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Supply Chain Resilience in the Face of Disruptions: Strategies for Business Continuity and Performance Optimization

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Supply chains are the lifeblood of global commerce, but they face an ever-increasing threat from disruptions, including natural disasters, geopolitical conflicts, and pandemics. This paper delves into the critical issue of supply chain resilience, examining strategies to fortify supply chains against unforeseen disturbances. Our research begins by defining supply chain resilience and its importance in maintaining operational continuity and customer satisfaction. We explore the dimensions of supply chain resilience, from the identification of vulnerabilities and risk assessment to response and recovery mechanisms. The paper highlights the pivotal role of technology, data analytics, and innovative practices in enhancing supply chain resilience. It provides a comprehensive review of existing tools, methodologies, and best practices, while also proposing novel approaches that integrate artificial intelligence and blockchain for real-time monitoring, risk prediction, and adaptive decision-making. We discuss the implications for managers, policy makers, and practitioners, emphasizing the need for proactive measures, collaboration, and continuous improvement to build agile and robust supply chains that can weather the storms of an unpredictable world. Our contribution to the discourse on supply chain resilience provides valuable insights for those seeking to safeguard supply chains and uphold the efficient flow of goods and services, even in the face of turbulent disruptions.
Keywords: supply chain resilience; measurement of resilience; supply chain disruption; risk assessment; strategies

1. Introduction

In an increasingly interconnected world, supply chains serve as the intricate circulatory system of global commerce. They facilitate the seamless flow of goods and services across borders, continents, and industries, underpinning economic stability and prosperity. However, this remarkable interconnectedness comes at a cost - supply chains are vulnerable to a wide range of disruptions. These disruptions, whether caused by natural disasters, geopolitical conflicts, pandemics, or other unforeseen events, have the potential to reverberate through the global economy, with far-reaching consequences for businesses and consumers alike. As the frequency and intensity of such disruptions continue to rise, the need for robust supply chain resilience has never been more critical.

1.1 The Imperative of Supply Chain Resilience:

Over the last two decades, we have witnessed an increasing prevalence of disruptions, each more challenging than the last. Natural disasters like earthquakes, hurricanes, and floods have wreaked havoc on supply chains, disrupting manufacturing operations and transportation networks. Geopolitical tensions and trade disputes have introduced uncertainty and volatility, leading to disruptions in the flow of goods and materials. The COVID-19 pandemic, an event of truly global scale, exposed vulnerabilities in supply chains, as lockdowns, travel restrictions, and labor shortages disrupted production, transportation, and distribution on an unprecedented level. These disruptions have inflicted substantial economic damage. Deloitte estimates that in 2020, the global cost of supply chain disruptions amounted to an astonishing $5 trillion, with businesses in almost every sector feeling the impact. These events make one fact abundantly clear: the ability to withstand, adapt to, and recover from such disruptions is paramount for business survival and success.

- The Fragility of Modern Supply Chains

The vulnerabilities of modern supply chains are rooted in their complexity and interdependence. Supply chains have evolved into intricate networks that span the globe, involving numerous stakeholders, including suppliers, manufacturers, logistics providers, and retailers. While this complexity allows for efficiency and cost-effectiveness, it also introduces points of failure. A disruption in one region or by a single supplier can trigger a domino effect, with repercussions felt across the entire supply chain. This fragility amplifies the need for supply chain resilience.

- The Competitive Advantage of Resilience

In a world where disruptions are no longer outliers but expected events, resilience is not merely a safeguard; it is a strategic advantage. Businesses that proactively invest in supply chain resilience measures are not only better equipped to weather disruptions but can also gain a competitive edge. Resilient supply chains are agile, adaptive, and better prepared to respond to change. They maintain customer satisfaction and confidence, uphold brand reputation, and position themselves to capture market share when others falter. The ability to deliver goods and services without interruption can differentiate a business and drive customer loyalty in an age where reliability is paramount.

The paper is organized into the following sections to comprehensively address the topic in which section 1 discuss the introduction about SCR. Section 2 discuss the methodology &

- The Approach to Supply Chain Resilience

Supply chain resilience is a multidimensional concept. It encompasses not only the ability to withstand and recover from disruptions but also the capacity to adapt and continuously improve in the face of changing circumstances. A resilient supply chain identifies vulnerabilities, assesses risks, and employs strategies to mitigate and manage disruptions. It embraces innovative technologies, data-driven decision-making, and collaboration with partners to build an ecosystem of resilience. Technology plays a pivotal role in enhancing supply chain resilience. From real-time monitoring systems to data analytics and artificial intelligence, technological solutions offer the ability to foresee disruptions and adapt swiftly to changing conditions. Innovative tools, such as blockchain, can provide end-to-end visibility, transparency, and traceability within the supply chain, reducing the risk of counterfeit products and enhancing security.

Collaboration and information sharing are fundamental components of resilient supply chains. Businesses, governments, and non-governmental organizations must work together to develop strategies for risk mitigation, crisis response, and recovery. The sharing of best practices, risk information, and situational awareness can strengthen the collective ability to adapt and recover in the face of disruptions.

2. Resiliences Methods And Recovery Strategies

In order to effectively recover from a supply chain disruption, it is imperative for a firm to implement efficient strategies (Blackhurst et al., 2005). Based on existing scholarly sources, it is recommended that managers address incidents by adhering to a three-stage response process. Initially, they should ascertain the extent of the disruption, followed by the development or selection of a pre-established recovery approach to address the disruption. Finally, the chosen solution should be implemented (Chopra and Sodhi 2014). Numerous literature reviews have provided comprehensive accounts of the many stages, tactics, and techniques employed by firms in response to and recovery from disruptions (Dolgui et al., 2018; DuHadway et al., 2019; Ivanov, 2020b; Ivanov et al., 2017; Sawik, 2019).

The idea of resilience encompasses both resistance, which involves a proactive approach, and recovery, which involves a reactive approach, as discussed in the literature (Chowdhury and Quaddus, 2017; Dolgui et al., 2018). In order to mitigate the effects of interruptions, it is imperative for a firm to uphold redundancy through the implementation of high safety-stock and additional production capacity. Additionally, the firm should prioritize flexibility by establishing alternate suppliers for sourcing and alternative transportation depots and modes for delivery. By doing so, the firm can effectively withstand disturbances and leverage them to minimize their impact. Similarly, the recovery phase involves employing certain strategies that are akin to those employed in the resistance strategy. These strategies include utilizing alternative suppliers to procure resources, maintaining a buffer stock to fulfill client demands, and having redundancy capacity to ensure uninterrupted production (Ivanov et al., 2017).

Additional significant mitigation strategies for disruptive events center around improving demand forecasting (Scheibe and Blackhurst, 2018), enhancing coordination among supply chain echelons both prior to and following the disruption through the utilization of information-sharing mechanisms (Dubey et al., 2019abc), fostering collaborative relationship efforts, and achieving decision synchronization (Nakano and Lau, 2020) by implementing supply chain management software (e.g., warehouse and transport management systems and vendor managed inventories) integrated with enterprise resource planning (ERP) systems and supplementary business intelligence software add-ons (Brusset and Teller, 2017).

Nevertheless, according to survey data, companies frequently respond to disruptions by implementing strategies such as augmenting safety-stock levels, adopting dual or multi-sourcing approaches, and enhancing forecasting capabilities. The authors Scheibe and Blackhurst (2018) argue that while coordination between supply chain (SC) nodes is considered crucial for recovering from disruptions, in practice, these nodes tend to operate independently. Their understanding of the SC is limited to one tier above and one tier below. The lack of collaboration and response has been identified as a significant vulnerability in various studies (Pettit et al., 2013). According to Blackhurst et al. (2005), the implementation of real-time supply-chain reconfiguration software has the potential to enhance responsiveness in specific situations. This software can improve coordination and decision-making by recalculating optimal routes and facility selection, thereby maximizing demand fulfillment and minimizing penalties and delay costs resulting from disruptions (Banomyong et al., 2019).

One illustrative instance of the backup sourcing recovery option can be observed in the case of the fire incident that occurred at the Philips semiconductor plant in Albuquerque. Ericson saw a cessation of production due to its reliance on getting materials exclusively from a single factory. In contrast, Nokia effectively utilized its emergency backup sourcing strategy to procure chips from alternative vendors (Chen and Yang, 2014). The BASF example illustrates a robust design of a supply chain that emphasizes flexibility. BASF constructed a robust supply chain (SC) that incorporated safety and risk mitigation measures, encompassing internationally recognized rules and mandates for capacity and security training of personnel. In the year 2016, an explosion occurred at a pipeline located within the BASF facility in Germany. This incident resulted in the destruction of a terminal that was responsible for the provision of essential raw materials, consequently restricting the availability of such commodities and product inventories. During this period, there was a temporary shift in logistical operations from utilizing ships and pipelines to relying on trucks and trains. According to Dolgui et al. (2018), BASF had taken proactive measures to anticipate and address any potential incidents. The company maintained regular communication with its customers to provide updates on the availability of products, thereby mitigating the impact on customer deliveries. Consequently, the economic consequences resulting from the accident were less severe than initially anticipated. An additional illustration highlighting the significance of flexibility is to the 2015 Nepal earthquake, wherein humanitarian groups encountered substantial impediments in the timely provision of relief assistance to the affected populace. The authors of the study conducted by Baharmand et al. (2019) recognized the need of establishing a versatile network, with the key variables contributing to its effectiveness being IT support, scheduling of fleets, and the amount of relief packages.

Organizations that are part of certain supply chains have the opportunity to employ practical evaluation instruments found in existing scholarly works to gauge their own supply chain resilience (Chowdhury and Quaddus, 2017; Pettit et al., 2013). This initial action serves to recognize their preparedness to counter and address disturbances, as well as comprehend areas in which they should strive for enhancement.

3. Model Approaches For SC Disruptions

The implementation of mitigation and recovery procedures is of great significance, and the incorporation of these "recovery strategies" typically involves the utilization of quantitative approaches (Ivanov et al., 2014a, b). These methods commonly assess the efficacy of each plan before its actual implementation. The anticipation of operational and disruption supply chain risks is primarily achieved through the utilization of quantitative analysis methods. These methods, which include mathematical optimization, simulation, and control theory, are employed to effectively manage risk, respond to disruptions, and stabilize the execution process. Furthermore, they are utilized to recover from and minimize the impact of deviations in the medium-term and long-term, as highlighted by Ivanov et al. (2017). Mathematical optimization utilizes algorithmic models to obtain optimal solutions. Simulations, on the other hand, are models that allow for the exploration of hypothetical possibilities. Control theory complements both approaches by offering analytical tools that are frequently employed to assess the dynamic performance of systems across time (Yang and Fan 2016).

In a more specific context, optimization models provide analytical solutions that enable the assessment of the effects of disruptions and the identification of resilient supply chain policies. These models have the capacity to integrate a wide range of characteristics and objectives, such as the minimizing of disruption cost. Mixed-integer programming (MIP) is a widely employed approach in the field of optimization for the purpose of modeling supply chain disruptions (Ivanov et al., 2017). Nevertheless, one significant drawback of optimization models lies in their inability to account for the dynamic characteristics of supply chains. For instance, disruptions are typically represented as static events without considering their duration or unpredictable impact. Consequently, these models heavily rely on numerous assumptions such as known demand and suppliers' reliability. In contrast, the utilization of stochastic programming modeling enables the incorporation of uncertainty by means of probability distributions that represent potential disruptive event scenarios. This approach facilitates the determination of optimal solutions by considering numerous objective functions (Sawik, 2014). Stochastic programming models involve the inclusion of a collection of discrete situations, each associated with a specific chance of occurrence. Probability distributions can be used to represent uncertainty in various aspects, such as demand, the impact of disruptions, and the costs associated with implementing reaction and recovery measures. Stochastic programming approaches have been employed to represent disruptions in supply chains (SC). However, the scenario-based approach utilized in stochastic programming introduces a significant increase in the number of variables and constraints, rendering the implementation and execution of these models challenging.

Simulation methods are considered to be more flexible compared to stochastic optimization models. This is because simulation methods are capable of replicating the behavior of a system and can accommodate a dynamic approach to randomness in disruption and recovery policies. Additionally, simulation methods are able to handle greater complexity by incorporating and managing multiple probabilistic scenarios for multiple variables simultaneously. They also incorporate the time dimension and have the ability to provide real-time analysis, as well as multiple results under each what-if scenario.

Simulation can also be utilized to augment the outcomes of optimization or serve as a technique for optimization based on simulation. Various simulation tools, including discrete-event simulation, system dynamics, agent-based modeling, optimization-based simulation, and graph theory-based simulation, have been utilized to depict and conceptualize the consequences of the ripple effect in supply chain disruptions (Ivanov et al., 2017), among other phenomena.

Control theory possesses the analytical capability to carry out system commands over a period of time and is utilized for the evaluation of potential dynamic performances of the system. The formulation of control models typically pertains to distinct operational hazards that serve as the primary control metrics, including demand fluctuation, degree of information sharing, and speed of convergence. These metrics are utilized to measure the performance of disruption recovery (Ivanov and Sokolov, 2019; Yang and Fan, 2016).

Graph theory is a prominent technique utilized in the examination of supply chain (SC) disruptions. This approach, exemplified by Bayesian networks and decision trees, employs mathematical structures to depict the interconnectedness of the SC. By leveraging predictions and decision scenarios, this modeling technique facilitates the representation of pairwise relations among entities within the SC (Hosseini and Ivanov, 2019).

Game theory, such as the Stackelberg game, is a form of mathematical modeling that examines the strategic interactions between rational decision-makers. In the context of supply chain disruptions, this approach considers the specific order in which decisions are made by decision-makers and explores the potential reactions that may arise in different circumstances.

Inventory theory is commonly employed in the modeling of supply chain disruptions. The design of resilient supply chains involves the utilization of well-known inventory models, including deterministic or stochastic optimization models. These models, such as economic order quantity models and periodic review models, play a crucial role in determining safety stock levels, optimal ordering quantities, and production quantities. Their primary objective is to minimize total costs by considering the trade-offs between inventory policies and disruption risks during both the design phase of resilient supply chains and the subsequent recovery period. The models can be classified as either two-echelon or multi-echelon models, depending on the size of the supply chain.

The publications under examination reveal a predominant utilization of optimization approaches, with a subsequent number of studies employing simulation techniques. Additionally, there are scholarly investigations that employ statistical analysis of database data or surveys, such as the study conducted by Brusset and Teller in 2017. Furthermore, some studies utilize graph theory, as exemplified by Nakatani et al. in 2018, or game theory, as demonstrated by Fang and Shou in 2015. Among the significant optimization methods employed in various studies, stochastic programming (Snoeck et al., 2019), mixed-integer programming (Amini and Li, 2011), and multi-objective programming (Teimuory et al., 2013) have been extensively utilized. The simulation techniques employed in this study encompass discrete-event simulation (Ivanov et al., 2017), system dynamics (Kochan et al., 2018), and agent-based modeling (Hou et al., 2018). Upon examining our collection of articles, it is evident that the papers have successfully devised quantitative analysis techniques to conceptualize the resilience, responsiveness, and recovery strategies. The appendix includes Table 5, which presents a selection of 10 articles that serve as examples of the diverse range of quantitative methods employed in the relevant literature. Each paper is accompanied by a concise explanation of the model's intended objective.

Quantitative techniques encompass a wide array of analytical methods that span from addressing individual, straightforward issues to tackling intricate and interconnected problems. The latter more accurately characterizes the necessity of supply chain modeling. Operations and supply chain managers have the ability to select from a range of quantitative techniques that are applicable to various areas of supply chain disruptions. By doing so, they may identify and implement an ideal or nearly optimal solution.

4. IT Tools For Resilience And Response To Disruptions

Combining modeling and digitization has led to the creation of practical solutions for enhancing SC resilience and real-time reaction to shocks. Several studies in our collection provide insightful insights on how digital technologies mitigate disruptive risks in the SC.

Initially, computerized planning systems like materials requirements planning, manufacturing resource planning, and enterprise resource planning (ERP) were used to schedule operations, reschedule during disruptions, and access enterprise data for informed decision-making, particularly during emergency interventions (Baryannis et al. 2019a, b). Furthermore, flexible manufacturing systems, automated guided vehicles, tracking and tracing technologies, RFID for inventory control, and GPS for efficient distribution are highly valued technologies.

The Internet of Things (IoT) advanced these technologies. The IOT is a dynamic network infrastructure that integrates interoperable physical devices (Things) like wireless sensors, smart devices, RFID chips, and GPS into the information network (Wi-Fi or data) for monitoring, reporting, and data exchange (Kranenburg 2008). The IOT can track and authenticate products and shipments, providing information on their location, storage condition, and arrival time. With augmented reality, the IOT merges the real and virtual worlds through a camera. Augmented reality in supply chains can improve navigation, reduce searching time for courier drivers, and provide real-time information to customers about product prices and stock availability. IoT and augmented reality technologies provide visibility and traceability for SC, alerting of potential disruptions, reducing uncertainty, and improving internal operations and collaboration (Ben-Daya, Hassini, & Bahroun, 2019).

Industry 4.0, 3D printing, big data analytics (BDA), and blockchain are emerging techniques that are rapidly integrating into business.

Industry 4.0 uses IOT to create a smart factory with internet-connected workstations, conveyors, and robotics that autonomously regulate and monitor product routes in the assembly line, allowing for customizable design (Katsaliaki and Mustafee 2019). Industry 4.0 offers customized goods manufacturing at mass production costs, with shorter lead times and improved capacity utilization.

Reduced cost risks and increased market flexibility and customer response result from tailored products and risk diversification (Ivanov et al. 2019). In contrast, 3D printing (additive manufacturing) creates objects from computer-aided designs by layering material. This production approach expands product offerings and disrupts standard SC configuration by manufacturing closer to customers and retailers. Shorter lead times and reduced demand risks from manufacturing closer to customers are key benefits of this technology (Ivanov et al. 2019), reducing disruptions.

Technology advancements have led to faster data generation from many sources and the development of storage, categorization, and analysis systems.

Statistical analysis and reliability improve with more data and elements to analyze. Predictive methods, combined with machine learning algorithms and AI, provide answers to complex questions and scenarios through prescriptive analytics (Gunasekaran et al. 2016; Chen and Zhang 2014). Big data analytics and machine learning enable value generation from huge data, providing firms with new competitive advantages (Chen et al. 2012). Improved SC data visibility and transparency can minimize information disruption risks, behavioral uncertainty, and demand risks through predictability, positively impacting resilience (Baryannis et al. 2019a, b; Brintrup et al. 2019).

Blockchain is a shared database of digital activities conducted by participating agents (Crosby et al. 2016). Blockchains can disrupt the management of supply chains, particularly in the area of supplier contracts. Blockchain technology in distributed contract collaboration platforms ensures information traceability and authenticity, while smart contracts digitally verify and enforce contract terms without third parties' involvement. Trackable and irreversible transactions validate transactions (Saberi et al. 2019). This marks a new era in SCs, addressing fraud and security threats (Wang et al. 2019).

Information technology can significantly mitigate the ripple effect. RFID can provide feedback control and SC event management systems can broadcast disturbances to other layers, assisting in scheduling revisions. Resilience360, a cloud-based analytics platform at DHL, manages disruption risks by mapping end-to-end SC partners, creating risk profiles, identifying critical hotspots, and alerting near-real-time about potential disruptions (Dolgui et al. 2018).

5. Research Implications

This finding has many ramifications for researchers. The profiling study offers an introduction to the area by highlighting key works. After 2004, papers on SC disruptions emerged, but the area has evolved rapidly, with several research examining the influence of response tactics on SC disruptions and risks during the past 15-20 years. This topic has not been over-researched, but rather has become more relevant because to the COVID19 epidemic and its global disruptions. Further study is needed to develop resilient strategies for many forms of disruptions, including new ones, using creative modeling techniques and digital technology. Several studies have examined SC disruptions and hazards, including Kleindorfer and Saad (2005), Tang (2006), Industry 4.0 (Ivanov et al. 2019), and blockchain (Saberi et al. 2019).

To account for the increasing frequency and intensity of SC disruptions (Zsidisin et al. 2016), we categorized them by type, impact, and occurrence, starting with catastrophic events and ending with infrastructural events with high occurrence but lower impact. Research on SC disruptions has focused on high-frequency, low-impact issues, but the pandemic has shifted focus, with several papers published in 2020 (Zsidisin et al. 2016; Ivanov 2020a; Queiroz et al. 2020).

Our work explored the ripple/snowball effect of localized disturbances, which influences downstream SC layers more than the bullwhip effect, which affects upstream SC. The ripple effect highlights the need for further research on SC disruptions, including models that encompass many echelons.

Das and Lashkari (2015) provide a quantitative analysis of SCs, including risk factors, impacts, mitigation measures, costs, rewards, and what-if scenarios for testing strategies. Optimization is the most common mathematical method for stochastic, mixed-integer, and multi-objective programming, while simulation techniques like system dynamics, discrete-event simulation, agent-based models, and Monte-Carlo simulations handle greater uncertainty and complexity. Our review papers highlight statistical analysis, graph theory, and game theory as modeling tools. Several models use cost to assess disruption impact and analyze the cost-benefit of mitigation or resilience measures.

To improve data promptness and accuracy, new digital solutions (e.g. IOT, BDA, machine learning) are being used to create real-time reconfigurable SC models based on past disruptions and knowledge. These trends necessitate new ideas and models for SCM and future research. Potential solutions for dynamic supply-chain models include Agent-based models, which use flexible networked software to align goals and processes (Blackhurst et al. 2005).

The research agenda for SC disruptions and ripple effects emphasizes the need for quantitative decision-making frameworks and the integration of new digital technologies like blockchain contracts. Behavioral analysis of managers interpreting automated knowledge highlights the need for training to address SC interruptions and enhance preparation. The study outlines numerous areas in the field that demand immediate inquiry by interested scholars. While humanitarian logistics research on disease outbreaks is extensive (Banomyong et al. 2019; Dubey et al. 2019abc), business research on pandemics is limited but growing rapidly (Ivanov 2020a). Special attention is needed for SC interruptions induced by pandemics like COVID19. Rapidly evolving lockdown, transport, and employee working conditions requirements require immediate evaluation and adaptation strategies to minimize disruptions in SCs.

6. Conclusion

IT professionals often create big data applications to enhance stakeholder value (Galetsi et al. 2019), leading to increased spending for IT infrastructure and BDA expertise (Galetsi et al. 2020). Investing in technology and information exchange improves SC visibility, trust, and resilience against disruptions (Dubey et al. 2019a,b,c; Kamalahmadi and Mellat-Parast 2016). The top administration of each firm should prioritize this, working with other SC tiers. Supply chains should prioritize TQM (total quality management) to increase resilience, as it is less expensive than problem resolution (Jabbarzadeh et al. 2018). Despite the inevitability of disruption, recovery policies should be prioritized regardless of the reason. To attain desired performance and stability, SC plans, inventory policies, and timetables must be adapted first by humans and then by computers (Ivanov et al. 2013). Disruptions become increasingly significant as SCs become more global and complicated. To create resilience, consider long-term collaborations, flexible government policies, a business continuity-focused IT approach, and a culture of contingency ready (Wright 2013).

References

1. Rana, N., & Dwivedi, Y. K. (2019). Investigating the impact of personalized e-mails on trust and distrust. Journal of Retailing and Consumer Services, 49, 75-85.

2. Zhang, J., & Zhang, Y. (2018). Ethical implications of marketing personalization: A demand and supply perspective. Journal of the Association for Information Science and Technology, 69(2), 152-166.
3. Cui, G., & Liu, Q. (2016). A dual perspective of trust in online marketing. Information & Management, 53(1), 3-11.
4. Teixeira, R., Patrício, L., & Nunes, N. J. (2021). The unintended consequences of AI-powered services in marketing. Journal of Service Research, 24(3), 355-372.
5. Lim, J., & Lee, K. C. (2019). Ethical considerations of AI and personalized marketing. IEEE Technology and Society Magazine, 38(4), 57-65.
6. Zhang, H., Fang, Y., Wei, K. K., Ramsey, E., McCole, P., & Chen, H. (2019). Repurchase intention in online retailing: The effects of trust and perceived risk. International Journal of Information Management, 45, 145-153.
7. Elahi, S., Almas, A., & Hu, J. (2018). Antecedents of online brand trust: The role of personalization, customer satisfaction, and the mediating effect of customer loyalty. Journal of Marketing Analytics, 6(2), 127-138.
8. Roche, E. F., Zutshi, A., Motta, M., & de Ochoa, F. (2017). Personal data privacy in the age of IoT and big data: A roadmap for research. Computer Standards & Interfaces, 50, 1-8.
9. Brodie, R. J., Ilic, A., Juric, B., & Hollebeek, L. (2019). Consumer engagement in a virtual brand community: An exploratory analysis. Journal of Business Research, 99, 252-260.
10. Chang, S., Cheng, C. C., & Teng, C. I. (2017). An empirical study of relationship quality in B2B brand attachment, brand trust, and brand performance. Industrial Marketing Management, 62, 62-74.