

Impact of Disruptive Innovations on Supply Chain Coordination, Robustness, and Logistics Performance: A Study of Korean Automotive Industry

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ABSTRACT

Disruptive innovation helps develop new trends, including the Internet of Things, artificial intelligence, and block chain technology, which influence supply chain management. This research proposes a conceptual framework to assess the relationship between cause and effect of the concept of disruptive innovation, supply chain coordination, supply chain robustness, and the variable of logistics performance within the Korean automotive sector. Through a comprehensive analysis of the literature and theoretical reasoning, this study confirms that: 1) disruptive innovation has a positive relationship with supply chain coordination, which helps achieve coordinated sharing of real-time information in various organizations; 2) disruptive innovation has a positive relationship with supply chain robustness, which helps in anticipation and response to disruption; 3) supply chain coordination has a positive relationship with logistics performance, which helps in efficiency and cost reduction; and 4) supply chain robustness has a positive relationship with logistics performance, which helps ensure the continuum without any barriers. The findings of the research have implications for managerial, theoretical, policy, and society-wide perspectives. However, the research has several limitations, such as focusing on the Korean automotive sector; future studies should empirically validate the dynamic concept of disruption across various sectors.

Keywords: *disruptive innovation, korean automotive industry, logistics performance, supply chain coordination, supply chain robustness*

1. INTRODUCTION

The automotive industry played a pivotal role in the 20th century as it helped to catalyze global economic growth and scientific progress (Sturgeon *et al.*, 2008). Nevertheless, disruptively innovative technologies, such as electric vehicles, self-driving cars, and connected car technologies, spark radical changes across the automotive market, forcing companies to overhaul their business

models and supply chain tactics (Gao *et al.*, 2016). Considering that the Korean automotive industry has been known for its rapid growth and scientific achievements, lessons drawn from analyzing the impact of disruptive technologies on supply chain coordination, resilience, and logistics performance will be of paramount importance for further research (Lee *et al.*, 2023).

Specifically, the market described was characterized by high concentration, as Hyundai Motor Group and Kia Motors controlled a large share of the global market importance, and hence the economy of the country (Kim and Park, 2021). These companies were able to leverage the power of purchaser-supplier coalitions to facilitate economies of scale, invest in R&D, and build strong buyer-supplier links (Jun *et al.*, 2022). The state coherently furthered these tendencies by developing governmental policies, providing tax breaks, and creating supportive infrastructure (Lee and Mah, 2017).

Given that Korean automakers are leading the wave of disruptive innovations—specifically, in the very areas of electric vehicles and connected car technologies in Korea, which are now becoming the standards in the automotive industry (Kim *et al.*, 2018). However, they are also struggling with critical disruptors—notably, supply chain coordination and resilience. Indeed, the transition to EVs requires the total reimagining of the supply chain layout. At the same time, the growing complexity of connected car technologies necessitates much closer collaboration between automakers, suppliers, and tech partners (Jun *et al.*, 2022).

Thus, this research seeks to address the following question: how do disruptive innovations affect supply chain coordination, resilience, and logistics performance in the Korean automotive industry? By analyzing the particular strategies and approaches those Korean automakers and their chain partners adopted in response to the disruptors presented above, this study will make a significant contribution to understanding and ascertaining the digital transformation challenges and responses for the

contemporary automotive sector in countries such as South Korea.

2. LITERATURE REVIEW

2.1 Disruptive Innovation

Disruptive innovation is a concept introduced by Clayton Christensen to describe how leaner, smaller companies with fewer resources can challenge larger, incumbent businesses (Christensen *et al.*, 2015). Such innovations often target untouched market segments with inferior goods or services. However, they then continuously enhance their quality, performance, and cost-effectiveness, displacing incumbent large companies and transforming the industry (Christensen *et al.*, 2015).

Disruptive innovations appear in or create new market segments by offering new, sometimes technological solutions that change the ways value is delivered to customers in terms of affordability, accessibility, convenience, or simplicity (Guo *et al.*, 2020). Disruptive innovations are critical to the modern economy and to the ongoing evolution and transformation of supply chain management (Ivanov *et al.*, 2019). They have the potential to revolutionize practically every aspect of the supply chain, starting with product design and development, production, and logistics and ending with customer service (Guo *et al.*, 2020). By leveraging disruptive technologies, such as the Internet of Things (IoT), artificial intelligence (AI), and block chain, supply chain managers can significantly enhance visibility, agility, and efficiency and create new value propositions for customers, supporting sustainable growth and development (Ivanov *et al.*, 2019).

Furthermore, as Guo *et al.* (2020) conclude, disruptive innovations provide a unique framework for supply chain management and business model development. Disruptive innovations disrupt existing business processes, creating opportunities for the development of new ones. For instance, the rapid development of e-commerce and the spread of omni channel retailing have significantly disrupted traditional retail supply chains powered by physical stores and warehouses. Instead, businesses started to promote click-and-collect and same-day delivery strategies (Guo *et al.*, 2020).

Disruptive innovations also have a positive impact on the improvement of overall supply chain performance and enable high logistics efficiency (Ivanov *et al.*, 2019). Supply chain managers can implement automation, use data-driven approaches, and apply operations strategies to reduce costs and improve quality, increasing performance and customer satisfaction (Guo *et al.*, 2020).

2.2 Supply Chain Coordination

Supply chain coordination involves activities, processes, infrastructure, and decision-making among stakeholders such as suppliers, manufacturers, distributors, and retailers in the supply chain that focuses on the synchronization of their actions to achieve minimal costs, shorter lead times, improved quality, and maximum customer satisfaction (Kim and Lee, 2024). Coordination in the supply chain minimizes the bullwhip effect and curtails operational inefficiencies, and requires information sharing and alignment of incentives among all partners in the supply chain. This enables organizations to leverage a

collaborative approach to have agility in responding to fluctuations and disruptions while minimizing their working capital, by having control over inventory levels across the network.

This is achieved through enhanced collaboration, reliability, risk-sharing, and “using joint aims, metrics, and incentives” between the parties (Xu and Beamon, 2006). Coordination necessitates the sacrifice of the isolation that marks manufacturing and management thinking at various manufacturing levels to coordinated thinking and action. Effective coordination requires improved interaction, communication, and trust between various organizations and the utilization of appropriate technologies and procedures to facilitate the movement of information and materials (Xu and Beamon, 2006).

Coordination is vital for organizational excellence and competitiveness in the current global business environment, which is competitive and increasingly volatile (Arshinder *et al.*, 2008). Coordination helps reduce costs, increase customer value, and improve efficiency; it also reduces the supply chain's vulnerability to disruption.

It also helps to reduce the cause of the bullwhip effect, which is responsible for significantly increasing demand variability upstream in the supply chain (Lee *et al.*, 1997). By sharing information and aligning activities and decisions with supply chain partners, organizations can minimize the impact of the bullwhip effect, resulting in lower levels of inventory, fewer instances of stock outs, and better customer service (Lee *et al.*, 1997).

In this regard, supply chain coordination is a crucial aspect of modern supply chain success and sustainability. As long as they align activities, share information, and make decisions with supply chain partners, organizations can achieve important efficiencies, agility, and customer value improvements while minimizing risks and enabling innovation.

2.3 Supply Chain Robustness

According to Klibi *et al.* (2010), supply chain robustness means the supply chain's capability to continue functioning at the desired level of performance in the face of disruptions, uncertainties, and variabilities. This conceptual definition considers the ability of the supply chain to withstand the shocks caused by sudden and unpredicted events, such as natural disasters, supplier closure, fluctuations in demand rates, and delayed or restricted transport vehicles (Klibi *et al.*, 2010).

Supply chain robustness is achieved through risk management, which requires a systematic approach covering the entire network and the identification, assessment, and mitigation of the vulnerabilities and threats existing within it. This may involve diversification of suppliers and types of transportation, buffer inventory level, process standardization, and planning for potential failure (Wieland and Wallenburg, 2012). To achieve this robustness, organizations typically implement ongoing monitoring systems that deliver early warning indicators of possible disruptions around their networks. Digital technologies like block chain, IoT sensors, and AI-powered analytics that provide real-time visibility and predictive insights increasingly enhance these visibility capabilities.

Supply chain robustness is core to operations

management because it determines the extent to which organizations can deliver products or services to customers regularly and consistently in the face of disruption and uncertainty (Nguyen *et al.*, 2022). Considering the risks supply chains face today, including but not limited to natural disasters, political instability, the increasing rate of pandemics, cyber-attacks, and so on, it follows that supply chain robustness can have significant implications on a company's long-term competitiveness and sustainability. Moreover, it will reduce disruption's frequency and severity and diminish their consequences for their customers and stakeholders while speeding up and facilitating recovery-centered activities (Klibi *et al.*, 2010).

2.4 Logistics Performance

Logistics performance pertains to the efficiency and effectiveness of an organization's logistics processes, which include the various activities involved in planning, implementing, and controlling the flow and storage of goods, services, and related information from the point of origin to that of consumption (Mentzer *et al.*, 2001). Logistics performance is important to the overall supply chain as it affects cost, quality, and timeliness associated with product and service delivery to the customer (Lee and Ha, 2024).

Key indicators of logistics performance include transportation costs, inventory levels, order fill rate, lead time, and on-time delivery (Fugate *et al.*, 2010). To achieve the desired enhanced performance outcomes, ensure that the aforementioned indicators provide the maximum optimization by leveraging different strategies, including transportation management, inventory management, warehousing and distribution, and information technology integration (Fugate *et al.*, 2010).

It is critically important for an organization's competitiveness and profitability in the context of today's dynamics and globalization of business to logistics performance. Better logistics management helps organizations decrease costs, provide an improved quality of customer service, and acquire a strong market position (Mentzer *et al.*, 2001).

One of the most significant benefits of improved logistics performance is cost reduction. Transportation route optimization, less shipping consolidation, and less inventory may become the foundation for lower logistics costs and, therefore, better financial performance of organizations (Mentzer *et al.*, 2001). This cost advantage can be directly turned into competitive pricing strategies and higher profit margins, allowing organizations more leeway in positioning themselves within a market. Enhanced logistics performance results in better service levels, shortened order cycle times, increased delivery reliability, and ultimately enhanced customer satisfaction and loyalty.

Efficient logistics processes may also help to decrease the amount of waste, such as outdated inventory or damaged products, which may also contribute to lower costs. Along with this benefit of logistics performance, there is another crucial one—better customer service and satisfaction. Fast, reliable, and convenient delivery helps organizations to meet increasing demand (Fugate *et al.*, 2010).

3. HYPOTHESIS SETTING AND RESEARCH MODEL

3.1 Disruptive Innovation and Supply Chain Coordination

Disruptive innovations, like the IoT, AI, and block chain technology, “contribute to a much better supply chain coordination due, because they allow better sharing of information, improve visibility, and enable more effective cooperation between partners” (Ivanov *et al.*, 2019; Guo *et al.*, 2020).

These innovations can substantially overcome the significant challenges in gathering supply chain information—lack of real-time data, limited transparency, and information asymmetry between the supply chain stakeholders (Queiroz *et al.*, 2019), “as it ensures that the records of transactions are shared across chains of databases in a secure, tamper-proof, and verifiable way” (Kamble *et al.*, 2020).

As a specific example, IoT devices enable tracking and monitoring of inventory levels, production processes, and shipment status in real-time throughout the supply chain. As such, accurate demand forecasting, efficient resource allocation, and timely decision-making become possible (Guo *et al.*, 2020). AI-powered analytics can be used to optimize various processes in the supply chain and predict the risk of disruptions while recommending countermeasures to minimize risk and enhance coordination (Ivanov *et al.*, 2019). Finally, the use of block chain technology ensures that all transactions are decentralized and appended to a public ledger that cannot be manipulated.

This ensures that there is no risk of errors, fraud, or dispute. Furthermore, it promotes trust and collaboration between the involved stakeholders (Guo *et al.*, 2020). Therefore, through the mentioned examples, disruptive innovation is likely to have a positive effect on supply chain coordination.

H1: Disruptive innovation positively affects supply chain coordination.

3.2 Disruptive Innovation and Supply Chain Robustness

IoT, AI, and blockchain technology are disruptive innovations that can revolutionize the existing supply chain and thereby increase robustness. According to Ivanov and his colleagues and Guo and others (Ivanov *et al.*, 2019; Guo *et al.*, 2020), these technologies can enable organizations to better predict, endure, and recover from potential disturbances and uncertainty.

The technologies can help address various challenges for ensuring this SC property, such as lack of visibility, an incapacity to handle risk, and network susceptibility (Kamble *et al.*, 2020). This is achieved through real-time data, predictive analytics, and secure information flows, which enable the solution of problems with disruptive identifications and propensities and reduce disturbances (Queiroz *et al.*, 2019).

For instance, IoT sensors continuously monitor supply chain operations, equipment, and environmental conditions to enable rapid pre-emptive detection of disruptions, such as equipment failure, quality defects, or natural disasters

(Guo *et al.*, 2020). AI-supported risk management solutions use vast amounts of data from various sources to anticipate and evaluate probable instances of risk, proffer suitable mitigation factors, and enhance resource mobilization processes for effective risk containment (Ivanov *et al.*, 2019). Blockchain is used to maintain an immutable and transparent record of all transactions within the supply chain to allow rapid trace-back and isolation of disruptions, such as infected products and counterfeit parts (Kamble *et al.*, 2020).

Through these disruptive technologies, both organizations and scholars show that there is potential to develop these dimensions of supply chains and improve supply chain robustness, as the authors focus on.

H2: *Disruptive innovation positively affects supply chain robustness.*

3.3 Supply Chain Coordination and Logistics Performance

Coordination in the supply chain is another way through which proper alignment and synchronization of activities, processes, and decisions across the supply chain partners can help enhance logistics performance (Arshinder *et al.*, 2008; Xu and Beamon, 2006). According to Fungus *et al.* (2010), some of the most critical issues in logistics performance can be tackled through effective supply chain relationships. They include high transportation costs, excess levels of inventory, low order fill rates, extended lead times, and low on-time delivery (Arshinder *et al.*, 2008). Through promoting collaboration, information sharing, and joint decision-making, coordination can help organizations optimize their logistics processes to reduce inefficiencies, hence improving customer service.

For example, coordinated planning and forecasting could reduce the bullwhip effect, which can reduce product availability due to stock outs, excessive lead times, or periods of reduced order fill rates (Lee *et al.*, 1997). Collaborative transportation management could also enable shipment consolidation, optimal routing, and eventual reduction in transportation rates (Xu and Beamon, 2006). Coordinated inventory management through vendor-managed inventory could enhance inventory availability due to reduced lead times, probably gained through a reduction in the bullwhip effect.

Supply chain coordination enables partners to share the best practices, ideas, and available resources to enhance logistics performance; thus, it drives continuous improvement and innovation in logistics processes. The use of partners' shared knowledge enhances efficiency, flexibility, and responsiveness to their logistics operations (Xu and Beamon, 2006).

Therefore, supply chain coordination is likely to have a positive impact on logistics performance. It enables organizations to streamline their logistics processes and costs, improve customer support and service, and develop a competitive edge in the market.

H3: *Supply chain coordination positively affects logistics performance.*

3.4 Supply Chain Robustness and Logistics

Performance

To achieve high logistics performance, supply chains need to be robust, that is, to maintain functionality and performance in the face of disruptions, uncertainties, and variability (Klibi *et al.*, 2010; Wieland and Wallenburg, 2012). Robust supply chains are capable of handling disruptions and uncertainties that lead to disruptions, such as demand fluctuations, supply shortages, transportation delays, and natural disasters, without a substantial loss of efficiency, effectiveness, and customer service (Klibi *et al.*, 2010). Robustness can be achieved through investing in strategies and capabilities, such as flexibility, redundancy, and risk management, that enable supply chains and organizations to withstand and recover from disruptions with a minimal impact on logistics performance.

For example, a robust supply chain with flexible manufacturing and flexible distribution can adjust production and inventory levels in response to random or unexpected shifts in demand, reduce stock outs, and increase order fill rates (Klibi *et al.*, 2010). A robust supply chain with redundant transportation routes and alternative suppliers can mitigate disruptions, minimize delays in inbound transportation, and increase on-time delivery rates and customer satisfaction.

In addition, a strong supply chain reinforced by sound risk management could help identify and prevent possible risks, including supplier firm performance, quality concerns, or warehouse security breaches, to prevent significant interruptions to logistics activities. By reducing the magnitude and frequency of disruptions, organizations could improve logistics stabilization, performance, and efficiency (Klibi *et al.*, 2010).

Consequently, supply chain robustness may favor logistics performance by helping organizations sustain operations, reduce disruptions, and achieve logistics processes with a high level of efficiency, effectiveness, and customer service.

H4: *Supply chain robustness positively affects logistics performance.*

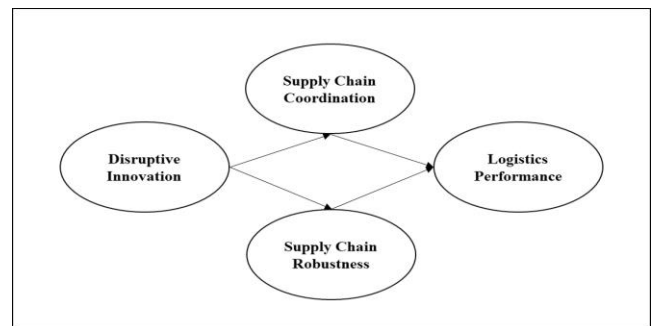


Figure 1 Research model

4. METHODOLOGY AND ANALYSIS

4.1 Methodology

To validate the research model, we conducted a preliminary survey evaluation of supply chain-related employees from February to March 2024. Based on their feedback, we finalized the questionnaire items, which were assessed using a seven-point Likert scale. The participants

in our empirical analysis were selected from employees working in supply chain-related departments within companies based in South Korea. Notably, our survey encompassed ten different industrial sectors, chosen based on export and import trend data provided by the South Korean Ministry of Trade, Industry, and Energy. The online survey was administered in April 2024, with a total of 2200 questionnaires distributed through a professional survey agency called Entrust Survey. We successfully obtained 300 complete surveys, which represents a relatively low effective response rate. This may be from the agency’s distribution method, where questionnaires are randomly sent to individuals employed at various companies. However, the survey was designed to filter out individuals not working in supply chain management departments, which contributed to the lower response rate. Despite this,

the study participants held adequate knowledge and expertise related to supply chain management.

This research employed a structural equation model, which is a statistical analysis technique allowing simultaneous examination of the structural relationships between multiple latent variables set according to the hypotheses, enabling the inference of the relevance between the constituent concepts. This approach enables the empirical analysis of complex relationships between latent variables based on the structural equation model, making it a suitable choice for this research.

4.2 Measurement of Variables

Table 1 shows the variables’ measurements.

Table 1 Measurement of variables

	Operational definition	References
Disruptive innovation	Technological Advancement: This dimension measures the extent to which new technologies are introduced and adopted within the industry, leading to significant improvements in products, services, or processes.	Christensen <i>et al.</i> , 2015, Nagy <i>et al.</i> , 2016
	Business Model Innovation: This dimension assesses the degree to which companies create and implement novel business models that disrupt existing market structures and value networks.	
	Market Impact: This dimension evaluates the extent to which disruptive innovations create new markets or reshape existing ones, leading to significant changes in customer behavior and market dynamics.	
	Organizational Agility: This dimension measures the ability of organizations to quickly adapt and respond to disruptive changes in the market, technology, or regulatory environment.	
Supply chain coordination	Information Sharing: This dimension assesses the extent to which supply chain partners exchange accurate, timely, and relevant information to facilitate collaborative decision-making and problem-solving.	Petersen <i>et al.</i> , 2005; Simatupang and Sridharan, 2005
	Goal Alignment: This dimension measures the degree to which supply chain partners share common objectives, strategies, and performance metrics, enabling them to work together towards mutually beneficial outcomes.	
	Joint Planning and Decision-Making: This dimension evaluates the extent to which supply chain partners engage in collaborative planning and decision-making processes, such as demand forecasting, inventory management, and capacity planning.	
	Incentive Alignment: This dimension assesses the degree to which supply chain partners design and implement incentive mechanisms that encourage collaboration, innovation, and continuous improvement.	
Supply chain robustness	Flexibility: This dimension measures the ability of a supply chain to adapt to changes in demand, supply, or other external factors without significant disruptions to its operations.	Chowdhury and Quaddus, 2017; Stevenson and Spring, 2007
	Redundancy: This dimension assesses the degree to which a supply chain has backup resources, such as inventory, capacity, or suppliers, to mitigate the impact of disruptions.	
	Visibility: This dimension evaluates the extent to which supply chain partners have access to timely and accurate information about the status of products, processes, and resources throughout the supply chain.	
	Collaboration: This dimension measures the degree to which supply chain partners work together to identify, assess, and mitigate risks, as well as to develop contingency plans and share resources during disruptions.	
Logistics performance	Cost Efficiency: This dimension assesses the ability of a logistics system to minimize costs associated with transportation, inventory, warehousing, and other logistics activities while maintaining desired service levels.	Fugate <i>et al.</i> , 2010; Govindan <i>et al.</i> , 2015
	Delivery Reliability: This dimension measures the extent to which a logistics system consistently delivers products or services to customers on time, in total, and without damage.	
	Responsiveness: This dimension evaluates the ability of a logistics system to quickly respond to changes in customer demand, market conditions, or other external factors.	
	Sustainability: This dimension assesses the degree to which a logistics system minimizes its environmental impact, such as carbon emissions, waste, and resource consumption, while also considering social and economic factors.	

4.3 Reliability and Validity

Reliability, also called accuracy, demonstrates how consistently the measurement target has been measured. It can be measured using several methods; however, Cronbach’s alpha value is typically used in the social sciences. Specifically, if Cronbach’s alpha value is 0.7 or higher, it has good reliability (Hair *et al.*, 2010). The study variables observed the following values: disruptive innovation=0.826, supply chain coordination=0.792, supply chain robustness=0.770, and logistics performance=0.829.

Table 2 Verification of reliability and convergent validity

	Cronbach's alpha	CR	AVE
Disruptive innovation	0.829	0.847	0.766
Supply chain coordination	0.817	0.842	0.761
Supply chain robustness	0.757	0.768	0.683
Logistics performance	0.788	0.762	0.680

Note. CR; Composite Reliability, AVE; average variance extracted.

Subsequently, to verify the validity of the causal relationships, a confirmatory factor analysis was conducted. The fit of the measurement model generally met the recommended criteria presented by Hair *et al.* (2010).

Moreover, the average variance extracted (AVE) values of all variables were 0.5 or higher, and the construct reliability values were 0.7 or higher, indicating that convergent validity was also secured. **Table 2** shows the results of the convergent validity and reliability verification for the study’s variables, and **Table 3** shows the fit of the measurement model.

Table 3 Fit of the measurement model for confirmatory factor analysis

CMIN/DF	TLI	CFI	IFI	RMSEA
1.412	0.902	0.911	0.924	0.052

Note. CMIN/DF; the chi-square/degree of freedom, TLI; Tucker Lewis Index, CFI; Comparative Fit Index, IFI; Incremental Fit Index, RMSEA; Root Mean Square of Error Approximation

By contrast, discriminant validity shows the difference between independent variables. Specifically, if the correlation between variables is low, each variable is considered a separate construct. The criterion for verifying this discriminant validity is satisfied when the AVE of each variable exceeds the squared value of the correlation coefficient between the two constructs. In this study model, the largest squared value of the correlation coefficient was 0.382, and the minimum value of AVE was 0.680. Therefore, discriminant validity was secured, and the related analysis results are shown in **Table 4**.

Table 4 Discriminant validity analysis results

	Disruptive innovation	Supply chain coordination	Supply chain robustness	Logistics performance
Disruptive innovation	0.766	-	-	-
Supply chain coordination	0.047	0.761	-	-
Supply chain robustness	0.382	0.218	0.683	-
Logistics performance	0.321	0.142	0.327	0.680

Note. Except for the diagonal, the values represent the squared correlation coefficients.

Table 5 Fit of the structural model for maximum likelihood

CMIN/DF	TLI	CFI	IFI	RMSEA
1.490	0.901	0.903	0.911	0.059

Note. CMIN/DF; the chi-square/degree of freedom, TLI; Tucker Lewis Index, CFI; Comparative Fit Index, IFI; Incremental Fit Index, RMSEA; Root Mean Square of Error Approximation

Table 6 Path analysis results

Hypothesis	Standard Coefficients	t-Values
H1	0.160	2.010***
H2	0.316	3.065**
H3	0.374	3.658***
H4	0.388	3.704***

** p<0.01, *** p<0.001

4.4 Research Model Verification

This study utilized the maximum likelihood method to verify the causal and correlational relationships between disruptive innovation, supply chain coordination, supply chain robustness, and logistics performance. The fit of the

structural model mostly satisfied the recommended values proposed by Hair *et al.* (2010). Accordingly, we analyzed the structural equation model and found that all hypotheses were accepted. **Table 5** shows the fit of the structural model, and **Table 6** shows the path analysis results.

5. DISCUSSION

From the above results and discussions, it can be concluded that disruptive innovation has a considerable positive impact on supply chain coordination. This impact has far-reaching implications for the automotive sector. To start with, it indicates that disruptive innovations are essential in facilitating collaboration among all stakeholders in the automotive supply chain. This finding is supported by previous research that has shown the transformative power of disruptive technology in boosting supply chain efficiency (Ghadge *et al.*, 2020; Ivanov *et al.*, 2019).

In addition, this finding identifies the need for automotive companies to adopt disruptive innovations. As the industry continues to be more complicated and uncertain, effective coordination is projected to become more than a performance driver to a performance

determinant (Belhadi *et al.*, 2021). Spending on disruptive technology and operations assists automotive companies in developing a more agile, responsive, and reliable supply chain (Oliveira and Handfield, 2019).

However, facilitating the integration of these innovations requires adequate planning, resource allocation, and management support. Additionally, automotive companies may need to develop dedicated strategies to promote continuous learning, innovation, and development (Gölgeci *et al.*, 2021).

Consequently, the adoption of H1 clearly communicates the need to incorporate disruptive technologies and disruptive processes to improve the coordination, performance, and resilience of the supply chain within the automotive industry. Conversely, the integration of these technologies becomes beneficial following the management's willingness to strategize and innovate and the commitment of the relevant actors to learn and adapt.

The usage of H2 also bears substantial policy measures for the automotive industry's supply chain. Therefore, the finding indicates that more radically disruptive technologies and processes can further improve the supply chain's ability to ensure and boost recovery from disruptions such as natural disasters, financial crises, and global pandemics (Belhadi *et al.*, 2021; Ivanov and Dolgui, 2020).

In summary, the disruptive innovation each demands that the auto manufacturers adopt an ensemble of H3, which makes the auto supply chains more resilient. Such disruptive innovations as Industry 4.0 technologies, big data analytics, and blockchain improve supply chain visibility, flexibility, and agility, which are the basic sufficient and more necessary and required conditions for a robust supply chain that changes prompt react in changing conditions while continuing its operation during disruption (Kamble *et al.*, 2020; Maheshwari *et al.*, 2021).

Furthermore, the automakers' adoption of H3 acted as a proxy for more of an end. In general, given that the auto service is more globalized and more interconnected, the spillover from disruption has increased as disruption has ever the potential to occur. Additionally, Disruptive development and practices can pave the way for a more robust chain capable of expecting, overcoming, and enduring disaster (Golan *et al.*, 2020). The reality that automakers rely on diverse suppliers, logistics providers, and other partners means that executives should follow a closely coordinated approach to ensure that disruptive technology is optimally coping throughout the whole supply chain network (Ralston and Blackhurst, 2020). Creating the most effective distribution plans, risk management policies, and improvement plans is a far superior method to improve the robustness of new chain development due to the restricted autonomy (Hosseini *et al.*, 2019; Ivanov *et al.*, 2019).

The third hypothesis also has important implications for the automotive industry. More specifically, the need for exceptional logistics performance highlights that effective coordination of supply chain partners is possible. The latter is only essential for meeting customer needs, cutting costs, and boosting competitiveness within and across industries (Raweewan and Ferrell, 2018; Wamba *et al.*, 2020).

Coordination refers to activities that should be synchronized, information sharing, and decisions that should be made jointly by all members of the supply chain (Ganbold *et al.*, 2020). Coordinated performance reduces inventory and lead times while boosting delivery reliability (Gonul Kochan *et al.*, 2018). For the automotive industry, logistics operations are extremely critical due to the global nature of supply chains and the high expectations of customers (Wamba and Queiroz, 2020).

However, while coordination is possible, it does not mean it can happen without the use of various models, systems, technologies, and formal and informal incentives that differ among partners' interests. While coordination can and should be achieved, its applicability is threatened by time-consuming and tasking problems such as low-trust issues, power, and goal divergence (Bag *et al.*, 2020; Um *et al.*, 2017). Furthermore, as illustrated in the EU context, the increasing dynamism and complexity of automotive supply chains also require partners to proceed flexibly while seeking new collaborative strategies (Büyüközkan and Göçer, 2018).

Therefore, the acceptance of H3 confirms the substantial impact of coordination on logistics in the automotive industry. Companies should constantly invest in technologies and processes that would streamline coordination and collaboration in their logistics in order to achieve maximum cost and logistics performance and maximum customer satisfaction.

The acceptance of H4 shows the significance of resilient SCM to disruptions and maintaining the intersection of logistics operations and performance in the automotive industry (Nezamoddini *et al.*, 2021; Ruel *et al.*, 2021). Robustness generally refers to one's ability or strength to remain intact, persist, or function in the face of disturbance or change (Ali *et al.*, 2017). Jabbarzadeh *et al.* (2018) and Rajesh (2021) define supply chain robustness as the supply chain's competence to withstand and adapt to disruptions. In the context of the highly integrated nature of automotive supply chains, the effect of supernormal payoff profile and high leverage is bound to be even harsher (Hosseini *et al.*, 2019; Ramezankhani *et al.*, 2018). Thus, companies in this industry should actively seek strategies and possess the necessary capabilities to enhance their supply chain's robustness. Potential options to improve supply chain robustness may include risk response plans, supply chain risk assessments, and planning, supplier diversification, sourcing the same supplier from various countries and using alternative transport routes, and adopting flexible business models and manufacturing systems (Govindan *et al.*, 2021; Ivanov *et al.*, 2019). Additionally, advanced technologies such as the IoT, big data analytics, block chain, and cybersecurity can provide visibility, traceability, and agility, which facilitates connectivity and visibility across the supply chain.

Nevertheless, achieving a higher degree of supply chain robustness would require significant investments, effective integration with partners, and reliance on trade-offs with other objectives of the supply chain (Belhadi *et al.*, 2021; Chowdhury *et al.*, 2019; Ivanov and Dolgui, 2020).

Therefore, proving H4, the contingency analysis supports the importance of resilience for superior logistics performance in the automotive industry. If companies invest

in strategies, capabilities, and technologies that enable them to develop a more robust supply chain, they may more effectively address disruptive factors and performance challenges.

5.1 Policy Implications

Several important implications could be drawn from the findings of this study. First, if managers are looking to pursue opportunities to improve supply chain coordination, robustness, and logistics performance by utilizing disruptive innovations, they may invest in technologies such as IoT, AI, and block chain to enhance information sharing, visibility, and collaboration among the members of a supply chain. In addition, a culture of innovation and risk management and attitudes that prioritize constant improvement may be implemented to increase a supply chain's resilience and flexibility. Finally, they must prioritize the alignment of networks, objectives, decisions, and processes across the supply chain to achieve better coordination and logistics optimization.

Second, our results have implications for the literature in relation to the impact of disruptive innovation on supply chain management. By identifying the cause-and-effect relationships between disruptive innovation and supply chain coordination, robustness, and logistics performance, our study contributes to understanding the manner in which recent technological advancements influence traditional supply chain relations. Finally, this study lays the groundwork for additional studies to explore the inner workings, moderators, and conditions that influence the use, development, and performance of disruptive innovations in a supply chain context.

Third, policymakers and government agencies envision to promote the competitiveness and resilience of industries and economies. More specifically, they should create incentives, allocate the necessary resources, and provide the appropriate regulatory support for the implementation of disruptive technologies in supply chains, especially by small and medium-sized enterprises. They also can support the collaboration and the transmission of knowledge between the industry, academia, and the government to accelerate the design and diffusion of innovative supply chain solutions. Additionally, policymakers could focus on the development of standards, governance, and ethical guidelines to use disruptive solutions and technologies in supply chain operations.

Finally, the adoption of disruptive solutions in supply chain management has considerable societal implications. These implications mainly involve sustainability, social responsibility, and consumer interest. These solutions can promote more efficient, transparent, and traceable supply chain operations.

5.2 Limitations

There are some limitations in this research. First, the study focuses on the automotive industry in Korea, which can limit the generalizability of the findings to other industries or geographical areas. Indeed, the specific features of the automotive industry, such as a complex supply chain network, high capital intensity, and a high level of quality and safety requirements, can influence the implementation and impact of disruptive innovations

differently from other industries. Therefore, future research should investigate the generalizability of these findings to other industries and countries to develop a comprehensive perspective on the impact of disruptive innovations on supply chain management.

Second, the disruptive innovations are ongoing and constantly impact business. The rapid development of technology and the emergence of new disruptive impacts, such as the COVID-19 pandemic, changes the adoption of the impact of disruptive innovations on supply chain management. This means that the scope of this research is limited in time and should be investigated in future research to keep up with the changing dynamics of disruptive innovation. Indeed, future research should adopt a longitudinal and adaptive approach to promising the impact of disruptive innovation on supply chain management, considering the changes in technology, business frameworks, and market conditions.

DECLARATIONS OF INTEREST

This research has no conflicts of interest to declare.

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