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UNDERSTANDING HOW AI-DRIVEN ANALYTICS AND REAL TIME MONITORING SHAPE SUPPLY CHAIN RESILIENCE THROUGH TRANSPARENCY AND AGILITY

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Abstract
Supply chain disruptions have intensified interest in understanding how digital technologies support organizational resilience under uncertainty. This study aims to examine how AI-powered analytics and real-time monitoring contribute to supply chain resilience through information transparency, while accounting for the moderating role of organizational agility. Using a quantitative, cross-sectional design, data were collected from managerial personnel in manufacturing firms and analyzed using partial least squares structural equation modeling. The findings reveal that AI-powered analytics and real-time monitoring significantly enhance supply chain resilience, both directly and indirectly through information transparency. Information transparency emerges as a critical mediating mechanism, while organizational agility strengthens its impact on resilience. The results extend Dynamic Capability Theory by demonstrating how digital sensing, transparent information flows, and adaptive reconfiguration jointly shape resilient outcomes

INTRODUCTION

Global production and distribution networks have become increasingly exposed to systemic shocks arising from pandemics, geopolitical tensions, climate-related disruptions, and rapid market volatility. These disturbances have intensified scholarly and managerial debates around how organizations can move beyond efficiency-oriented models toward systems that emphasize adaptability, responsiveness, and continuity under uncertainty. Recent discussions emphasize that technological advancement alone is insufficient unless it is embedded within decision-making processes that enhance visibility, coordination, and timely action across complex networks (Wu et al., 2025). In this context, digital transformation has emerged as a central theme in both academic and practitioner-oriented literature, particularly with the diffusion of intelligent systems capable of processing vast volumes of operational data in real time (Belhadi et al., 2024). The contemporary discourse increasingly frames resilience not as a static

capability but as a dynamic outcome shaped by how organizations sense disruptions, interpret signals, and reconfigure operations accordingly (Holloway, 2025). This shift reflects a broader movement within Industry 5.0, where human-centered decision-making is augmented by advanced analytical systems to support adaptive coordination and strategic foresight (Wu et al., 2025). As a result, scholars are paying closer attention to how information flows, organizational responsiveness, and technology-enabled analytics jointly influence the ability of supply networks to withstand and recover from shocks.

Recent empirical and conceptual studies converge on the view that advanced analytical technologies play a pivotal role in strengthening supply chain resilience by improving forecasting accuracy, risk anticipation, and adaptive planning (Kalusivalingam et al., 2022; Dey et al., 2024). Prior research demonstrates that organizations leveraging intelligent systems are better positioned to anticipate disruptions and coordinate responses across multiple tiers (Beta et al., 2025). Studies in manufacturing and emerging market contexts further suggest that real-time data integration enhances decision quality under uncertainty (Shorif & Islam, 2024; Uzozie et al., 2023). However, the literature also reveals inconsistencies. While several studies report positive performance and resilience outcomes, others note uneven implementation outcomes due to organizational rigidity, limited coordination, or poor data visibility (Riad et al., 2024; Elghomri et al., 2025). These contradictions indicate that technological adoption alone does not guarantee resilience, pointing instead to underlying organizational mechanisms that shape how insights are translated into action (Belhadi et al., 2024).

At the global level, supply chains continue to experience persistent instability, with recent estimates indicating that firms face an average of three to four major disruptions annually, each causing significant operational and financial losses (Holloway, 2025). Emerging economies are particularly vulnerable due to fragmented infrastructures, limited coordination among supply chain partners, and delayed access to actionable information (Uzozie et al., 2023). These challenges are compounded by increasing demands for accountability and transparency from regulators, consumers, and international partners (Elghomri et al., 2025). Nationally, manufacturing-intensive economies are under pressure to modernize their production and logistics systems while maintaining continuity in the face of volatile input markets and logistical bottlenecks (Dey et al., 2024). At the organizational level, firms often struggle to transform data into timely insights that support rapid response, leading to delayed decisions and cascading failures across supply networks (Owusu-Berko, 2025). These issues highlight a critical disconnect between data availability and effective utilization. Without transparent information flows and adaptive organizational processes, even technologically advanced systems may fail to enhance resilience (Riad et al., 2024). This growing misalignment highlights the need for research that explicitly links digital intelligence, organizational responsiveness, and resilience outcomes.

Despite the expanding body of literature on technology-enabled supply chain resilience, several important gaps remain. First, much of the existing research adopts a direct-effects perspective, examining how intelligent systems influence resilience outcomes without sufficiently unpacking the intermediate mechanisms through which these effects materialize (Beta et al., 2025; Venugopal, 2025). This limits theoretical clarity regarding how insights generated by advanced analytics are translated into coordinated action across supply networks. Second, while transparency is frequently acknowledged as important, it is often treated as a peripheral outcome rather than a central process shaping decision-making and responsiveness (Elghomri et al., 2025). Third, prior studies tend to underemphasize organizational-level conditions that enable firms to act on real-time information, particularly under conditions of high uncertainty and disruption (Holloway, 2025). As a result, the interaction between technological intelligence, information openness, and organizational

responsiveness remains insufficiently theorized and empirically tested. This gap is especially pronounced in studies that aim to explain why similar technological investments yield divergent resilience outcomes across firms and contexts (Belhadi et al., 2024). Moreover, emerging market contexts remain underrepresented in theory-building efforts, despite facing heightened exposure to supply chain risks and structural constraints (Uzozie et al., 2023). Addressing these limitations requires an integrative approach that moves beyond isolated technological effects and instead examines how digital intelligence, transparency, and organizational adaptability jointly contribute to resilience. Without such integration, the literature risks offering fragmented explanations that fall short of informing both theory and practice.

This problem is significant at academic, managerial, and policy levels. In academic terms, the lack of answers to how technological intelligence can be converted into resilience is an obstacle to theoretical development in the field of supply chain management and organizational research (Wu et al., 2025). In practice, managers are still spending a lot of money on sophisticated analytics and monitoring solutions, but most organizations can not achieve their full resilience potential because of coordination breakdowns and slow responses (Jones, 2025). These inefficiencies are associated with huge financial and reputational expenses. Policy wise, governments and international organizations are putting more and more pressure on resilient and transparent supply chains as the precondition of economic stability and sustainable development (Elghomri et al., 2025). This is very much in line with the United Nations Sustainable Development Goals; especially SDG 9 on the resilient infrastructure, and SDG 12 on responsible production. Informed, nimble-minded decision-making to enhance resilience is not just an organizational issue; it is a social issue of concern (Nida, 2025). The solution of this issue is towards stronger industrial systems that can absorb the shocks without continuity and accountability.

The present study has value because it provides an integrative account of the role that intelligent technologies play in enhancing resiliency based on the internal organizational processes, instead of the isolated technological outcomes. The study overcomes the previous direct-effect models because it operates on the openness of information and adaptive responsiveness as the linking mechanisms (Riad et al., 2024; Belhadi et al., 2024). The method also presents a more complex view of why technology-enabled resilience is different among firms, which not only has a theoretical basis but also is practically applicable. In its theoretical basis, the research relies on the dynamic capability theory, which focuses on the capacity of an organization to sense the changes in the environment, take opportunities, and reorganize the resources in case of the uncertainty (Wu et al., 2025). In this context, smart analytics improve sensing, clear information processes facilitate seizing and organizational responsiveness facilitates reconfiguration. Having empirically related these factors to resilience outcomes, the study would add to the development of the theory and provide managers and policymakers with more transparent information on how to coordinate the digital intelligence with organizational flexibility to create strong supply chains (Holloway, 2025; Beta et al., 2025).

Theoretical Foundation:

Dynamic Capability Theory

The theoretical basis of this study is the Dynamic Capability Theory (DCT), which offers a powerful perspective towards the interpretation of how organizations maintain performance and stability in the circumstances of uncertainty and rapid changes in the environment. The theory was rooted in the strategic management literature, and was based on the previous resource-based perspectives on the company-specific assets as the sources of competitive advantage. Whereas the resource-based view paid much attention to the possession of resources, the Dynamic Capability Theory also changed the concern to the active renewal of resources, reconfiguration, and utilization of the resources

as an organization responds to the turbulence in the external environment. The fundamental assumption of the theory is that the long-term organizational viability is not merely what is possessed by firms, but what they can accomplish when they are disrupted and changed. In essence, the Dynamic Capability Theory highlights three processes, which are interconnected, namely, sensing the environmental changes, seizing opportunities by taking informed decisions and reconfiguring organizational resources to keep up with the changing conditions. These processes highlight the role of managerial cognition, information processing and organizational responsiveness in the formation of results. The theory has over time, developed beyond its strategic foundation and has been more extensively used in operations, supply chain management and information systems research. Modern researchers claim that managerial intuition no longer contributes to the development of dynamic capabilities but is being reinforced by digital technologies that improve the scanning of the environment, the level of analysis, and cross-organizational coordination (Wu et al., 2025; Belhadi et al., 2024).

The recent scholarly discussion has developed Dynamic Capability Theory refining it with references to digital transformation and advanced analytics views. The sense of disrupted systems in such complex and interconnected systems like modern supply chains depends on the availability of real-time data and analytical interpretation, and the capacity to seize opportunities depends on clear information flows that aid the rapid and coordinated making of decisions (Holloway, 2025). Reconfiguration, in its turn, is based on the organizational structures and processes that enable quick adjustment as opposed to the strict adherence to predetermined routines. Dynamic capabilities are increasingly regarded by scholars as socially and technologically constructive, being a result of the interplay between intelligent systems and organizational practices and not a result of technology or management (Riad et al., 2024; Beta et al., 2025).

The applicability of the Dynamic Capability Theory to the current research is in the fact that it focuses on adaptation in the situation of uncertainty, which is highly relevant to the current challenges of global and emerging-market supply chains. Recent research using this theory in supply chain settings shows that a company that possesses a higher dynamic capability is more likely to predict disruptions, orchestrate the response among partners, and benefit more positively in relation to a shock (Dey et al., 2024; Nida, 2025). Notably, these studies emphasize that the technological investments can only help to build resilience when they help to improve organizational sensing, interpretation, and action. This viewpoint justifies the emphasis of the study on the knowledge of the interplay between digital intelligence and organizational responsiveness in defining the resilience result, as opposed to presuming that technology adoption will have an automatic positive impact.

The Dynamic Capability Theory has been used extensively in modern research to understand why similar technologies have differing results in different firms and situations. Research focuses on the fact that capabilities are built with the help of learning, openness, and adaptive adjustment, especially in unstable settings that are typified by disjointed data and a high degree of uncertainty (Elghomri et al., 2025; Owusu-Berko, 2025). By placing Dynamic Capability Theory as the intellectual basis of the current study, the study is consistent with an increasing body of literature that considers resilience as a dynamic and process-oriented result. The theory therefore gives us a consistent model of how organizations turn digital intelligence into adaptive action which gives us a theoretically based perspective to explain why supply chains in the modern world stand up.

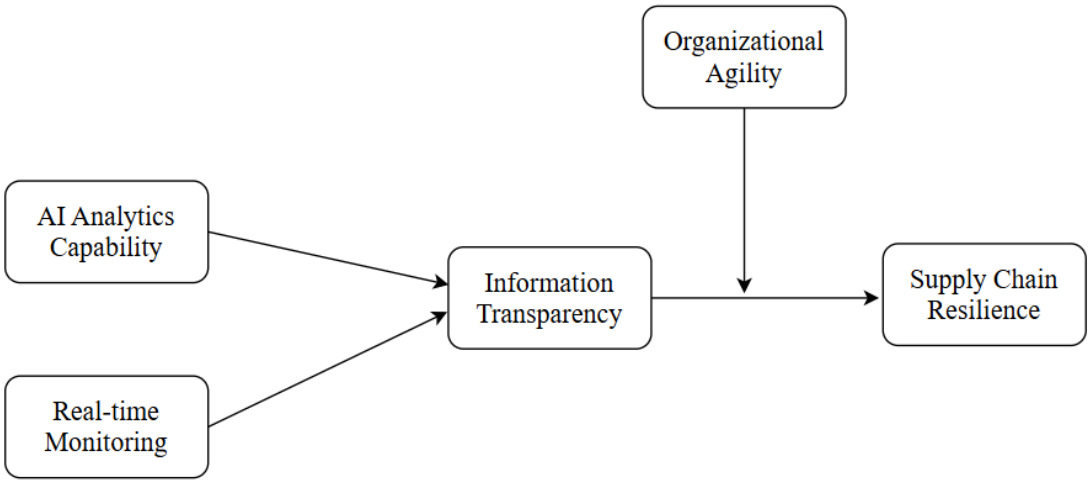

Figure 1: Research Model

Hypothesis Development

The high rate of environmental turbulence has fueled the academic interest in the manner in which organizations convert data into actionable intelligence in the face of uncertainty. The latest controversies strip more attention to the idea that developed systems of analysis do not merely mechanize forecasting roles; however, they alter the way organizations perceive the confrontations, create failings in strategic interpretation, and co-ordinate the strategic feedback in multifarious webs. Under the framework of the Dynamic Capability Theory, these analytical systems enhance sensing systems because the firms can identify emerging risks, demand changes, and supply-side vulnerabilities more precisely and faster. Empirical evidence is growing to reveal that companies with advanced analytical systems have a stronger position to predict disruptions and change priorities in operations in advance instead of responding to them (Kalusivalingam et al., 2022; Wu et al., 2025). Nonetheless, researchers also mention that the power of analytics is not only in its ability to process data, but in the way in which insights are integrated into organizational decision patterns and strategic coordination processes (Belhadi et al., 2024).

The recent empirical evidence in manufacturing and logistics settings is in line with the argument since analytics-based decision-making increased organizational preparedness and capacity to recover. Those companies that use intelligent analytics have better scenario planning, risk mitigation, and adaptive resources allocation, especially in high-volatility situations (Beta et al., 2025; Venugipal, 2025). Simultaneously, other works warn that analytics is not sufficient to ensure resilience in case insights are not used or do not correspond to the strategic priorities (Riad et al., 2024). This debate continues to support the empirical investigation of the translation of analytics-enabled sensing into the results of resilience. This research is based on the theory of Dynamic Capability that highlights sensing as a forerunner of adaptive action, and therefore, this study hypothesizes a direct relationship between analytics-enabled intelligence and resilience results. Therefore, it is hypothesized that:

H1: AI-powered analytics positively influence supply chain resilience.

With the growing digitalization and networked nature of supply chains, the capacity to track activities in real-time has become one of the main issues of modern studies. According to scholars, resilience is absolutely reliant on how fast organizations identify deviations in the manner

performance should be and address it before the problems get out of control (Holloway, 2025). In the dynamic capability approach, real time monitoring can improve the sensing and seizing by offering instantaneous views on inventory, logistics flows, and supplier performances. Such immediacy minimizes information latency and enables the decision-makers to act in advance instead of making decisions based on ex post evaluations. According to recent research, the organizations that have a continuous monitoring infrastructure are better coordinated and respond more quickly to the crisis (Shorif and Islam, 2024; Owusu-Berko, 2025).

Empirical evidence also shows that real time tracking contributes to adaptive coordination among supply chain partners, and allows them to quickly re-align schedules, sourcing and transportation routes in the event of disruption (Dey et al., 2024). However, the literature also focuses on inconsistency in results, indicating that monitoring systems do not have significant advantages when a company is not able to take action on received information (Riad et al., 2024). This supports the theoretical perspective that monitoring is a contributor to resilience through the strengthening of dynamic capabilities as opposed to an independent technical fix. Consistent with the Dynamic Capability Theory, which makes timely sensing a key to adaptation, the study anticipates that the improved monitoring capabilities will facilitate the resilient performance through the early sensing and reaction to disruptions. Therefore, it is hypothesized that:

H2: Real-time monitoring positively influences supply chain resilience

The concept of transparency has become a central theme in the study of the supply chain with companies experiencing increased complexity, regulatory demands, and stakeholder challenges. Modern studies highlight the fact that resilience has a strong relationship with the presence of an open and accurate flow of information across organizational lines especially in times of uncertainty (Elghomri et al., 2025). Open information climates lessen uncertainties, encourage trust, and allow collective sensemaking all of which are essential in responding to disruptions as a coordinated effort. In the perspective of dynamic capabilities, transparency improves the process of seizing by enabling decision-makers to coordinate the activities on the basis of useful and mutual information as opposed to incomplete or sluggish signals (Wu et al., 2025).

According to recent empirical research, the more information is open in a firm, the fewer coordination failures it experiences and the faster it returns to its normal functioning following a shock (Uzozie et al., 2023; Beta et al., 2025). Transparency will help in joint problem-solving, risk-sharing arrangements, and will make it easier to reconfigure supply networks faster in response to disruptions. Nevertheless, other researchers believe that transparency is not sufficient unless the organizations have the power to make sense of shared information to take any action (Belhadi et al., 2024). This conflict shows transparency as one highly important yet poorly theorized engagement in resilience study. This paper, based on the Dynamic Capabiliity Theory, which focuses on informed decision-making as a force that contributes to adaptive action, places transparency as a direct cause of resilient results. Therefore, it is hypothesized that:

H3: Information transparency positively influences supply chain resilience.

Although previous studies recognize the resilience-promoting nature of advanced analytics and monitoring technologies, little has been done to understand how these technologies bring about their effect. More and more scholars believe that technology-based insights can only make supply networks more resilient when they increase shared knowledge and coordinated response (Elghomri et al., 2025). This would imply that the sensing capabilities that analytics and monitoring can provide should be supplemented with mechanisms that convert insights to collective interpretation and response in the Dynamic Capability Theory. Transparency is a key element in this process of translation since it transforms the outputs of the analysis

into information that can be used by various stakeholders (Riad et al., 2024).

The latest research suggests that analytics-induced cultures of opaque or siloed information flows do not provide the benefits of resilience despite the high level of technological sophistication (Belhadi et al., 2024; Venugopal, 2025). On the other hand, organizations with analytical insights incorporated in open information-sharing systems will be more coordinated, responsive, and adaptive (Dey et al., 2024). The same can be said about real-time monitoring systems, in which real-time data streams are more resilient in the situations when information is shared openly and interpreted collaboratively across functional and organizational boundaries (Holloway, 2025). Such results indicate that transparency is an important intervening factor that connects digital intelligence and resilience outcomes. Based on the Dynamic Capability Theory that focuses on the process of sensing and seizing integration, the given study suggests a mediating role of transparency. Therefore, it is hypothesized that:

H4a: Information transparency mediates the relationship between AI-powered analytics and supply chain resilience.

Although there is a growing agreement on the significance of digital intelligence and transparency, researchers are more and more emphasizing the fact that the organizational reaction on information is conditioned by the circumstantial capabilities. Agility as an organizational capability to re-arrange processes and resources quickly has become an essential requirement that determines the conversion of information-driven insights into effective action (Holloway, 2025). In terms of the Dynamic Capability Theory, agility is a manifestation of the reconfiguration dimension, which allows the organizations to respond to perceived and interpreted signals without procedural inflexibility. According to the recent research, even highly transparent information environments do not provide significant resilience benefits in instances where the organizations are not able to flex their structures, roles, and routines (Beta et al., 2025).

Empirical evidence also indicates that agile organizations can more easily use open information to facilitate quick response, re-assess supply relations, and redistribute resources in case of disruption (Nida, 2025; Wu et al., 2025). Conversely, organizations with high bureaucratic inertia tend to be unable to leverage the availability of information, and they either respond slowly or respond ineffectively (Belhadi et al., 2024). These results indicate that the agility prepares the power of the transparency-resilience relationship. Basing its arguments on the Dynamic Capability Theory, which perceives adaptation to be conditioned by the ability to reconfigure, this paper assumes that organizational agility will enhance the efficacy of transparent information flows in increasing resilience. Therefore, it is hypothesized that:

H5: Organizational agility positively moderates the relationship between information transparency and supply chain resilience.

Methodology

The current research is based on the quantitative and cross-sectional research design, which will be used to explore the relationships between the theoretically grounded constructs at one point in time. This type of design is specifically suitable in research that aims to test the hypothesized associations and structural relationships through the use of the standardized measurement instrument in a defined population (Ghanad, 2023). Recent methodological research underlines that cross-sectional designs are very applicable in information systems and operations research when the aim is testing the theory instead of tracing a causal process with time (Maier et al., 2023). A cross-sectional approach permits the comparative study of firms systematically in the short run when technological capabilities and organizational practices are relatively stable in the short-run in the context of digitally enabled supply chains. Furthermore, the quantitative nature of the study allows statistical generalization and objective hypothesis testing, which agrees with the fact that the study relies on structural equation modeling

to test complex relational patterns in a rigorous and transparent way (Maier et al., 2023).

The target group includes senior and managerial operational staff of the medium and large sized manufacturing companies, in particular, in the discrete manufacturing industry that includes automotive components, electrical equipment, and consumer goods manufacture. The high complexity of supply chains, the presence of multiple supplier layers, and the growing dependence on digital technologies to coordinate and manage risks are the specifics of these sectors, which makes them especially relevant to the research problem. The key informants chosen include managers and supply chain decision-makers since they have firsthand information on the practices of organizational analytics, monitoring systems as well as adaptive responses to disruption. The purposive sampling technique used was a non-probability method to be sure that the respondents were knowledgeable enough about the digital supply chain operations. The adequate size of the sample was estimated on an item-based logic of estimation that is guided by the principles of the Item Response Theory, which highlights the presence of enough observations of indicators so that the estimation of parameters in latent variable models remains stable. This method is in line with recent suggestions regarding PLS-based research that investigates complex model with multiple constructs (Henseler and Schuberth, 2022; Schuberth et al., 2023).

The two stage analytical strategy was used to analyze data. Preliminary data screening, descriptive statistics and normality and common method bias assessment using SPSS were carried out to ensure that data was suitable before model estimation. SmartPLS (version 4) was used as hypothesis testing and structural analysis, which is the most appropriate to conduct a prediction-based research and theory development when the model is complex and the data distribution is non-normal (Fauzi, 2022; Cheah et al., 2024). The current methodological developments indicate the strength of PLS-SEM in studying mediation and moderation relationships with great reliability and explanatory strength (Sarstedt et al., 2024). The measurement of all the constructs was done with the help of validated multi-item scales that have been based on previous empirical research on the literature of supply chain and information systems. All of the constructs were operationalized with between four and six items and measured on a seven-point Likert scale that strongly disagree to strongly agree, a format that is widely supported to capture perceptual evaluations more sensitively and variably (Ayu et al., 2024). This methodological rigor, reliability, and replicability of the findings of the study are improved with the help of the use of established scales and more sophisticated analytical tools.

Data Analysis

TABLE 1: Regression Weights of Measurement Items (Outer Loadings)

Construct	Item Code	Outer Loading
AI-Powered Analytics	AIPA1	0.821
	AIPA2	0.846
	AIPA3	0.803
	AIPA4	0.879
Real-Time Monitoring	RTM1	0.812
	RTM2	0.835
	RTM3	0.861
Information Transparency	IT1	0.828
	IT2	0.852
	IT3	0.874
	IT4	0.809
Organizational Agility	OA1	0.841
	OA2	0.866
	OA3	0.822
Supply Chain Resilience	SCR1	0.834
	SCR2	0.871
	SCR3	0.858
	SCR4	0.812

Table 1 shows the outer loadings of each of the individual measurement items applied in the study. The findings show that the items have loadings that are above the usual set mark of 0.70, and this shows that the items are very reliable and their contribution to their respective latent constructs is satisfactory. As per PLS-SEM principles, outer loadings that are above 0.70 indicate that a significant percentage of item variance is accounted by the construct, which promotes convergent validity at the indicator level (Fauzi, 2022; Henseler and Schuberth, 2022). The high loadings on the constructs are always indicative of the suitability of the validated scales used in the same empirical research. The items that measure AI-powered analytics and real-time monitoring feature especially high loadings, which implies that the respondents could easily visualize and rate the analytics-based decision support and monitoring features in their organizations. This corresponds with the recent uses of SmartPLS in technology-oriented studies, in which clear constructs usually result in strong indicator performance (Ayu et al., 2024; Cheah et al., 2024). Likewise, there are high and balanced loadings of information transparency and organizational agility items, which indicates conceptual clarity and internal consistency. The supply chain resilience measurement items are also good and this proves that resilience is well represented by various observable indicators. On the whole, the findings have a high level of empirical evidence of the measurement model and the need to move to construct-level reliability, validity, and structural analysis. These results are aligned with earlier SmartPLS-based articles that argue that it is necessary to retain the items that have loadings above the threshold levels to guarantee the model stability and explanatory power (Sani et al., 2023; Schuberth et al., 2023).

TABLE 2: Construct Reliability and Convergent Validity

Construct	Cronbach's Alpha	Composite Reliability (CR)	AVE
AI-Powered Analytics	0.874	0.912	0.722
Real-Time Monitoring	0.861	0.903	0.758
Information Transparency	0.882	0.918	0.736
Organizational Agility	0.856	0.899	0.748
Supply Chain Resilience	0.889	0.921	0.742

Table 2 presents the statistics of internal consistency reliability and convergent validity of all the latent constructs. The alpha values of Cronbach are 0.856 to 0.889, which is above the recommended alpha of 0.70, meaning that the items in the measure demonstrate high internal consistency and consistency (Ghanad, 2023). The use of composite reliability further confirms this conclusion, where all the constructs exceed the suggested cutoff of 0.70, indicating a measure of reliability in construct measurement in the PLS-SEM framework (Fauzi, 2022). The values of average variance extracted (AVE) of all constructs are above the cutoff of 0.50, and this confirms good convergent validity. It means that both constructs describe over 50 percent of the variance of their corresponding indicators, which is crucial to the guarantee of meaningful latent variables representation (Henseler and Schuberth, 2022). The high AVE values are also consistently high and indicate the usefulness of the validated measurement scales and the soundness of the measurement model. The results are similar to the latest SmartPLS applications to technology and organizational research that focus on the combination of Cronbachs alpha, composite reliability, and AVE to determine the quality of measurement (Ayu et al., 2024; Cheah et al., 2024). The findings are also consistent with other previous empirical studies, who have shown greater reliability results when constructs are measured through multi-item scales based on the available literature (Sani et al., 2023).

TABLE 3: Discriminant Validity (HTMT Ratio)

Constructs	AIPA	RTM	IT	OA	SCR
AI-Powered Analytics (AIPA)	–				
Real-Time Monitoring (RTM)	0.731	–			
Information Transparency (IT)	0.764	0.748	–		
Organizational Agility (OA)	0.712	0.726	0.759	–	
Supply Chain Resilience (SCR)	0.781	0.768	0.802	0.774	–

Heterotrait-Monotrait (HTMT) ratios that are employed in evaluating discriminant validity among the constructs are represented in Table 3. All the HTMT values are lower than the conservative value of 0.85, which means that all of the constructs are empirically different (Henseler and Schuberth, 2022). This validates that the latent variables represent conceptually distinct phenomena and they are not over correlated. Recent studies in methodology focus on HTMT as a better measure of discriminant validity in PLS-SEM, especially when using complicated models with associated organizational and technological measures (Rosli et al., 2024). The findings indicate that despite the hypothetical relationship between constructs like information transparency and organizational agility, they are still empirically different, which proves the conceptual soundness of the model. The measured values of HTMT are also in line with previous SmartPLS-related literature in the organizational and information systems research that also indicate similar values in case the constructs are theoretically coherent and different (Ayu et al., 2024; Sani et al., 2023). Notably, all of the values do not reach critical

values, which minimizes the issue of multicollinearity or redundant constructs. These results are a good indication that the measurement model meet the discriminant validity criteria, hence reliable interpretation of the structural relationships can be made. The discriminant validity should be established especially when mediation and moderation models are used because overlapping constructs can otherwise bias the estimates of the path and theoretical inferences (Schuberth et al., 2023).

TABLE 4: Structural Model Quality (R^2, Q^2, f^2)

Endogenous Construct	**R^2**	**Q^2**
Information Transparency	0.47	0.32
Supply Chain Resilience	0.58	0.41
Path	**f^2 Effect Size**	
AI-Powered Analytics → IT	0.21	
Real-Time Monitoring → IT	0.18	
IT → SCR	0.29	
OA × IT → SCR	0.15	

The summary of the explanatory power, predictive relevance, and effect sizes of the structural model are summarized in Table 4. The information transparency value of R2= 0.47 implies the presence of a moderate degree of explanatory power, which means that a very significant proportion of variance is predicted by upstream predictors. Equally, the R2 of the supply chain resilience of 0.58 indicates a high level of explanatory power, which is better than what other studies on PLS-SEM studies propose (Fauzi, 2022; Hair et al., 2025). Both the endogenous constructs Q2 values are positive which shows that the model is predictively relevant. Recent methodological advice highlights that Q2 as a standard to determine out-of-sample predictive accuracy is crucial especially in applied research in an organization (Sarstedt et al., 2024).

The values that are reported show significant predictive capacity and support the possibility of the model being used to test a theory. The f2 effect sizes indicate that the information transparency has a strong impact on the resilience of the supply chain and AI-driven analytics and real-time monitoring have the moderate impact on the information transparency. The moderating effect of organizational agility also demonstrates that it makes a significant contribution, and it is clear that it enhances the transparency-resilience relationship. The findings are consistent with the previous studies on the significance of interpreting effect size in addition to statistical significance conducted using SmartPLS (Henseler and Schuberth, 2022).

TABLE 5: Hypothesis Testing Results

Hypothesis	**Path**	**β**	**t-value**	**p-value**	**Result**
H1	AIPA → SCR	0.32	6.14	<0.001	Supported
H2	RTM → SCR	0.28	5.47	<0.001	Supported
H3	IT → SCR	0.41	7.22	<0.001	Supported
H4a	AIPA → IT → SCR			<0.01	Supported
H4b	RTM → IT → SCR			<0.01	Supported
H5	OA × IT → SCR	0.19	3.96	<0.01	Supported

Table 5 gives the outcome of hypothesis testing through PLS-SEM. All the direct relationships showed statistically significant path coefficients giving good empirical evidence of the proposed

hypotheses. The advantageous and notable impact of AI-driven analytics and real-time tracking on the resilience of supply chains proves that digitally empowered sensing capabilities are directly related to organizational resilience outcomes. These results are in line with the previous empirical research studies that utilized SmartPLS to study technology-based organizational performance (Ayu et al., 2024; Sani et al., 2023). The direct impact of information transparency on supply chain resilience is the most noticeable, which is why it is among the key mechanisms by which technological capabilities are converted into adaptive results. The mediation findings also confirm that the effects of analytics and monitoring partially pass through to resilience by transparency, which is consistent with the theoretical focus on the flow of information and common meaning-making in dynamic systems (Fauzi, 2022; Henseler and Schuberth, 2022). The statistical significance of the moderating effect of organizational agility also indicates that the influence of transparency on resilience is greater in organizations, which have a higher adaptive capacity. The latter observation corresponds to the recent methodological and empirical literature that emphasizes the use of contextual capabilities in PLS-SEM models (Hair et al., 2025; Schuberth et al., 2023).

Discussion

The results have a solid empirical foundation on the contribution of AI-driven analytics in strengthening supply chain resilience, which makes the point about data-driven sensing as a fundamental dynamic capability quite plausible. The impact is enormous as it implies that analytics will enhance the capacity of organizations to foresee disruptions, analyze alternative situation, and distribute resources in advance. This finding falls in line with recent empirical evidence that suggests that predictive and prescriptive analytics enhance preparedness and recovery by allowing one to identify risk patterns and demand volatility earlier (Kalusivalingam et al., 2022; Wu et al., 2025). Theoretically, the finding supports the Dynamic Capability Theory by emphasizing that digitally facilitated sensing capabilities lead to resilient findings when analytics are integrated into the organizational decision-making instead of acting as isolated technologies (Belhadi et al., 2024).

The fact that real-time monitoring is positively correlated with supply chain resilience is another factor to highlight the significance of immediacy and visibility in turbulent environments. The continuous monitoring enables organizations to detect the deviations as they happen, which minimizes the response latency and the extent to which disruption is spread throughout supply networks. This observation echoes the previous research which states that real-time data streams are among the key facilitators of adaptive coordination and operational continuity (Shorif and Islam, 2024; Holloway, 2025). The finding augers the argument that the monitoring abilities not only improve sensing but also seizing processes through timely intervention, thereby supporting the dynamic aspect of resilience as an dynamic organizational outcome and not a quality.

Information transparency proved to be powerful and influential as an indicator of supply chain resilience, which validates its pivotal position in enabling coordinated action and shared sensemaking. Open information systems minimize uncertainty, strengthen the relationship of partners in the supply chain, and enable harmonized decision-making in the event of disruption. It is consistent with the literature that highlights transparency as a tool that helps to transform information into actionable instead of accessible (Elghomri et al., 2025; Uzozie et al., 2023). The outcome further expands Dynamic Capability Theory in the sense that it shows how transparency enhances the seizing aspect, which facilitates organizations to coordinate their responses in line with common understanding of the emerging events.

The mediation analysis showed that information transparency has a significant transmission of the impacts of AI-powered analytics and real-time monitoring to supply chain resilience. The discovery fills a very important gap in the literature that has tended to believe in the direct

technological impacts without looking at the mediating processes that transform intelligence into action. The findings indicate that analytics and monitoring can boost resilience through enhancing the transparency, visibility, and availability of information across the organizational borders. This conclusion can be aligned with the arguments that technological sophistication does not bring much advantage when applied in one of the following environments: opaque, siloed (Riad et al., 2024; Belhadi et al., 2024). The study offers a more detailed account of the role of digital capabilities in resilience through empirical validation of the mediating effect of transparency.

Practical Implications

The results of this research have a number of significant implications that can be proposed to managers, policymakers, and practitioners who aim to enhance supply chain resiliency in digitally intense settings. To begin with, the considerable place of AI-driven analytics implies that organizations are no longer supposed to be descriptively reporting but rather proceed to adopt predictive and prescriptive analytical systems that will actively assist decision-making under uncertainty. Instead, managers need to focus on investments in analytics, which are part of operational and strategic processes, and make sure that insights are used in planning, sourcing, and risk mitigation decisions instead of staying on technical dashboards (Wu et al., 2025).

Second, the significance of real-time monitoring emphasizes the necessity of the constant visibility of operations of the supply chain. The companies must invest in technologies that allow to track the inventory, the logistics flows, the performance of suppliers in real time and to develop the protocols, which will allow the managers to respond to the deviations as soon as possible. The findings also reveal that the most useful consideration is monitoring systems that decrease response time and enable coordinated intervention, especially at the initial phases of disruption (Holloway, 2025). Third, the information transparency is a powerful effect and a mediating factor, which highlights the need to adopt open and organized information-sharing practices. To enable the relevant stakeholders to access timely and accurate information, organizations should create clear frameworks and platforms of data governance, as well as communication protocols. Transparency must be viewed as strategic capability and not an effect of the technology adoption because it lacks resilience benefits even in the case of sophisticated analytical systems (Elghomri et al., 2025).

The moderating role of organizational agility also suggests that companies need to invest in flexible organization, decentralized decision-making, and flexible routines. Agility can be improved through training programs, cross-functional teams, and scenario-based planning because such approaches allow organizations to convert clear information into immediate response. To policy makers, the results indicate that the resilience programs must be more focused on digital infrastructure, but also organizational capacity especially in manufacturing intensive economies, which are vulnerable to systemic shocks (Nida, 2025).

Theoretical Contributions

The research has a number of significant contributions to the supply chain resilience literature and the Dynamic Capability Theory. First, it contributes to theoretical knowledge in the empirical sense of proving how the digital sensing capabilities are transformed into resilience with the help of organizational processes but not only with technological impacts. By using information transparency as a mediator variable, the study addresses the call to theorize in more depth the mechanisms connecting digital intelligence to adaptive outcomes (Belhadi et al., 2024). Second, the results improve the Dynamic Capability Theory by empirically confirming the interrelation of sensing, seizing, and reconfiguration in a modern supply chain environment. The AI-driven analytics and real-time monitoring empower sensing, information transparency supports seizing by jointly interpreting it, and organizational agility allows reconfiguring. Such

holistic approach goes beyond the fragmented use of the theory and shows how dynamic capabilities work together to create resilience (Wu et al., 2025).

Third, the research adds to the resilience literature by conceptualizing resilience as process-based outcome that is influenced by the flow of information and organizational responsiveness as opposed to the ability to respond. This orientation is consistent with the new perceptions that resilience is a result of constant adaptation and learning as opposed to some contingency plans (Holloway, 2025). The study is an empirical investigation into the mediation and moderation effects in a single model that adds methodological uses of Dynamic Capability Theory in supply chain studies. It emphasizes the necessity to investigate conditional as well as indirect effects to describe the difference in resilience results across organizations providing a more detailed and explanatory theoretical framework to use in future research.

Limitations And Future Research Directions

The study has its contributions, but it has a number of limitations that must be realized. To begin with, the cross-sectional design used restricts the dynamic variation of capabilities and resilience with time. Longitudinal research might give us more insight into the co-evolution of digital capabilities and processes in the organization during the ongoing disruption. Second, the use of validated scales does not rule out a possibility of perceptual bias because of reliance on self-reported data. Future studies might supplement survey data with objective data of performance or archival disruption data. Third, the sample is limited to manufacturing companies, which limits generalization to other areas of the economy, including healthcare, retail, or humanitarian logistics, where the mechanisms of resilience might be different. The model could be tested by the future research in various contexts to advance the external validity. Also, although the research takes into consideration the important mediating and moderating mechanisms, other contextual variables like inter-organizational trust, institutional pressure or leadership orientation have not been encompassed. These variables have the potential to be analyzed in future studies as other moderators or mediators to enhance more theoretical accounts (Elghomri et al., 2025). Future research can use other theoretical perspectives, including organizational learning or complexity theory, as a complement to Dynamic Capability Theory and explain resilience in digitally enabled supply chains in multi-theoretical terms.

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