



## DIGITAL SUPPLY CHAIN VISIBILITY AND SUPPLIER COLLABORATION: THEIR IMPACT ON SUPPLY CHAIN RESILIENCE AND OPERATIONAL PERFORMANCE

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### Abstract

**Background:** Supply chains face disruptions, information delays, supplier failures, and shifting customer requirements across interconnected networks. Digital supply chain visibility enables real-time information exchange, while supplier collaboration improves coordination and responsiveness. Evidence on their combined contribution to resilience and operational performance remains limited.

**Aim:** This study examined the effects of digital visibility and supplier collaboration on supply chain resilience and operational performance, including resilience's influence on performance.

**Methods:** A quantitative cross-sectional survey collected data using a structured questionnaire from 300 procurement, logistics, warehouse, operations, and supply chain professionals. Measures covered digital visibility, supplier collaboration, resilience, and operational performance. Descriptive statistics, Pearson correlations, multiple regression, and mediation analysis were applied at  $p < 0.05$ .

**Results:** High digital visibility was reported by 68.0% of respondents, strong supplier collaboration by 64.3%, and established disruption-response processes by 71.0%. Digital visibility and supplier collaboration correlated positively with resilience ( $r = 0.61$  and  $r = 0.57$ , respectively;  $p < 0.001$ ). Both predicted resilience ( $\beta = 0.42$  and  $\beta = 0.35$ ;  $p < 0.001$ ), explaining 48.6% of its variance. Resilience predicted operational performance ( $\beta = 0.52$ ,  $p < 0.001$ ), explaining 43.2% of its variance, and partially mediated both relationships with performance.

**Conclusion:** Digital visibility and supplier collaboration strengthen resilience and operational performance. Organizations should prioritize real-time information systems and coordinated supplier relationships to respond to disruptions, maintain continuity, and improve outcomes. These capabilities help firms anticipate problems, coordinate recovery actions, reduce operational delays, and sustain service levels in uncertain environments.

**Keywords:** Digital Supply Chain; Supply Chain Visibility; Supplier Collaboration; Supply Chain Resilience; Operational Performance; Supply Chain Management.

## 1. Introduction

### 1.1 Background of the Study

The nature of supply chains has changed, becoming longer, more interdependent, and more reliant on external partners. The underlying structure optimizes efficiency and expands to reach markets, with the downfalls of any local business entering into many companies. The COVID-19 pandemic, geopolitical



conflicts, transport restrictions and supplier bottlenecks demonstrate how limitations in one region of the network can impact production, delivery and customer service in another (Ivanov, 2020; Ivanov & Dolgui, 2020). Concern about this vulnerability is not new. Previous research has suggested that it is not merely supply chain cost (Christopher & Peck, 2004; Sheffi & Rice, 2005) that firms should target but rather supply chain shock absorb and recovery. The adaptability of a supply chain to anticipate disruptive scenarios and react when needed, while retaining the continuity of operations at a desired level of connectedness and control (Ponomarov & Holcomb, 2009), is a commonly used definition for supply chain resiliency.

This ability is all about information. Supply chain visibility is level of access to and information sharing between actors that they believe is of critical importance in their supply chain and of value to other actors (Barratt & Oke, 2007). An examination of the literature reveals that visibility is a multi-facet concept and includes the nature of information shared, the timeliness and accuracy of the information, and how the information is utilized (Somapa et al., 2018). Today there is a more expansive spectrum of visibility through digital technologies. With real-time tracking, digital data collection, big data application, and digital twins, businesses are able to anticipate these disruptions and test reactions before investing resources (Ivanov et al., 2019; Ivanov & Dolgui, 2021). Confidence in decisions decreases and risk exposure increases when there is no such visibility to act upon the delayed or incomplete information (Christopher & Lee, 2004).

Co-ordination may not exist when there is visibility. In addition, companies require cooperative business relationships with suppliers. Supplier collaboration involves shared planning, sharing information, collaborating to solve problems, and accommodating each other's coordination changes between buyers and suppliers. The relational viewpoint suggests that companies benefit from developing relationship specific investments, knowledge sharing and governance arrangements that can only be achieved if the relationships extend beyond the boundaries of one organization (Dyer & Singh, 1998). The empirical research shows that collaboration and integration are related to improvement of the firm's performance (Cao & Zhang, 2011; Flynn et al., 2010; Li et al., 2006). The relationship between collaboration and resilience competencies is also emerging (Chowdhury et al., 2019; Scholten & Schilder, 2015; Wieland & Wallenburg, 2013).

### **1.2 Research Problem and Gap**

Although strides have been made, the three following gaps remain.

First, the issues of visibility and collaboration are not treated as coupled issues. Digital technology studies are on information and analytics; Collaboration studies are on relationships. The two are tested in few studies together in one model, so their relative contribution to resilience is not well known.

Second, reviews of the resilience literature indicate that there is still a need for better, more empirical studies of the mechanisms that connect between resilience and its precursors and consequences (Hohenstein et al., 2015).

Third, a considerable amount of the evidence lies in conceptual activities, simulations or in case studies (see for instance Ivanov & Dolgui, 2021, Scholten & Schilder, 2015). These methods add depth, but don't allow for statistical generalizations. Consumer-oriented responses to survey questions can provide additional insights on the relationships between visibility, collaboration, resilience and performance.

The following sequence of experiences constitutes the practical problem. While many organizations have begun spending on digital visibility tools and on supplier programs, they lack empirical evidence to base their strategy of whether such investments help enhance resilience and, consequently, the operational performance, through that resilience. This is an attempt to tackle the problem addressed in this study.

### **1.3 Rationale**

A combination of testing digital supply chain visibility and supplier collaboration provides a more comprehensive understanding of organizations' resilience building practices. An outcome that includes operational performance also indicates whether resilience is a protective factor or it is linked to operational outcomes. Mediation tests add evidence to the mechanism – resilience (MEANS). Results can influence managers focused on allocating resource investments in information system and supplier relationship dimensions and can be useful in theory and research regarding the process of information, relational advantage and dynamic capabilities in supply networks (Ivanov, 2022).



### **1.4 Research Questions**

1. To what extent is digital supply chain visibility associated with supply chain resilience?
2. How is supplier collaboration related to supply chain resilience?
3. How much does supply chain resilience correlate with operational performance?
4. Does supply chain resilience come between the digital supply chain visibility and supplier collaboration and operational performance?

### **1.5 Objectives**

1. To measure supply chain professionals' digital supply chain visibility, partnering and disruption responsiveness.
2. To examine the relationships of digital supply chain visibility and supplier collaboration with supply chain resilience.
3. To analyze how supply chain resiliency is related to operational performance.
4. To explore whether SC resilience acts as a relationship between digital supply chain visibility and supplier collaboration and operational performance.

### **1.6 Hypotheses**

H1: Digital supply chain visibility positively impacts the supply chain resilience.

H2: Supplier collaboration is positively related to supply chain resilience.

H3: Relationship between supply chain resilience and operational performance will be positive.

H4a: Supply chain resilience is an intermediary that connects digital supply chain visibility with operational performance.

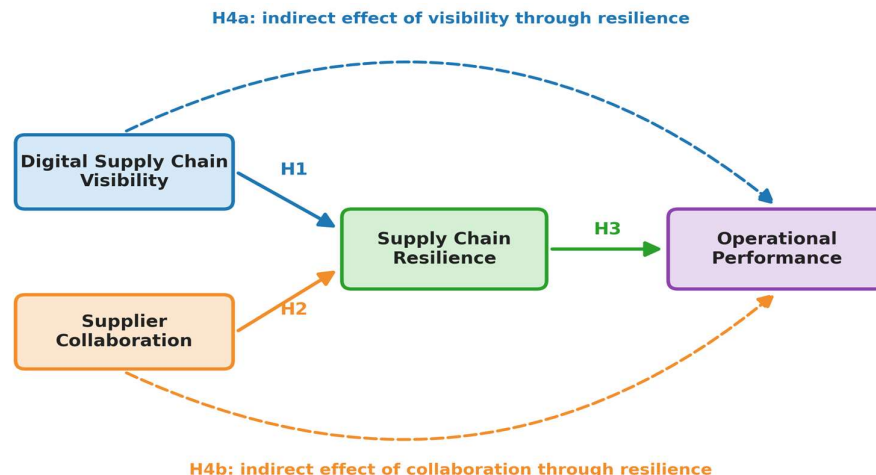
H4b: There is an indirect relationship between supplier collaboration and operational performance through supply chain resilience.

## **2. Conceptual Framework**

The framework is based to four complementary theoretical presumptions. The theory of organizational information processing suggests in the context of uncertainty that there must exist enough and appropriate information-processing capability at the firm level to cope with the information requirements of the firm (Galbraith, 1974). This is its capacity that is enhanced by digital visibility in the supply chain. Information systems and working with suppliers cooperatively can be recognized as valuable, hard-to-imitate resources that create a supplier advantage in the eyes of the resource-based view (Barney, 1991). The relational view adds this, can be gained across firm boundaries via shared knowledge and shared routines (Dyer & Singh, 1998). Lastly, the Dynamic Capabilities approach outlines the ability to sense, seize and reconfigure resources in the face of changing environments (Teece et al., 1997). Information and relationship power can be considered as such resilience, and this converts into action and operation.

**Figure 1**

*Conceptual Framework*





Solid arrows show the direct paths tested in H1 to H3. Dashed arrows show the indirect effects through supply chain resilience tested in H4a and H4b.

### **3. Materials and Methods**

#### **3.1 Research Design**

The research design that was used in this research was quantitative, cross-sectional explanatory survey design. The design was chosen because the research aims were to explore the relationships between the following factors of the digital supply chain at a specific time, Digital Supply Chain Visibility, Supplier Collaboration, Supply Chain Resilience, and Operational performance. Quantitative survey methods enable the ability to measure responses uniformly across survey participants and have the advantage of being able to statistically analyze relationships between multiple constructs. The study area was in Pakistan. As an outcome, the unit of analysis was the individual supply chain professional, and the constructs of interest were related to professionals' perceptions of supply chain practices and outcomes within their institutional environment.

#### **3.2 Participants and Sample**

The last analytical sample comprised of 300 professionals in the supply chain. The individuals who participated in this survey ranged from those engaged in procurement, logistics and warehousing, to operations and supply chain management just in general. These roles were chosen because they find themselves in direct contact with the exchange of information, supplier coordination, handling disruption and making operational decisions. The number of observations was adequate for the regression modelling that was planned. Because regression sample-size requirements depend on the number of predictors and expected effect structure, larger samples are needed with fewer predictors than with a few predictors. In this regard, Green (1991) points out that regression requirements for a sample number exceed the "rules of thumb" routinely applied to basic multiple regression.

#### **3.3 Measures and Questionnaire**

Data was collected using a structured questionnaire. The research employed a questionnaire to evaluate four basic constructs: Digital supply chain visibility, Supplier collaboration, Supply chain resilience and Operational performance. Each item was evaluated as "present, very present, slightly present, not present, or absent" (scale of 1 to 5, respectively), higher scores indicating higher levels of presence or effectiveness of the construct. Digital supply chain visibility looked at the level of reach, timeliness, accessibility and sharing of key information within the supply chain, across the activities and processes within it. Assessment of supplier collaboration evaluated joint planning, information sharing, communication, and working together to solve problems with suppliers. Supply chain resilience involved the organization's preparedness, reaction, adaptation and recovery to disruption in the supply chain. Operational performance was related to perceived effectiveness including responsiveness, reliability, continuity and operational outcomes.

#### **3.4 Data Collection Procedure**

A questionnaire with structure questions were used for collecting data from the Supply Chain professionals from Pakistan. The respondents were chosen based upon their involvement in supply chain-related activities. The questionnaires were subject to a screening process and structurally complete questionnaires gave 300 observations for the analysis.

#### **3.5 Data Analysis**

In terms of the analysis, it was divided into several phases. The first step was to provide descriptive statistics to summarize the sample as well as the visibility, interaction, and disruption responses reported. Second, Pearson correlation coefficients were computed to explore bivariate relationships amongst the key constructs. Third, the relationship between digital supply chain visibility and supplier collaboration with supply chain resilience was investigated using multiple regression analysis. The fourth regression model evaluated the relationship between supply chain-resilience and operational performance.

Finally, mediation analysis was conducted to test whether there was an indirect pathway between the two antecedent variables and operational performance through mediation of the construct 'resilience'. P-values < .05 were considered statistically significant. Visibility and collaboration have indirect effects of .22 and .18,



respectively, based on the analyses available. Since no confidence interval nor direct-effect coefficients are available in the provided study record, the mediation results are presented conservatively.

### **3.6 Analytical Assumptions and Interpretation**

Analytical Assumptions and Interpretation: Correlation and regression analyses were interpreted as indicative of the degree of statistical association. The cross-sectional design is not a 'cause-to-effect' design. Therefore, it is acknowledged that phrases like 'predicts' in the statistical context are to be interpreted as regression associations not as causing change in one variable as a result of change in another. The manuscript also does not claim that the higher visibility coefficient is statistically significantly different from the collaboration coefficient without providing a formal comparison of the two coefficients.

## **4. Results**

### **4.1 Sample Characteristic**

A sample of 300 professionals in the supply chain was selected. The respondents had the following job roles: procurement manager, logistics manager, warehouse manager, operations manager, and supply chain executives (Table 1).

**Table 1**

*Sample Characteristics (N = 300)*

| <b>Respondent role</b>  | <b>Included in sample</b> |
|-------------------------|---------------------------|
| Procurement managers    | Yes                       |
| Logistics managers      | Yes                       |
| Warehouse managers      | Yes                       |
| Operations managers     | Yes                       |
| Supply chain executives | Yes                       |

### **4.2 Descriptive Findings**

Table 2 shows that most respondents indicated that conditions in their organizations were favorable. Sixty-eight.7% indicated high visibility in the digital supply chain and 64.3% considered their collaboration with suppliers to be strong. Also, 71.0% reported their organization had in place procedures to effectively deal with supply chain disruptions.

**Table 2**

*Descriptive Findings on Visibility, Collaboration, and Disruption Response (N = 300)*

| <b>Construct</b>                | <b>Indicator</b>                                             | <b>Respondents, n (%)</b> |
|---------------------------------|--------------------------------------------------------------|---------------------------|
| Digital supply chain visibility | High level of visibility reported                            | 206 (68.7)                |
| Supplier collaboration          | Strong collaboration with suppliers reported                 | 193 (64.3)                |
| Disruption response             | Mechanisms for effective response to disruptions implemented | 213 (71.0)                |

Percentages are shares of all 300 respondents.

### **4.3 Correlation Analysis**

The positive and significant relationship between digital supply chain visibility and the supply chain resilience is  $r = 0.61$  with a significant value of  $p < 0.001$ . Similarly, there was a positive and significant relationship between collaboration with suppliers and resilience ( $r = 0.57$ ;  $p < 0.001$ ) (Table 3; Figure 3). The two correlations signify a moderate to strong relationship.

**Table 3**

*Pearson Correlations with Supply Chain Resilience (N = 300)*

| <b>Variable pair</b>                                        | <b>r</b> | <b>p</b> | <b>Direction and strength</b> |
|-------------------------------------------------------------|----------|----------|-------------------------------|
| Digital supply chain visibility and supply chain resilience | 0.61     | < 0.001  | Positive, moderate to strong  |
| Supplier collaboration and supply chain resilience          | 0.57     | < 0.001  | Positive, moderate to strong  |



Two-tailed tests.

#### 4.4 Regression Analysis: Determinants of Supply Chain Resilience

The digital supply chain visibility significantly predicted supply chain resilience ( $\beta = 0.42$ ,  $p < 0.001$ ) and supplier collaboration had a significant positive impact ( $\beta = 0.35$ ,  $p < 0.001$ ) in the multiple regression model. The two predictors accounted for about 48.6% of the variance in resilience ( $R^2 = 0.486$ ) (Table 4; Figures 4 and 5). The two groups of H1 and H2 were thus backed. Both the coefficient for visibility and the coefficient for collaboration are observed but not formally ranked as the two do not statistically differ.

**Table 4**

*Multiple Regression Predicting Supply Chain Resilience (N = 300)*

| Predictor                       | $\beta$ | p       | Hypothesis   |
|---------------------------------|---------|---------|--------------|
| Digital supply chain visibility | 0.42    | < 0.001 | H1 supported |
| Supplier collaboration          | 0.35    | < 0.001 | H2 supported |

Note. Dependent variable: supply chain resilience. Model fit:  $R^2 = 0.486$ ; 48.6% of variance explained.

#### 4.5 Regression Analysis: Resilience and Operational Performance

The model also accounted for about 43.2% of the variance in operational performance ( $R^2 = 0.432$ ) and supply chain resilience was an important positive predictor of operational performance ( $\beta = 0.52$ ,  $p < 0.001$ ) (Table 5; Figures 4 and 5). H3 was supported.

**Table 5**

*Regression Predicting Operational Performance (N = 300)*

| Predictor               | $\beta$ | p       | Hypothesis   |
|-------------------------|---------|---------|--------------|
| Supply chain resilience | 0.52    | < 0.001 | H3 supported |

Dependent variable: operational performance. Model fit:  $R^2 = 0.432$ ; 43.2% of variance explained.

#### 4.6 Mediation Analysis

Table 6 and Figure 6 summarize the results of mediation. Both antecedents predicted the mediator (visibility,  $\beta = 0.42$ ; collaboration,  $\beta = 0.35$ ; both  $p < 0.001$ ) and a mediator predicted operational performance ( $\beta = 0.52$ ,  $p < 0.001$ ). Mediation analysis showed that digital supply chain visibility-operation performance relationship and supplier collaboration-operation performance relationship were partially mediated by resilience in the supply chains. Partial mediation was present in that relationships resided between each antecedent variable and operational performance, and an even partial mediation effect was present in that other relationships between the same were accounted for by resilience. The support for H4a and H4b was granted.

**Table 6**

*Summary of Mediation Results*

| Hypothesis | Pathway                                                                                        | Component paths                                        | Conclusion        |
|------------|------------------------------------------------------------------------------------------------|--------------------------------------------------------|-------------------|
| H4a        | Digital supply chain visibility $\rightarrow$ resilience $\rightarrow$ operational performance | $a = 0.42$ ( $p < 0.001$ ); $b = 0.52$ ( $p < 0.001$ ) | Partial mediation |
| H4b        | Supplier collaboration $\rightarrow$ resilience $\rightarrow$ operational performance          | $a = 0.35$ ( $p < 0.001$ ); $b = 0.52$ ( $p < 0.001$ ) | Partial mediation |

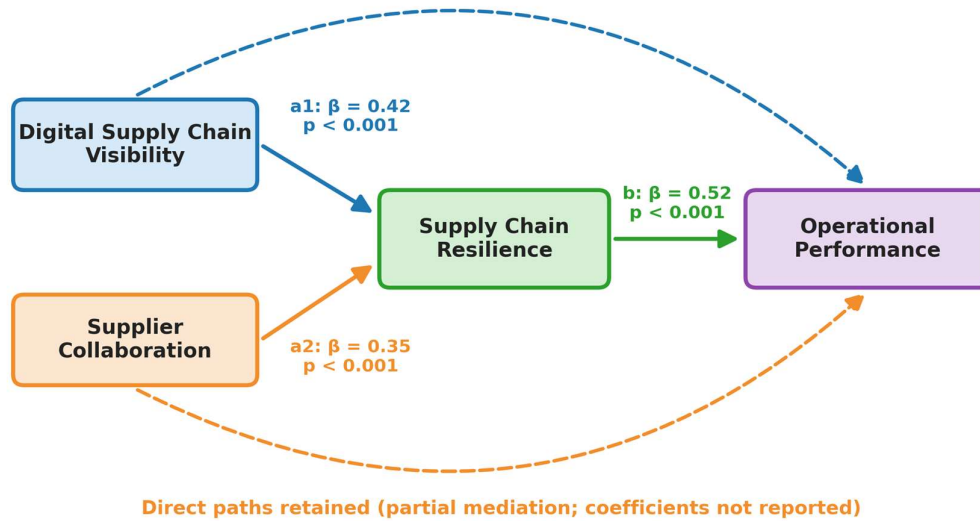
Path a indicates the influence of the antecedent on resilience; path b indicates the influence of resilience on operational performance. Indirect effects ( $a \times b$ ) were 0.22 for H4a and 0.18 for H4b. Direct-effect estimates and confidence intervals are not reported.



**Figure 2**

*Mediation model. Supply chain resilience partially mediates the relationships of digital supply chain visibility and supplier collaboration with operational performance. Dashed arrows show the direct paths that remained; their coefficients are not reported here.*

Direct paths retained (partial mediation; coefficients not reported)



## 5. Discussion

### 5.1 Summary of Main Findings

This study explored the correlation of the digital supply chain visibility and collaboration between the supply chain entities with the level of supply chain resilience and operational performance of 300 professionals who work on supply chains. The predictors for resilience were both positive and together they accounted for 48.6% of the variance in resilience. Resilience was in turn positively related to operational performance and partially mediated the relationships of both antecedents with performance. The outcome of the results is consistent with the proposed framework, except that the design is cross sectional.

### 5.2 Digital Supply Chain Visibility and Resilience

The positive correlation between visibility and resilience,  $r = 0.61$  and  $\beta = 0.42$ , aligns with the "information processing" perspective which suggests that increased information leads to increased organizations' ability to handle uncertainty (Galbraith, 1974). This also conforms to previous empirical research. In exploring the conditions under which IT use is an asset from an information-processing perspective, Wong et al. (2020) found that it is linked to both acts of resilience and performance, Gu et al. (2021) reports. Some of the antecedents of resilient supply chains identified by Dubey et al., 2019, included information-related enablers. The discovery is also consistent with the concept of reduced visibility leading to reduced confidence and increased risk (Christopher & Lee, 2004; Barratt & Oke, 2007). This approach indicates that having timely information from partners is conducive to aspects of detecting and responding to disruptions. There was a lack of specific detail in the present data, as it does not make clear which technologies or information types are most important.

### 5.3 Supplier Collaboration and Resilience

The variables capacity resilience was also positively correlated with supplier collaboration ( $r = 0.57$ ;  $\beta = 0.35$ ). This follows case-based evidence of the benefits of collaborative practice to resilience (Scholten & Schilder 2015); and survey evidence which links relational competencies and relational practice with resilience (Chowdhury et al., 2019; Wieland & Wallenburg, 2013). It is also consistent with the finding of Pantheon that resilience-related capabilities—like collaboration—were found to be strong in companies researched during the global financial crisis (Jüttner & Maklan, 2011). According to the Relational Perspective, when disruption happens, joint routines and shared knowledge enable partners to react quickly



and without conflict. (Dyer & Singh, 1998) The regression coefficient for visibility is larger than that for collaboration, however, the difference has not been tested, and the study does not provide evidence that visibility is more important.

#### **5.4 Resilience and Operational Performance**

The model had beta of 0.52 for operational performance, which is positive, and the model accounts for 43.2% of the variance in operational performance. These findings align with those linking resilience or its ability to a firm performance in studies (Belhadi et al., 2024; Dubey et al., 2021; Yu et al., 2019). Firms that successfully absorb and bounce back from disruption will have more stable deliveries, cost and service. Since both of these measures were self-reports at the same time it could be due to shared perceptions and this relationship doesn't show resilience, being a positive influence on performance.

#### **5.5 The Mediating Role of Resilience**

Partial mediation is that while visibility/collaboration is related to operational performance in one way, there are other ways as well. The other direct relation seems to make sense in theory. Even in the absence of significant disruption, the visibility and collaboration can enhance planning accuracy, inventory decisions, coordination and quality. Previously, researchers have correlated supply chain practices, integration and collaboration directly to performance within the operations and on the firm level (Cao & Zhang, 2011; Flynn et al., 2010; Li et al., 2006). The pattern thus indicates that these are every day and protecting capabilities. Proper testing of this interpretation would necessitate data distinguishing between periods of disruption.

#### **5.6 Theoretical Implications**

The study has three merits. First, in addition to testing information-based and relationship-based antecedents, it tests them together, reflecting information processing theory and relational view (Dyer & Singh, 1998; Galbraith, 1974), which serves to illustrate a difference between them. First, the examination of information-based and relationship-based antecedents occurs together which indicates that they are complementary, reflecting the information processing theory and relational view (Dyer & Singh, 1998; Galbraith, 1974). Second, it promotes a perspective on resilience as a dynamic ability—taking advantage of resources and generating performance (Teece et al., 1997). Third, it indicates that advantages may occur partially or only indirectly through resilience, which implies that the accounts of advantage based on resources (e.g., Barney 1991) must leave room for impacts that may not go via resilience.

#### **5.7 Practical Significance**

The amount of variance accounted for by resilience (48.6%) and by operational performance (43.2%) is sizable in the context of survey-based organizational research. It also highlights that half or more of the variance is related to elements outside the model – namely leadership; risk management culture; supply base structure; and flexibility. It is managers' job to acknowledge the value of visibility and collaboration but not enough to build resilience.

### **6. Practical Implications**

Invest in sharing real-time data with stakeholders and ensure that data is utilized in planning and disruption decisions, as well as collected. Collaborate with suppliers by planning together, working with problems together, and communicating together and not just agreeing together on a contract. Mix investment into relationship building. The results indicate that both are related to resilience. Keep in place formal responses to disruptions. There is a high level of response (71.0%) to this question and firms may be lagging behind if they don't have them. Keep an eye on track resilience along with operational performance; if operational performance is positively related to track resilience, then both might be tracked together.

### **7. Strengths and Limitations**

The strengths are based on data from 300 professionals (oppositional and leadership roles), the combination of two antecedents in one test, and application of correlation analysis and regression analysis as well as mediation analysis to achieve the set objectives. There are several points that need to be taken into consideration. First, the cross-sectional design does not allow causal inferences and a reverse or reciprocal relationship could exist. For instance, more resilient companies could be investing more in visibility and collaboration. Second, the data are self-reported and gathered from just one respondent, posing the threat of



common method bias and perceptual error (Podsakoff et al., 2003). Thirdly, operational performance assessment was done based on perception and not on any objective measure. Fourth, the percentages for high visibility, strong collaboration, and effective response are based on the rule of classification and might not be representative of all industries or areas. Fifth, the reported models did not account for firm size and/or industry as control variables.

### **7.1 Future Research**

Research employing a longitudinal or multi-wave design could also be performed to consider the temporal order, while merging survey data with objective performance data could be conducted in the future. Single-source bias would be minimized if matched buyer-supplier data is available. Researchers could evaluate specific sector differences, as well as compare specific technologies like digital twins and analytics, and test the moderators including environmental uncertainty and supply chain dynamism. Full model can be evaluated using the program of structural equation modeling (SEM). Last but not least, research could draw on these insights to develop all-encompassing models of viable and sustainable agile, resilient supply chains.

### **8. Conclusion**

A digital supply chain visibility and a collaboration between suppliers were both positively and significantly linked with the level of supply chain resilience, explaining 48.6% of the variance. Resilience had a positive relationship with operational performance and both antecedents with performance were partially explained by this link. These observations validate the idea of information visibility as well as supplier collaboration being critical competencies in today's supply chain. The study is a cross-sectional study and the information is dependent on self-reports which do not offer proof of cause-and-effect. Managers can still consider these three attributes to be interdependent goals, however, and future longitudinal studies can help determine the effect of enhanced visibility, collaboration and resilience on operational performance.

### **Author's Contributions**

All authors participated in ideation, development, and writing the manuscript. All authors read and approved the final manuscript.

### **Conflict of Interest Statement**

The authors declare that there is no conflict of interest regarding the publication of this article.

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### **Informed Consent**

Informed consent was obtained from all participants prior to data collection. Participants were informed about the purpose of the study, the voluntary nature of their participation, and their right to withdraw at any time without any consequences. The confidentiality and anonymity of respondents were guaranteed throughout the research process.

### **Data Availability**

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request. The authors are committed to transparency and will provide detailed methodological information and analysis protocols upon request.

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