain how firm-level capabilities translate to resilience outcomes. The study found that firms operating in GVCs generate resilience indirectly through complementarities as they enable the emergence of network-level capabilities, which in turn drive resilience outcomes.

Keywords: global value chains, resilience, ecosystem theory, complementarities.

INTRODUCTION

The global economy of 21st century is described by an exceptional level of international integration. With the rise of global value chains in recent decades, it has become common for different stages of production to take place across multiple countries. GVCs have brought a high level of transformation, opening new business opportunities and increasing productivity (Schmidt et al, 2020). GVCs now enable real-time coordination among highly specialized firms located around the globe. They provided firms access to a broader and more diverse range of capabilities and resources, supporting innovation and the development of more sophisticated products. Empirical evidence across industries and firms pertain a positive relationship between GVC participation and productivity (OECD, 2025).

The recent global disruptions, such as geopolitical uncertainty and fragmentation of production revealed the fragility of the modern GVCs. The reliance of firms on various links in the value chains and lack of flexibility on the side of suppliers positioned the current GVC configurations in question. Shrinking international trade contracted the international economy. These disruptions presented a great need to examine resilience of GVCs towards disruptions and their impacts (Castaneda-Navarrete et al, 2020).

Furthermore, the global economy is experiencing major shifts fuelled by digitization and modularization. In this evolving environment, industries that once operated within clear GVCs and well-defined boundaries have become interconnected across sectors and regions, implementing innovative governance solutions (Thun et al, 2025). In this rapidly evolving global system, the ecosystem view provides a structural context that extends beyond the boundaries of the GVC itself, underpinning its operational effectiveness. Furthermore, it underscores the necessity for the supply chain to engage with the broader community to ensure long-term viability and resilience (Pimenta et al, 2022). What is more, Mollenkopf et al (2021) also address ecosystems as extension of the GVCs as they perform the facilitation of exchange of goods and services among firms that do not typically exchange in GVCs, therefore these firms are integrating resources for maintaining the necessary level of supply.

According to Schmidt et al (2020), GVCs are affected by interdependencies associated with ecosystems which lead to resilience benefits. What is more, according to the recent research (Adner, 2017; Jacobides et al, 2018), ecosystems pertain an integrative view on GVCs stressing the strong interdependencies between value creating actors. By building an interconnected ecosystem, firms operating in GVCs can rapidly spot bottlenecks, address challenges, and make well-informed decisions, consequently enhancing resilience and adaptability (Bürgel et al., 2023). Hence, the perspective of the ecosystem theory in terms of complementarities allows to examine GVCs in the broader spectrum and in more profound manner since ecosystems can be considered as extension of GVCs. Therefore, this study aims to answer the following research question: What are the key factors influencing resilience of firms operating in GVCs? The aim of this study is to define the determining factors of resilience of firms operating in GVCs in the perspective of complementarities from the ecosystem theory.

The paper is structured as follows. After the introduction, the following section presents the literature review on resilience of firms operating in GVCs and the perspective of ecosystem theory and its complementarities, followed by methodology of the study. This paper proposes theoretical framework for identifying the determining factors of resilience of firms operating in GVCs, follows with discussion, then synthesizes the conclusions of the research and discusses limitations of the study incorporating avenues for future research.

Literature review

Conceptualizing resilience in the context of the research. In nowadays rapidly changing world, GVCs must act on a timely manner in order to be able to meet the changes and the needs in the markets, which, in turn means, that they must respond in accordance to unpredictable, dynamic and even unstable environments. Academicians have referred to resilience as a firm's capability to respond to disruptions and restore normal operations (Rice & Caniato, 2003). Resilience of the firm can also be defined as multi-level trait as identified by Ambulkar et al (2015) "capability of the firm to be alert, to adapt to, and quickly respond to changes brought by a supply chain disruption". However, in the context of GVCs, resilience is attained by communities, not by single members (Shin & Park, 2021). Since a GVC can be pictured as one single community and each firm as part of that community, the leaders of such chains

are encouraged to evaluate the performance of the firms on the GVC level, on individual one. GVC resilience helps firms to overcome disruptions while maintaining operations on a high level (Raj et al, 2022).

According to Shi & Mena (2021) resilience of GVCs can be divided into three main segments. The first is concentrated on the capacity of the chain to respond to various disruptions, as in the definition provided by Christopher & Peck (2004) “the ability of a system to return to its original state or move to a new, more desirable state after being disturbed”. The second is concentrated on the capacity of the chain to withstand disruptions as in the definition provided by Kim et al (2015) “a network-level attribute to withstand disruptions that may be triggered at the node or arc level”. The third is concentrated on the capacity of the chain to return to the original state and to recover from the disruption as in the definition provided by Melnyk et al (2014) “the ability of a supply chain to both resist disruptions and recover operational capability after disruptions occur”. These definitions acknowledge all four phases of resilience, that is: readiness, response, recovery and growth.

According to the definitions of resilience provided above, it is evident that resilience is perceived as dynamic capability. What is more, the resilience of GVCs is announced to be of a dynamic nature (Lin et al, 2022). It refers to the ability to “integrate, build and reconfigure internal and external competencies to address rapidly changing environments” (Teece et al, 1997), with the consideration to value creation (Do et al, 2021). Several research has sufficiently grounded that resilience is an important dynamic capability which contributes significantly to assistance for firms while navigating through disruptive settings (Singh et al, 2020; Mishra et al, 2021). The dynamic capabilities perspective is formed of the key conditions emphasizing: capabilities of firms in sensing - identifying and assessing opportunities and threats, in seizing - capturing value by resource mobilisation; and transforming resources and capabilities to gain long-term competitive advantage in turbulent environments (Do et al, 2021; Raj et al, 2022). Therefore, it is an ideal theoretical lense for positioning resilience. The mentioned definitions of resilience of firms operating in GVCs provide initial basis for the firms to acquire different strategies of resilience. They build a foundation for the firms to evaluate and take upon the determined activities to reach their strategic goal in regard to resilience.

Ecosystem theory perspective. Ecosystems contains groups of organizations that are related along “varying degrees of multilateral, nongeneric complementarities” coupled together with the absence of hierarchical controls (Kapoor, 2018). The ecosystem perspective enables explaining strategies and outcomes of the firm, operating in GVCs, through the lens of complementarities (Kapoor, 2018). Complementarity is one of the bases for the ecosystems to emerge (Jacobides et al, 2018) and is considered to be a building block of the ecosystem theory (Adner & Kapoor, 2010). The output of complementarities increases the value of a focal product that is generated by the clients from using it (Carst & Hu, 2023). Complementarity has a significant potential for innovation recognition and implementation. Together with its value-added factors and the core offering of the company, the full value potential enhances tremendously not only improving the recognition and performance of the company, but also the one of the entire ecosystem (Adner & Kapoor, 2010; Carst & Hu, 2023). What is more, in a nowadays world with international competition within firms taking place, complementarity plays a crucial role in providing competitive advantage and a certain level of differentiation.

The term complementors appeared in the business literature to define the added-value actors of the ecosystems. Complementors are generally perceived as distinct downstream actors (Adner & Kapoor, 2010) known for providing “complementary products and services that contribute towards the focal

offer's value creation" (Kapoor 2018). According to Carst & Hu (2023), there are five main characteristics of complementarities in the ecosystems: autonomy, adaptability, heterogeneity, rationality and entrepreneurial-mindedness. Firstly, complementors may not have formal signed agreements with other actors in ecosystems. What is more, they may not share the same GVCs as other participants of the ecosystem (Gawer & Cusumano, 2014). Therefore, the focal firm does not always have direct control of complementors and their products. Secondly, complementors are quickly adapting to changes in markets, demands and the focal product itself. They even may originate from different markets (Kapoor & Agarwal, 2017). They are considered heterogenous allowing complementarities to be desired in various types of ecosystems or GVCs since they typically increase the value of focal product by the innovations that they carry (Carst & Hu, 2023). What is more, complementors meet the needs of the customers by providing innovative solutions, making swift decisions, maintaining a competitive portfolio and valuing experience (Cennamo & Santalo, 2019).

Complementarities pertain a strategic position in the focal value creation for an ecosystem and makes a significant impact on the success and overall survival of the ecosystem (Carst & Hu, 2023) nonetheless the GVCs and firms operating within them by providing resource, capability, knowledge or process complementarities. What is more, Legenvre et al (2022) states that there is a significant difference between complementarities from ecosystems and suppliers from GVCs.

Ecosystem is understood as a governance form differentiated from GVCs or industries (Legenvre et al, 2022). This study also follows the notion of the mentioned authors, that ecosystems and GVCs coexist together, with ecosystems pertaining the complementary role for GVCs. Therefore, ecosystems are addressed as extension of GVCs as they perform the facilitation of exchange of goods and services among firms that not typically exchange in GVCs, thus these firms are integrating resources for maintaining the necessary level of supply, nonetheless resilience.

Research methodology

Synthetic literature review method was selected for the purpose of the research. It allowed to evaluate, analyse and integrate the previous studies in the field of the research (Naumann, 2017) in order to answer the following research question: "What are the key factors influencing resilience of firms operating in GVCs"? The literature search was conducted using Scopus database. The research was limited to articles, with the following keywords un the abstracts and titles of the articles: ("global value chain*" OR "GVC*" OR "global value network*" OR "GVN*" OR "supply chain*" OR "supply network*" AND "resilience" AND "capabilit*"). Peer-reviewed journal articles published between 2008 and 2025 were included, limited to English language publications in the field of "Business, management and accounting" from the Scopus list. The initial yield of articles was 772 articles and after conducting the screening process of the titles and abstracts, 169 articles were included for the full revision of the article. After the application of inclusion and exclusion criteria, the sample contained of 72 articles. The inclusion criteria included studies addressing capabilities of firms operating in GVCs; studies addressing capabilities of GVCs; and conceptual or empirical studies providing insights relevant to resilience of firms operating in GVCs as well as of the chain itself. The exclusion criteria involved studies focused on resilience without GVC context or of firms not operating in GVCs; studies focused on firms or GVCs but not involving the context of resilience; studies lacking implications on firms operating in GVCs or on resilience. Non-peer reviewed journal articles were not included in the study. After abstract and full article screening process, 32 articles were selected for in-depth analysis on the basis of the purpose of the research and their identified themes.

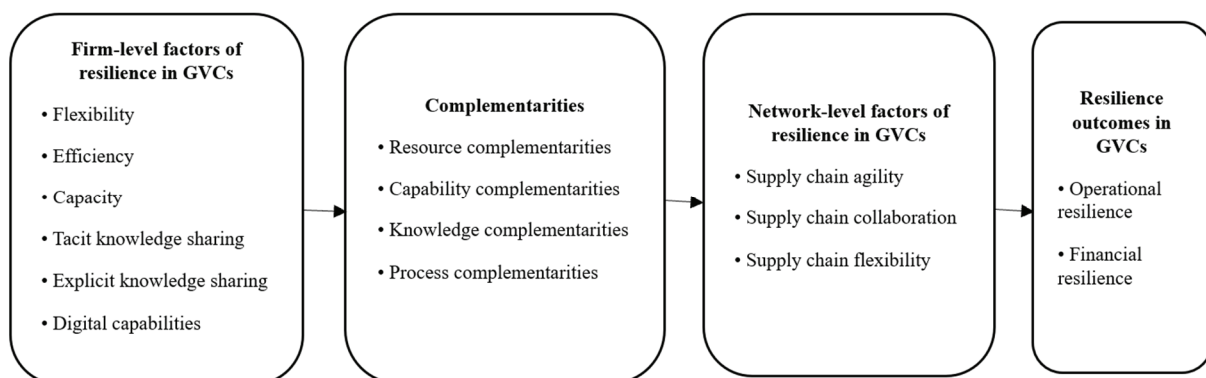
The thematic analysis was conducted to synthesize the results of the study within selected literature. The selected literature was coded according to selected themes. The thematic coding included firm-level determining factors of resilience, namely knowledge sharing, flexibility, efficiency, capacity and digital capabilities; and network-level determining factors of resilience, namely agility, flexibility and collaboration of the GVC. The identified literature was segregated accordingly, following review of the themes highlighting strengths, contradictions and limitations within each theme to pertain coherence.

To enhance the conceptual depth of the research, theoretical analysis was also performed incorporating the perspective of ecosystem theory in the light of complementarities. The perspective of complementarities allowed the extended view of resilience of firms operating GVCs and facilitated the level of resilience within firm- and network-level determining factors of resilience.

Results

According to the performed research, the determining factors of resilience can be categorized into two main categories: 1) firm-level, which are characterized by the dynamic capabilities of tacit knowledge sharing, implicit knowledge sharing, flexibility, capacity, efficiency and digital capabilities; 2) network-level, which are linked with agility, flexibility and collaboration of the global supply chains. Hence, the conceptual model (Figure 1) was proposed, with each determining factor of resilience discussed below.

Figure 1: Conceptual framework



Created by the authors.

Firm-level resilience is described as “the capability of a firm to be alert to, adapt to, and quickly respond to changes brought by a supply chain disruption” (Ambukar et al, 2015). Firm-level resilience consists of the dynamic capabilities of the firm that enables it to handle disruptions in order to continue the activities of the business. Many authors, such as Chowdhury & Quaddus (2017) or Pettit et al (2013) examine resilience through dynamic capabilities, such as flexibility, capacity and efficiency while Alkhatib & Momani (2023) include digital dynamic capabilities for measuring of firm-level resilience.

According to Pettit et al (2013), flexibility is one of the key factors of resilience of firms operating in GVCs. It is the dynamic capability of the firm to adapt rapidly to changing conditions in the market (Duclos et al, 2003). Some authors pose resilience as multi-layer flexibility, which stems from the resilience theory, since it captures the capacity for the firms to strategically, operationally and tactically adapt in the face of unexpected disruptions (Singh, 2024). Strategic flexibility stands for adjustment of the firms’ approach in order to meet the dynamic market conditions; operational flexibility allows the firm to reconfigure its internal systems and processes to meet the dynamic operational market needs

maintaining the continuous level of efficiency; while tactic flexibility enables the firm to swiftly switch their strategy and allows to withstand the rapid changes (Singh et al, 2019).

Capacity is a dynamic capability of firms operating in GVCs that is described as “availability of assets to enable sustained production levels” (Pettit et al, 2013). It includes several subfactors, such as reserve capacity, redundancy, backup energy sources and communications (Chowdhury & Quaddus, 2017) that are critical in maintaining a high level of resilience in firms operating in GVCs.

An important role is evident to be played by the capability of efficiency. Pettit et al (2013) define efficiency as a “capability to produce outputs with minimum resource requirements”. According to Matawale et al (2016), competition among firms will not improve their efficiency, therefore they argue that firms must implement competition together with their respective GVCs, which allows a broader perspective of complementarities offered by ecosystems.

Another important aspect of firm-level resilience is found to be knowledge sharing. It represents the transfer of knowledge from one individual or group, to the other one (McAdam et al, 2012). Knowledge is considered to be the key intangible asset for any firm and sustains competitive advantage (Teece, 2007). Knowledge sharing is combined of two main constructs: explicit knowledge sharing, which represents easy to capture, codify or transmit knowledge sharing. It is the most evident in procedures implemented by the firm: formal language, technological systems or informational handbooks (Huang et al, 2010) and exists in written form (Wang, Wang & Liang, 2014); and tacit knowledge sharing which includes direct interaction that is pertained through the willingness and capacity of the actors to share the knowledge (Holste & Fields, 2010). Knowledge sharing is positively related to firm performance, revenue from new products, sales growth, lower production costs, better team performance, faster implementation of projects and increased innovation capabilities (Hsu, 2008; Wang & Wang, 2012; Wang et al, 2016) enhancing resilience.

Finally, digital capabilities became the key in every firm in order to survive. According to Frank et al (2019), digital tools refer to technologies that provide intelligence and connectivity. It is widely understood by firms that the application of digital technologies have a significant role in the resilience of the network they are within as well as on the firm-level as they allow to improve decision-making activities, analytics, time management, interfaces with other participants of the GVCs (Alkhatib & Momani, 2023), resulting in better integration within GVC as well as mitigating the possible disruptions (Ivanov & Dolgui, 2020). What is more, digital capabilities boost the reaction and recovery times for firms in GVCs, with quicker deployment of proactive strategies (Ivanov et al, 2021). Digitalization is identified as increasing resilience of firms (Zouari et al, 2021). Therefore, it is identified by scholars that digital maturity of the firm is associated with positive outcomes of resilience (Issa et al, 2018).

Nevertheless, dynamic capabilities are interrelated, not stand-alone actors (Pettit et al, 2013), therefore it is necessary to combine different dynamic capabilities of firms operating in GVCs in order to achieve a positive outcome of the level of resilience, as is the case of this study.

On the other hand, network-level resilience can be considered as resilience at the GVC level. It is influenced by external environments, such as social, economic, policy, technological or cultural ones. These environments have a behavioural impact which in turn impacts organizational resilience and the overall resilience of GVC (Fowler et al, 2023). Therefore, the following three determining factors of resilience at the network-level were identified.

Firstly, Al-Shboul (2017) identifies supply chain agility as one of the determinants of resilience on the network-level as well as one of the key competitive advantages of firms operating in GVCs. It allows firms to respond swiftly to shifts in markets and other turbulences in this way allowing them to reach superior position. Agility on the chain level enables firms to improve performance as well as customer service as the competition is not only between individual firms but also between networks such as GVCs, therefore it is important for GVCs to maintain the level of agility by aligning with partners, suppliers and customers (Mehralian et al, 2015). Agile response is characterized by product variety, order configuration, size and number of them to handle as well as other dimensions, therefore GVC agility allows to meet the needs of customers in timely and cost-effective manner (Al-Shboul, 2017) and it provides firms opportunities to customize products at the time of production (Matawale et al, 2016). Therefore, agility on the chain level provides mutual understanding between members of the network.

Secondly, supply chain collaboration is defined as “two or more autonomous firms working together to plan and implement supply chain operations” (Panahifar et al., 2018). Collaboration is crucial for those firms that desire to increase their profits as it generates generous benefits (Dyer, Singh & Hesterly, 2018). It is also indicated that collaboration enables flexibility which allows better chance in adaptive situations and reduces the costs of the latter (Baah et al, 2022). Collaboration within the GVC allows the firms to manage firms more coherently at the face of disruptions (Bag & Rahman, 2023), which enables the exchange of information, cooperative mitigation, shared problem solving within the firms in order to minimize the impact of the disruption (Singh, 2025). It also encompasses sharing of information in between other network partners, such as manufacturers, suppliers, retailers or distributors (Cao et al, 2010). What is more, it is argued that collaboration is a strategic asset which enables operational efficiencies (Bag and Rahman, 2023).

The third network-level factor of resilience in GVCs is identified as supply chain flexibility. It is considered as a capacity of the supply chain to adapt their operations as a response to unexpected disruptive events. The flexibility of GVCs reached its peak during the last five years, highlighting its relevance in timely response to unexpected disruptions and shifting conditions within the markets. Flexibility in this context allows a timely change of suppliers, modification of manufacturing techniques of trade routes in order to cater to the fluctuated needs of the market in the time of disruptions (Singh, 2025). Flexibility on the chain level allows the network to quickly change their operations in response to unexpected disruptions, enabling continuity of operations (Kamalahmadi et al., 2022).

The logic of the introduced conceptual model is based on the notion that firm- and network-level factors influence the adoption of complementarities by firms operating in GVCs. The successful adoption of the complementarities often depends on the level of dynamic capabilities within the firm. In this way, if complementarities are successfully adopted by firms operating in GVCs, they in turn affect network-level factors of resilience, contributing to the resilience outcomes, which highlights the importance of integrating complementarities into resilience enhancing processes. To sum up, firms operating in GVCs generate resilience indirectly through complementarities as they enable the emergence of network-level capabilities, which in turn drive resilience outcomes.

We argue that complementarities serve as a key mediating mechanism. Specifically, firm-level factors such as flexibility, efficiency, capacity, knowledge sharing, and digital capabilities do not directly generate resilience. Instead, they enable the joint and mutually reinforcing use of resources and capabilities across firms, i.e., complementarities. These complementarities, in turn, facilitate the emergence of network-level characteristics, such as supply chain agility, collaboration, and flexibility.

It is these network-level factors that ultimately determine resilience outcomes. Therefore, resilience in GVCs is best understood as the outcome of a sequential process in which firm-level capabilities are transformed into network-level resilience through complementarities.

Discussion

This study adopts an ecosystem perspective to explain how firm-level factors translate into resilience outcomes in firms operating in GVCs. While prior research has identified various firm-level determinants of resilience, the mechanisms through which these factors operate across interdependent actors remain underexplored. The findings of the study showed that the proposed framework aligns with previous studies on ecosystems perspective on resilience of firms operating in GVCs, suggesting relevance of the field, however the literature about the phenomena is still scarce. The key insight of the study is that firms operating in GVCs can successfully enhance the level of resilience through firm- and network-level factors of resilience in the form of dynamic capabilities incorporating complementarities stemming from ecosystem theory which serve as a key mediating mechanism.

Prior research (Castaneda-Navarrete et al, 2020; Shi & Mena, 2021; Shin & Park, 2021) focused on resilience of firms in GVCs within the boundaries of GVCs, while complementarity perspective allows structural context that extends beyond the boundaries of the GVC itself, underpinning its operational effectiveness. What is more, it underscores the necessity for the supply chain to engage with the broader community to ensure long-term viability and resilience (Pimenta et al, 2022). The study contributes to the emergent theoretical framework that combines complementarities with resilience of firms operating in GVCs.

With respect to firm-level factors of resilience in GVCs, flexibility, capacity and efficiency serve as crucial dynamic capabilities for enhancing resilience on the firm level (Chowdhury & Quaddus, 2017; Pettit et al, 2013). What is more, findings by Teece et al (1997) confirm that knowledge sharing is a major determinant to resilience of the firm and is one of the keys for surviving in dynamic and disruptive environments. Considering the rapidly evolving technological advances, findings by Ivanov & Dolgui (2020) and Ivanov et al (2021) confirm the proposed theoretical framework, by evaluating reaction and recovery times of firms in GVCs with high digital capabilities. The network-level factors of resilience in GVCs were also identified and emphasised in the study. The previous studies (Al-Shboul, 2017; Singh, 2025) identified agility, collaboration and flexibility on the chain level as important determining factors of resilience allowing coherent management, cooperative mitigation, shared problem solving to minimise the impact of disruptions, supporting the proposed theoretic framework.

Importantly, while firms operating in GVCs grasp increasing resilience, ecosystem theory perspective suggests enhancing resilience by providing complementarities. Complementarities pertain a strategic position in the focal value creation for an ecosystem and make a significant impact on the success and overall survival of the ecosystem (Carst & Hu, 2023). What is more, Mollenkopf et al (2021) also address ecosystems as extension of the global value chain as they perform the facilitation of exchange of goods and services among firms that do not typically do so in GVCs, these firms are integrating resources for maintaining the necessary level of supply. Hence, the study shows resilience as a sequential process in which firm-level capabilities are transformed into network-level resilience through complementarities as a key mediating mechanism, that ultimately determine resilience outcomes.

Conclusions

This study emphasized the factors of resilience on both firm- and network-level and ecosystem theory perspective of complementarities as the central role for enhancing resilience of firms operating in GVCs. The findings suggest that ecosystem theory lense with the perspective of complementarities enhances resilience of firms operating in GVCs. The study highlights that firm-level factors of resilience in GVCs generate resilience indirectly through complementarities as they enable the emergence of network-level capabilities, which in turn drive resilience outcomes.

This research contributes to theory and practice. It encourages a shift from closing in GVCs and opening up for the ecosystems that the GVC, that they are operating in, are within. This research contributes to the literature by bridging the gap between GVCs and strategies of increasing their resilience. It provides a structured lense through which firms operating in GVCs and GVC orchestrators can better understand and employ the determining factors of resilience.

Firms operating in GVCs can use this model for assessing their capabilities and identifying the important aspects necessary for development. For example, recognizing lack of certain dynamic capability, the firm operating in GVCs may turn to their ecosystem partners to find a complementarity for it, in turn enhancing resilience. Additionally, firms may turn to an ecosystem partner which is not their GVC partner for a successful exchange of goods and services, in turn increasing the level of resilience.

Finally, the study has several limitations. Future research should empirically test the proposed conceptual model incorporating real-world data across different industries and regions in to validate the theoretical insights. What is more, longitudinal research could provide fruitful results in understanding the evolving nature of the identified determining factors of resilience as they are dynamic in nature.

REFERENCES

- Adner, R. & Kapoor, R. (2009). Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal*, 31(3), 306-333.
- Alkhatib, S., F. & Momani, R., S. (2023). Supply Chain Resilience and Operational Performance: The Role of Digital Technologies in Jordanian Manufacturing Firms. *Administrative Sciences*, 13(2), 40.
- AL-Shboul, M., A. (2017). Infrastructure framework and manufacturing supply chain agility: the role of delivery dependability and time to market. *Supply Chain Management An International Journal*, 22(2), 172-185.
- Ambulkar, S., Blackhurst, J. & Grawe S., J. (2015). Firm's Resilience to Supply Chain Disruptions: Scale Development and Empirical Examination. *Journal of Operations Management*, 33-34(1), 111-122.
- Azadegan, A. & Dooley, K. (2021). A Typology of Supply Network Resilience Strategies: Complex Collaborations in a Complex World. *Journal of Supply Chain Management*, 57(1), 17-26.
- Baah, C., Acquah, I., S., K. & Ofori, D. (2022). Exploring the influence of supply chain collaboration on supply chain visibility, stakeholder trust, environmental and financial performances: a partial least square approach. *Benchmarking An International Journal*, 29(1), 172–193.
- Bag, S. & Rahman, M., S. (2023). The role of capabilities in shaping sustainable supply chain flexibility and enhancing circular economy-target performance: an empirical study. *Supply Chain Management: An International Journal*, 28(1), 162–178.
- Burgel, T., R., Hiebl, M., R., W. & Pielsticker, D., I. (2023). Digitalization and Entrepreneurial Firms' Resilience to Pandemic Crises: Evidence from COVID-19 and the German Mittelstand. *Technological Forecasting and Social Change*, 168, 122135.

- Cao, M., Vonderembse, M., A., Zhang, Q. & Ragu-Nathan, T., S. (2010). Supply chain collaboration: Conceptualisation and instrument development. *International Journal of Production Research*, 48(22), 6613 – 6635.
- Carst, A., E. & Hu, Y. (2023). Complementors as ecosystem actors: a systematic review. *Management Review Quarterly*, 74(4), 579–2635.
- Castañeda-Navarrete, J., Hauge, J. & López-Gómez, C. (2020). COVID-19's impacts on global value chains, as seen in the apparel industry. *Development Policy Review*, 39(6), 953-970
- Cennamo, C. & Santalo, J. (2019). Generativity Tension and Value Creation in Platform Ecosystems. *Organization Science*, 30(3), 617–641.
- Chowdhury, M., H. & Quaddus, M. (2017). Supply chain resilience: Conceptualization and scale development using dynamic capability theory. *International Journal of Production Economics*, 188(C), 185-204.
- Christopher, M. & Peck, H. (2004). Building the resilient supply chain. *The International Journal of Logistics Management*, 15(2), 1–14.
- Doh, J., Rodrigues, S., Saka-Helmhout, A. & Makhija, M. (2017). International business responses to institutional voids. *Journal of International Business Studies*, 48, 293-307.
- Duclos, L., Vokurka, R. & Lummus, R. (2003). A Conceptual Model of Supply Chain Flexibility. *Industrial Management and Data Systems*, 103, 446-456.
- Dyer, J., H., Singh, H. & Hesterly, W. (2018). The Relational View Revisited: A Dynamic Perspective on Value Creation and Value Capture. *Strategic Management Journal*, 39(12), 3140-3162.
- Fowler, D., S., Epiphaniou, G., Higgins, M., D. & Maple, C. (2023). Aspects of resilience for smart manufacturing systems. *Strategic Change*, 32(6), 183-193.
- Frank, A., G., Dalenogare, L & Ayala, N., F. (2019). Industry 4.0 technologies: Implementation patterns in manufacturing companies. *International Journal of Production Economics*, 210(3), 15-26.
- Gawer, A. & Cusumano, M., A. (2014). Industry Platforms and Ecosystem Innovation. *Journal of Product Innovation Management*, 31(3), 417-433.
- Holste, J., S. & Fields, D. (2010). Trust and tacit knowledge sharing and use. *Journal of Knowledge Management* 14(1), 128-140.
- Hsu, I-C. (2008). Knowledge sharing practices as a facilitating factor for improving organizational performance through human capital: A preliminary test. *Expert Systems with Applications*, 35(3), 1316-1326.
- Huang, Q., Davidson, R., M. & Gu, J. (2008). Impact of personal and cultural factors on knowledge sharing in China. *Asia Pacific Journal of Management*, 25(3), 451-471.
- Issa, A., Hatiboglu, B., Bildstein, A. & Bauernhansl, T. (2018). Industrie 4.0 roadmap: Framework for digital transformation based on the concepts of capability maturity and alignment. *Procedia CIRP*, 72, 973-978.
- Ivanov, D., & Dolgui, A. (2020). Viability of Intertwined Supply Networks: Extending the Supply Chain Resilience Angles towards Survivability. A Position Paper Motivated by COVID-19 Outbreak. *International Journal of Production Research*, 58, 2904-2915.
- Ivanov, D., Blackhurst, J. & Das, A. (2021). Supply chain resilience and its interplay with digital technologies: making innovations work in emergency situations. *International journal of physical distribution & logistics management*, 51(2), 97-103.
- Jacobides, M., G., Cennamo, C. & Gawer, A. (2018). Towards a Theory of Ecosystems. *Strategic Management Journal*, 39(8), 2255-2276.
- Kamalahmadi, M., Shekarian, M. & Parasat, M. (2022). The impact of flexibility and redundancy on improving supply chain resilience to disruptions. *International Journal of Production Research*, 60(2), 1-29.
- Kapoor, R. & Agarwal, S. (2017). Sustaining Superior Performance in Business Ecosystems: Evidence from Application Software Developers in the iOS and Android Smartphone Ecosystems. *Organization Science*, 28(3), 531-551.
- Kapoor, R. (2018). Ecosystems: broadening the locus of value creation. *Journal of Organization Design*, 7(1), 1-16.
- Kim, Y., Chen, Y., S. & Linderman, K. (2015). Supply network disruption and resilience: A network structural perspective. *Journal of Operations Management*, 33-34(1), 43–59.

- Kubacki, K., Szablewska, N., Siemieniako, D. & Brennan, L. (2024). Vulnerability, resilience and empowerment: the tripartite typology for addressing modern slavery in global value chains. *Critical Perspectives on International Business*, 20(5), 561–588.
- Legenvre, H., Hameri, A.-P. & Golini, R. (2022). Ecosystems and supply chains: How do they differ and relate. *Digital Business*, 2(2), 100029.
- Lin, Y., Chen, A., Zhong, S., Giannikas, V., Lomas, C. & Worth, T. (2023). Service supply chain resilience: a social-ecological perspective on last-mile delivery operations. *International Journal of Operations & Production Management*, 43, 140-165.
- Matawale, C., R., Datta, S., & Mahapatra, S. (2016). Supplier selection in agile supply chain: Application potential of FMLMCDM approach in comparison with Fuzzy-TOPSIS and Fuzzy-MOORA. *Benchmarking: An International Journal*, 23(7), 2027–2060.
- McAdam, R., Moffett, S., & Peng, J. (2012). Knowledge sharing in Chinese service organizations: a multi case cultural perspective. *Journal of Knowledge Management*, 16(1), 129-147.
- Mehralian, G., Zarenezhad, F. & Ghatari, A., R. (2015). Developing a model for an agile supply chain in pharmaceutical industry. *International Journal of Pharmaceutical and Healthcare Marketing*, 9(1), 74-91
- Melnyk, S., A., Closs, D., J., Griffiths, E., E., Zobel, C., W. & Macdonald, J., R. (2014). Understanding Supply Chain Resilience. *Supply Chain Management Review*, 18(1), 34-41.
- Mishra, R., Singh, R., & Subramanian, N. (2021). Impact of disruptions in agri-food supply chain due to COVID-19 pandemic: Contextualized resilience framework to achieve operational excellence. *The international Journal of Logistics Management*, 33(3), 926-954.
- Mohammed, A., Jabbour, A. B. L. de S., & Diabat, A. (2023). COVID-19 pandemic disruption: a matter of building companies' internal and external resilience. *International Journal of Production Research*, 61(8), 2716–2737.
- Mollenkopf, D., A., Ozanne, L., K., & Stolze, H., J. (2021). A Transformative Supply Chain Response to COVID-19. *Journal of Service Management*, 32, 190-202.
- Naumann, C. (2017). Entrepreneurial mindset: A synthetic literature review. *Entrepreneurial Business and Economics Review*, 5(3), 149–172.
- OECD (2025). OECD Supply Chain Resilience Review: Navigating Risks. [Accessed 28.02.2026]. Available from Internet: https://www.oecd.org/content/dam/oecd/en/publications/reports/2025/06/oecd-supply-chain-resilience-review_9930d256/94e3a8ea-en.pdf
- Panahifar, F., Byrne, P., Salam, M., A. & Heavey, C. (2018). Supply chain collaboration and firm's performance: The critical role of information sharing and trust. *Journal of Enterprise Information Management*, 31(3), 358–379.
- Pettit, T., J., Croxton, K., L. & Fiksel, J. (2013), Ensuring Supply Chain Resilience: Development and Implementation of an Assessment Tool. *Journal of Business Logistics*, 34(1), 46-76.
- Pimenta, M., L., Cenzarino, L., O., Piato, E., L., da Silva, C., H., P., Oliveira, B., G. & Liboni, L., B. (2022). Supply chain resilience in a Covid-19 scenario: Mapping capabilities in a systemic framework. *Sustainable Production and Consumption*, 29, 649-656.
- Raj, A., Mukherjee, A., A., Lopes de Sousa Jabbour, A., B. & Srivastava, S., K. (2022). Supply chain management during and post-COVID-19 pandemic: Mitigation strategies and practical lessons learned. *Journal of Business Research*, 142, 1125-1139.
- Rice, J., B. & Caniato, F. (2003). Building a secure and resilient supply network. *Supply Chain Management Review*, 7(5), 22-30.
- Schmidt, M., C., Veile, J., W., Müller, J., M. & Voigt, K., I. (2021). Ecosystems 4.0: redesigning global value chains. *The International Journal of Logistics Management*, 32(4), 1124-1149.
- Shi, W. & Mena, C. (2021). Supply Chain Resilience Assessment With Financial Considerations: A Bayesian Network-Based Method. *IEEE Transactions on Engineering Management*, 70(6), 2241 – 2256.
- Shin, N. & Park, S. (2021). Supply chain leadership driven strategic resilience capabilities management: A leader-member exchange perspective. *Journal of Business Research*, 122, 1-13.

- Singh, R., H., Modgil, S. & Acharya, P. (2019). Assessment of Supply Chain Flexibility Using System Dynamics Modeling. *Global Journal of Flexible Systems Management*, 20(1), 39-63.
- Singh, R., K. (2024). Strengthening resilience in supply chains: the role of multi-layer flexibility, supply chain risks and environmental dynamism. *The International Journal of Logistics Management*, 35(6), 1807–1826.
- Singh, R., K. (2025). Measuring supply chain resilience performance: role of data analytics, collaboration and flexibility. *Measuring Business Excellence*, 29(1), 121–136.
- Singh, S., Kumar, R., Panchal, R. & Tiwari, M. K. (2020). Impact of COVID-19 on Logistics Systems and Disruptions in Food Supply Chain. *International Journal of Production Research*, 59(7), 1993-2008.
- Teece, D. J. (1997). Explicating Dynamic Capabilities: The Nature and Microfoundations of (Sustainable) Enterprise Performance. *Strategic Management Journal*, 28(13), 1319-1350.
- Teece, D., J. (2018). Business models and dynamic capabilities. *Long Range Planning*, 51(1), 40-49.
- Teece, D., J., Pisano, G. & Shuen, A. (1997). Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, 18(7), 509-533.
- Thun, E., Taglioni, D, Sturgeon, T., J. & Dallas, M., P. (2025). Massive Modular Ecosystems. A Framework for Understanding Complex Industries in the Digital Age. *Policy Research Working Paper Series*, 11106.
- Wang, Z. & Wang, N. (2012). Knowledge sharing, innovation and firm performance. *Expert Systems with Applications*, 39(10), 8899-8908.
- Wang, Z., Sharma, P., N. & Cao, J. (2016). From knowledge sharing to firm performance: A predictive model comparison. *Journal of Business Research*, 69(10), 4650-4658.
- Wang, Z., Wang, N. & Liang, H. (2014). Knowledge sharing, intellectual capital and firm performance. *Management Decision*, 52(2), 230–258.
- Zouari, D., Ruel, S., & Viale, L. (2021). Does Digitalizing the Supply Chain Contribute to Its Resilience? *International Journal of Physical Distribution & Logistics Management*, 51, 149-180.