HOW SUPPLY CHAIN TRANSPARENCY INFLUENCES THE AGILITY DIMENSIONS OF THE RESPONSIVENESS VIEW

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ABSTRACT

Researchers in supply chain have called to adopt a Responsiveness View of supply chain management and logistics to understand our field better. This study explores IT utilization, and its relationship to supply chain transparency and agility from a Responsiveness View of logistics and supply chain management. We examine how organizations achieve the operational dimension of Responsiveness (agility) by leveraging two dimensions of supply chain transparency. Drawing on the Responsiveness View and RBV, a model is proposed and evaluated using data collected from 212 supply chain managers in the manufacturing and distribution area. The result reveals that two dimensions of supply chain transparency (supplier traceability and stakeholder visibility) mediate the relationship between a firm's technology utilization (RFID) and responsiveness capability, which in turn results in higher supply chain performance.
Keywords: Supply Chain agility, Responsiveness View, Supply Chain transparency, Supplier traceability, Stakeholder visibility

INTRODUCTION

Disruptions caused by the pandemic have underscored the significance of supply chain responsiveness (Falcone et al., 2022; Richey et al., 2022). Today, the supply chain focus is shifting from traditional time and cost efficiency optimization logic to responding effectively to disruptions and opportunities (Richey et al., 2022; Morgan et al., 2023). Businesses with responsiveness capability can pivot their supply chains to adjust to the volatile shifts and find alternative ways to fulfill customer demands. Scholars call for a responsiveness view of the logistics and supply chain management to develop and test relationships between activities and outcomes that capture supply chain phenomena and associated relationships (Richey et al., 2021; Richey and Davis-Sramek, 2022; Davis-Sramek and Richey, 2021; Ali and Golgeci, 2019). The responsiveness View suggests that all supply chain adjustments are related to responsiveness, such as responding to needs, wants, and conditions (Richey et al., 2022, p83; Morgan et al., 2023).

A supply chain strategy is executed through a combination of adaptability, flexibility, agility, improvisation, and resilience as a whole to achieve both strategic and operational goals (Richey et al., 2022; Morgan et al., 2023). Five dimensions of responsiveness emphasize operational and strategic dimensions, and one may choose to focus on either one or multiple dimensions depending on the research questions (Richey et al., 2022). In this study, we focus on the process-oriented dimension of responsiveness, agility, which is defined as "the firm and supply chain's willingness and ability to immediately make process level changes based upon their understanding and reaction to externalities"

(Richey et al., 2022, p.77). Agility reflects the ability to reorganize and redistribute recourse rapidly and smoothly to accommodate unforeseen circumstances in a timely manner.

Combined with the resource-based view (RBV) (Barney, 1991), this study investigates when and how organizations create agility as a dynamic capability to gain sustainable competitive advantage. In obtaining supply chain agility, Dubey et al.;, (2018) investigate visibility as an important capability and antecedent of agility and adaptability. However, they have not investigated the role of traceability in supply chain agility. With the growing demands for product integrity from stakeholders, including employees, customers, suppliers, stockholders, banks, environmentalists, government, and other groups who can help or hurt the corporation, in decision-making (Freeman, 1984; Holliday et al., 2002; Phelan, H, 2011;Seuring and Muller 2008), it is logical to communicate entire supply chain information to stakeholders (Holliday et al., 2002; Carter et al., 2011; Tsanos et al., 2014). By considering the involved stakeholders in the construct, Morgan et al., (2018) conceptualized supply chain transparency as two dimensions visibility and traceability. Building upon this definition, they study how supply chain transparency drives knowledge creation and mediates the relationship between firm's risk and two dimensions of responsiveness, flexibility and adaptability (Morgan et al., 2023).

Literature suggests that transparency provides the potential to be an inter-organizational competitive advantage (Morgan et al., 2023; Dubey et al., 2018). Supply chain transparency (SCT) is not limited to a single firm but extended firm boundaries and embedded in inter-firm processes, so it is hard to replicate by competitors (Gold et al., 2009; Ketchen and Hult, 2007). SCT can improve and strengthen the supply chain by making information available to all stakeholders, enabling a quick response to any disruption to the supply chain. Firms can make adjustments across the supply chain to adapt the service and goods to meet consumers' changing demands through obtained supplier transparency (Stank et al., 2013; Doorey, 2011; Christopher and Towill, 2000). In the food industry, operational transparency has been found to increase customer service quality and efficiency (Buell et al., 2017). Although SCT has been marked as a supporting pillar of supply chain management (Morgan et al., 2018; Richey et al., 2016; Carter and Easton, 2011), there is a lack of empirical studies demonstrating how SCT uses the information generated by existing technology to leverage the supply chain performance even though both heavily rely on shared data across the supply chain. Firms seek supply chain transparency to improve customer service and productivity by reducing lead times and better inventory level control (Visich et al.,2009), which can be achieved by adopting technologies to monitor and track both upstream and downstream supply chain operations (Reyes et al.,2016; Carter and Liane Easton, 2011; Reyes and Frazier, 2007). In prior studies, supply chain partners considered transparency as an enabler of partnership trust as transparency empowers better communication through data sharing within the supply chain (Richey, 2016; New, 2015). This study aims to present a model examining how SCT influences one operational dimension of responsiveness, as identified in the responsiveness view: agility (Richey et al., 2022). Drawing on the Resource-Based view (RBV), this research seeks to answer the following questions:
Research Question #1: Does SCT utilize technology information to enhance supply chain performance?
Research Question #2: How does tracking/tracing information impact responsiveness operational dimension, agility?
Research Question #3: Does supply chain operational responsiveness lead to increased supply chain performance?

This research contributes to the supply chain management literature in several important ways by examining these questions. Our study adopts the Responsiveness View to explore the antecedent relationship between SCT and supply chain agility (Richey et al., 2022); it empirically demonstrates

how SCT works as a facilitator to leverage supply chain agility (SCA) using information technology integration. Second, this research extends the literature on RFID's impact on SCA via two dimensions of SCT, which provides valuable guidance for RFID adoption, especially to those who hesitate to adopt and have no clue to harvest the benefits of RFID. Third, we illustrate the relationship between SCT and SCA. Examining the link between two dimensions of supply chain transparency and SCA explicates the role of supplier traceability and shareholder visibility in creating SCA. Finally, we relate Responsiveness to outcomes in supply chain performance; our study addresses the impact of SCA on logistics service quality performance. This approach allows us to answer the question: Does SCA lead to increased performance?

The structure of our paper is organized as follows. First, we discussed the theoretical basis of this research and the literature background. Second, we propose hypotheses based on the theoretical framework that elaborates each research question. Afterward, the research methods are described in detail, consisting of survey-based data collection and cleaning. Then we present the results and discuss theoretical and practical implications, research limitations, and suggestions for future research.

THEORETICAL BACKGROUND

Resource-Based View, Dynamic Capabilities, and Responsiveness View

Resource-based view (RBV) has been widely used to explain organizations' competitive advantage for a long time (Barney, 1991; Kraaijenbrink et al., 2008). This theory's central argument is that an organization's competitive performance can be achieved through valuable, rare, inimitable, non-transferable, and non-substitutional resources (Wade and Hulland, 2004). Resources include tangible or intangible assets for providing products and services and capabilities for using the assets (Sanchez et al. 1996). Tangible and intangible assets, for example, can be information systems, IT infrastructure, and strong vendor relationships, while capabilities can be technical or managerial ability (Wade and Hulland, 2004).

Responsiveness is defined as “the process and outcome of organizational adjustments achieved as individual organizations within a supply chain alter behaviors, norms, and policies to help place supply chain and its members in a favorable position to achieve customer value under dynamic environmental conditions.” (Richey et al., 2022, p.83). The concept of responsiveness can be understood as dynamic capabilities. Drawing on Richey et al., (2022), "the responsiveness capability is a set of capabilities that reflect the various ways supply chain managers react to customer demand and market forces" (p.70). Responsiveness represents a higher-order ability, a multi-dimensional outcome that can be achieved by developing and combining specific dimensions as capabilities (Richey et al., 2022, p. 64). It is an inclusive view of firm adjustments as they develop and operationalize their respective activities within and across supply chains (Richey et al., 2022). Researchers can examine one or more dimensions of responsiveness depending on the perspective, either strategic structure and policy adjustment (i.e., adaptability and flexibility) or process adjustments (i.e., agility and improvisation) (Richey et al., 2022). Morgan et al., (2023) examined supply chain transparency as an important antecedent to responsiveness, considering strategic dimensions of adaptability and flexibility. This study focuses on one dimension of process adjustment of responsiveness, agility.

Supply Chain Agility

Supply chain agility (SCA) is recognized as a critical capability for organizations to sustain competitiveness (Goldman 1995; Swafford, 2006; Gligor, 2016). Braunscheidel (2009) defined a firm's supply chain agility as: "the capability of the firm, internally, and in conjunction with its key suppliers and customers, to adapt or respond in a speedy manner to a changing marketplace, contributing to the agility of the extended supply chain" (p 126). Organizations with SCA can respond to the shifting market and enable the whole supply chain to be responsive to market changes and uncertainty (Christopher and Towill, 2001; Williams et al., 2013). SCA enables an organization to respond quickly and more effectively to a rapidly changing marketplace, thus allowing the organization to obtain superior performance over its competitors (Katayama, 1999). Scholars have defined supply chain agility as the ability of the firm to adjust tactics and operations within its supply chain to respond to environmental changes, opportunities, and threats (Gligor et al., 2012b; Gligor et al., 2013; Gligor and Holcomb, 2014; Dubey et al., 2018). Teece et al. (2016) emphasize agility as "the capacity of an organization to efficiently and effectively redeploy/redirect its resources to value creating and value protecting (and capturing) higher-yield activities as internal and external circumstances warrant." (p. 17). Considering these definitions, we can understand agility as the capability of an organization to adjust and respond to changes in its external environment (e.g., market shifts, changes in customer demands and preferences, technological development) rapidly and efficiently in immediate attention (Richey et al., 2022).

Supply Chain Transparency

Supply chain transparency, traceability, and visibility are three closely related but distinct terms (Bell et al., 2016; Morgan et al., 2018; Duan and Aloysius, 2018). Previous studies in supply chain management defined visibility as "access to high-quality information that describes various factors of demand and supply" (Williams et al., 2013, p. 545); "the ability of supply chain partners to access information related to operations of the entire supply chain, besides the activities in which they participate" (Tsanos et al., 2014, p. 436); and "making information about various aspects of the supply chain available to stakeholders as well as utilizing the information within the firm" (Morgan et al., 2018, p. 962). These definitions suggest that visibility involves data accessibility and availability, which means the degree to which the stakeholders in the supply chain have detailed and accurate information related to demand and supply (Montecchi et al., 2021; Wang and Wei, 2007). In prior studies, traceability refers to the ability of the system to identify and verify the chronic state of activities (Xu et al., 2021). Supply chain traceability focuses on "tracing product movement through the supply chain" (Morgan et al., 2018. p.962). As a product passes through supply chain processes, relevant information is cumulated and shared among the organizations in the processes, which helps suppliers track the movement of products and information flow in the supply chain. Different from visibility and traceability, supply chain transparency shifts focus and applies a stakeholder perspective (Bell et al., 2016; Morgan et al., 2018).

Supply Chain Performance

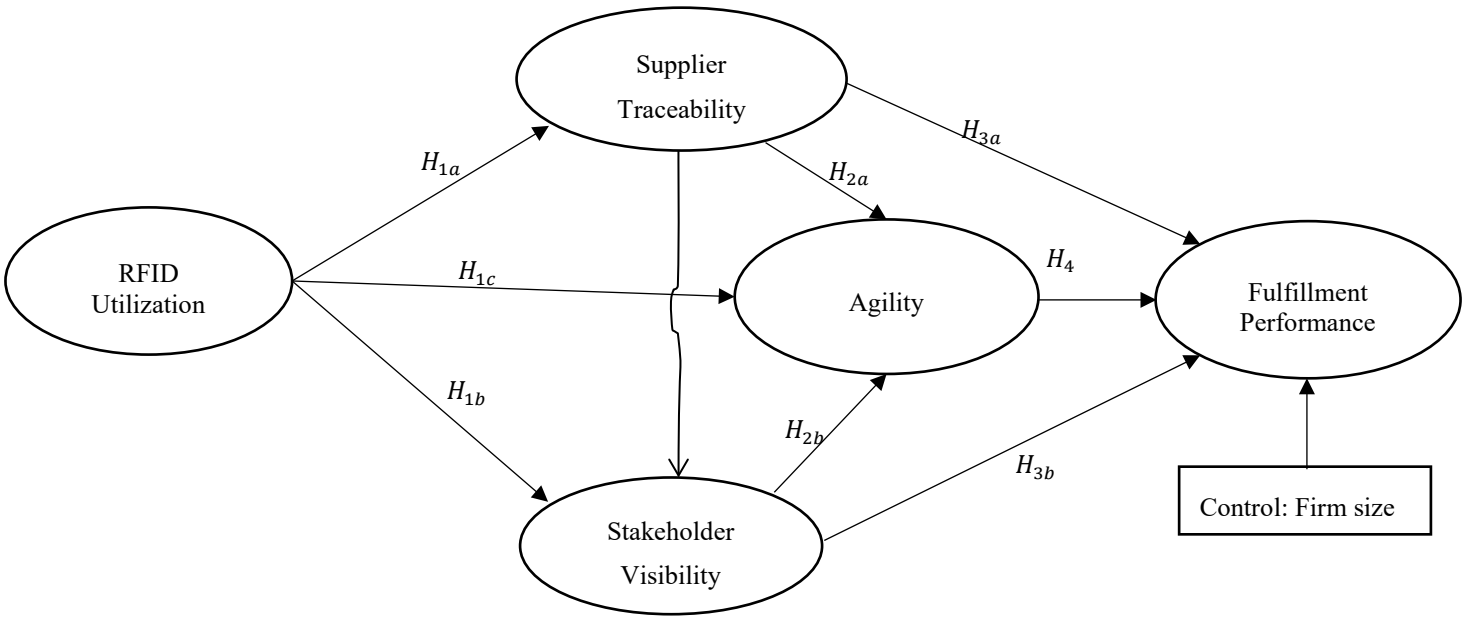
SCP is a construct that measures and quantifies the efficiency and effectiveness of the SC processes (Maestrini et al., 2018). SCP is critical to any organization's success because it creates an understanding of the competitive result (Fawcett and Cooper, 1998). The primary role of performance measurement includes yielding insight into the nature of value-added processes and providing critical feedback concerning the success of organization strategies. SCP is not easy because SC integrates several partners who cooperate to achieve logistical and strategic objectives (Lihong, 2012., Garcia-Alcarza et al., 2021). According to Lihong (2012), supply chain performance can be measured in two ways: (1) measuring the

level of customer satisfaction and (2) monitoring the total costs incurred (Lihong, 2012). Measure cost is the first choice when assessing process efficiency in the supply chain. There are some difficulties with financial measures and cost accounting data, because many organizations are reluctant to release information to outsiders. Furthermore, the level of aggregation in the supply chain is so high that it is challenging to utilize for evaluation (Chow et al., 1994). Logistics service quality has developed as one key part of firms' strategy, which in turn could create a competitive advantage for an organization (Mentzer, 2001). Richey (2007) emphasized that logistics excellence has been recognized as a prime area for creating competitive advantage through customer satisfaction; technology readiness could improve a company's performance through enhanced logistic service quality (LSQ). Customer segments place their emphasis on different components of LSQ (Stank, 2001). In this research, logistics service quality was selected as the outcome for the examination of performance.

HYPOTHESIS DEVELOPMENT

Figure 1 illustrates the research model proposed in this study, which visually represents the conceptual links among the constructs. The subsequent parts provide theoretical rationales for formulating hypotheses.

FIGURE 1 Structural model 1



IT Utilization, Supplier Transparency

According to the concept of SCT, exchanging information among stakeholders is a key practice for a supply chain to be transparent (Morgan et al., 2018). In other words, the transparency of a supply chain is facilitated by the availability and dissemination of information pertaining to the movement of items throughout the network (Zhu et al., 2018). It is required to make accurate and relevant information available to stakeholders in a timely manner in order to enhance visibility in a supply chain. Also,

traceability involves information gathering and sharing throughout a supply chain. Business entities maintain comprehensive information about their suppliers and consumers, facilitating the sharing of this pertinent data throughout the supply chain. This practice empowers suppliers to effectively track the sequential progression of a product along the various stages of the supply chain (Morgan et al., 2023; Bechini et al., 2008; Sodhi and Tang, 2019).

In the supply chain context, radio frequency identification (RFID), an automatic identification and data collection technology, has a significant potential to improve traceability and visibility in the supply chain (Sarac et al., 2010). The potential of this technology is attributed to its capacity to acquire real-time data pertaining to specific goods (Tajima, 2007**)** and provide enhanced visibility and tracking of assets in a more reliable, immediate, and precise manner (Dey et al., 2016). According to the study by Delen et al. (2007)**,** the utilization of RFID technology can improve the level of information visibility within the supply chain, as demonstrated by the analysis of real RFID data obtained from a prominent retailer. In addition, Gandino et al. (2009) investigated the use of RFID and traceability in the agri-food industry. Their study found that RFID automated the processes, which is key for effective traceability with increased accuracy, completeness, and reliability in the system.This theoretical reasoning and prior studies imply that the use of IT (e.g., RFID) in supply chain systems contributes to increasing supplier traceability and stakeholder visibility by improving information sharing among the entities in a supply chain (Delen et al., 2007; Hardgrave et al., 2013). Therefore, we propose the following hypotheses:
H_{1a} Firm reliance on RFID is positively related to the supplier traceability dimension of supplier transparency.
H_{1b} Firm reliance on RFID is positively related to the shareholder visibility dimension of supplier transparency.

IT Utilization and Supply Chain Agility

RBV suggests that a firm's distinctive core competence lies in its inimitable, organizational, and coordinative capabilities (Barney 1994, 2012). Technology is a major tangible resource facilitating information transfer, storage, manipulation, and recall through technological implementation. The relational complexity of IT integration in firms makes it hard to imitate and substitute. Effective use of technological resources has been found to contribute to channel efficiency, and help firms outperform their peers (Richey, 2007). Williams et al. (2013) find that high-quality data, which have attributes of being accurate, timely, complete, and in usable forms, from upstream or supply-related, partner-level information are important enablers of supply chain agility by anticipating market changes (Reichhart and Holweg, 2007; Dove, 2005). As an example of Information technology, RFID is commonly employed among supply chain partners (Adam et al., 2014; Hinkka et al.,2015). The enhanced information sharing brought by RFID about the product through the supply chain will strengthen the collaboration among supply chain partners and empower the partners to be more responsive to each other (Stank et al., 2001; Daugherty et al., 2005; Min et al., 2005; Morgan et al., 2016). As noted by previous scholars, IT integration is an enabling mechanism that positively affects supply chain agility by effectively gathering, storing, accessing, sharing, and analyzing data (Swafford et al., 2008). A supply chain can adapt to demand changes by integrating information technology and resources (Swafford, 2008). Thus, we develop the following hypothesis:
H_{1c} Firm reliance on RFID is positively related to supply chain agility.

Supply Chain Transparency and Responsiveness

According to RBV, SCT offers a company differentiation and a competitive advantage over its competitors. This competitive advantage can be sustained only until its competitors offer a similar SCT level (Sodhi and Tang, 2019). SCT relies heavily on technical support, as information regarding product movement along the supply chain is collected in real-time through the incorporation of information technologies; the traceability of the history of the product and visibility of the current activities could be achieved by IT systems (Dehning, 2007; Morgan et al., 2018). By reporting the visibility of upstream and downstream supply chain operations and the traceability of products dating back to their origin to current activities, all stakeholders could be engaged in better decision-making processes, resulting in a competitive advantage (Morgan., 2018, Musa et al., 2014).

Through supplier traceability and stakeholder visibility, all stakeholders are able to quickly look across the network and understand where they have space (Lee et al., 2014). The transparency achieved through data from RFID enables organizations to offer stakeholders a complete view of their supplier data across the supply chain, anticipating the operation activities and reducing risk (Visich et al., 2009; Wang et al., 2009). Transparency can demystify complex supply chains, help different stakeholders identify and minimize risks, improve conditions on the ground, and inform whether and where progress is being made(Gardener et al., 2019). the complete view of the supplier performance allows the company to coordinate and integrate information within a firm's function and firms within their supply chain (Lyons et al., 2004; Swafford et al., 2008). The enhanced transparency in the real-time manner of suppliers provides insights into supplier responsiveness to customer needs and the potential for continuous improvement (Agarwal et al., 2014). Drawing on this body of literature, we propose the following hypotheses:
H_{2a} and H_{2b} Supplier transparency is positively related to supply chain agility.

Supply Chain Transparency and Logistics Service Fulfillment

Suppliers maintaining a traceable system, such as RFID, provides transparency throughout the supply chain by tracking products along the entire supply, often through multiple tiers of suppliers (Morgan et al., 2023). This transparency can lead to fewer errors in order fulfillment because each step of the process can be monitored and verified. If there is a problem with an order, supplier traceability allows businesses to pinpoint the issue more quickly, reducing delays and improving overall fulfillment time (Swedberg, 2007). Supplier traceability allows businesses to predict delivery times better, understand stock levels, and plan inventory more effectively, leading to smoother order fulfillment (Bechini et al., 2008). In cases where products have defects or safety issues, supplier traceability makes it easier to recall specific batches or items without affecting the entire product line, ensuring that only the affected products are removed from the supply chain (Wowak et al., 2016; Wowak, Craighead and Ketchen, 2022). With improved supplier traceability, companies can provide customers with detailed information about product origins, manufacturing processes, and transportation, thereby improving order fulfillment. Enhanced stakeholder visibility helps a company avoid and mitigate potential supply chain risks (e.g., supplier delays, geopolitical risks, and quality issues) and respond to supply chain disruptions that threaten shareholder value (Sodhi and Tang, 2019). Shareholder visibility pushes companies to gather more data and insights about their supply chain to identify and address potential risks, translating to fewer disruptions and consistent order fulfillment (Choi and Krause, 2006). As firms gain more visibility into their supply chain operations across different tiers, they can consider other supply chain configurations (Sodhi and Tang, 2019), this real-time information across the supply chain to make real-time decisions can lead to better decision-making processes, forecasting accuracy, and order fulfillment quality. Thus, we propose that:

H_{3a} The supplier traceability dimension of supplier transparency is positively related to order fulfillment quality.
H_{3b} The shareholder visibility dimension of supplier transparency is positively related to order fulfillment quality.

Supply Chain Agility and Order Fulfillment

Serving the customer at the business-to-business level lies at the heart of network responsiveness conceptualization (Richey et al., 2022). Supply chain agility is a dynamic capability because it facilitates resource configuration and enables sensing and capitalizing the opportunities in a rapidly changing environment (Teece 2007; Gligor and Holcomb, 2012). Agility reflects the firm's capability to change states to accommodate unforeseen circumstances in a timely manner (Bernardes and Hanna, 2009). According to RBV, dynamic capabilities are hard to replicate sources of competitive advantage, SCA then allows organizations to achieve superior levels of performance (Dyer, 1996). Cao and Dowlatshahi (2005) described that agile entities' key feature is meeting customer expectations. It is captured by the speed of the supply chain in improving delivery performance. Adopting a service perspective, Stank et al., (1999) view operational service performance as "the activities performed by service providers that contribute to consistent quality, productivity, and efficiency" (Stank et al., 1999, p. 430). Swafford (2008) pointed out that a firm's level of supply chain agility works as the interface between the firm and its markets. To empirically test the association between SCA and order fulfillment quality, the following hypothesis is considered:
H_4 Agility is positively related to order fulfillment quality.

METHODOLOGY

Survey Sampling and Data Collection

We test our model using data collected from an empirical survey following the procedures described by Dillman (2009). The survey questions were developed based on a review of previous literature and adjusted from past research to fit the context of this study. These items were refined based on feedback given by four academic researchers and four practitioners working in the area of supply chain management and logistics. The survey was presented to targeted respondents through an internet panel service, which provides researchers with participants based on specific characteristics. This method of "outsourcing" data collection has gained popularity in SCM research in recent years. Similar studies have employed this approach. Morgan et al. (2015) explored the influence of information technology competency on logistic capabilities with this method of collecting data. Grawe et al. (2011) examined the impact of knowledge synthesis and innovative logistics processes on operational flexibility. The quality of this method has been verified by Autry et al. (2010), that responses do not differ greatly from counterparts collected through random mail samples as long as the targeted participant is knowledgeable regarding the subject matter. 212 usable responses were collected, including manufacturing, wholesale/ distribution firms. 68% of the represented firms were in manufacturing, whereas the remaining 32% were in distribution. To assess potential nonresponse bias, we compared all items from early (first 25%) and late (last 25%) respondents following the Rogelberg and Stanton (2007) procedure (Armstrong and Overton 1977). No significant differences were found between the first quarter and last quarter of all respondents, suggesting nonresponse bias was not a serious concern in the final sample.

Scale Development of Variables

All measurement items used in the analysis were adapted from previous research and measured on a seven-point Likert Scale. The factor RFID was measured with two items by adapting the scale from Richey (2016). Respondents indicated the extent to which they depend on RFID support from their suppliers and relative to their competitors. Seven items examined stakeholder's participation in transparent firm activities measuring the stakeholder visibility, which improves and strengthens the supply chain by making this information readily available to all stakeholders. Items developed by Morgan et al. (2018) were used to assess two dimensions of transparency, supplier traceability and stakeholder visibility. Eight items that capture the adjustment capabilities of a firm's supply chain process (Gligor, 2013) measured agility. This measure used the same seven-point scale to capture responsiveness in delivery and customer service. In order to measure fulfillment service performance to customers, the survey asked respondents to rate the service quality to their customers, including order accuracy, and order condition adjusted from (Mentzer, 2001). Fulfillment service performance to customers served as the final output, a scale consisting of 6 items was employed. A list of all items employed in this research is shown in Table 1.
Insert Table 1: Measurement Model

TABLE 1 Measurement model

Latent factor	Indicators	Standardized loadings	SE	AVE	CR
Agility	Q136Q1	0.769	0.033	0.515	0.895
	Q136Q2	0.686	0.041		
	Q136Q3	0.729	0.037		
	Q136Q4	0.657	0.043		
	Q136Q5	0.726	0.037		
	Q136Q6	0.754	0.034		
	Q136Q7	0.657	0.043		
	Q136Q8	0.756	0.034		
Stakeholder Visibility	Q120Q1	0.910	0.013	0.825	0.971
	Q120Q2	0.903	0.014		
	Q120Q3	0.894	0.015		
	Q120Q4	0.889	0.016		
	Q120Q5	0.911	0.013		
	Q120Q6	0.914	0.013		
	Q120Q7	0.938	0.010		
Supplier Traceability	Q121Q1	0.843	0.021	0.752	0.960
	Q121Q2	0.812	0.025		
	Q121Q3	0.868	0.018		
	Q121Q4	0.875	0.018		
	Q121Q5	0.907	0.014		
	Q121Q6	0.873	0.018		
	Q121Q7	0.889	0.016		
	Q121Q8	0.869	0.018		
Fulfillment Performance	Q105Q1	0.717	0.036	0.595	0.896
	Q105Q2	0.631	0.044		
	Q105Q3	0.599	0.047		
	Q106Q1	0.936	0.014		
	Q106Q2	0.897	0.017		
	Q106Q3	0.786	0.029		

Technology Utilization (RFID)	Q190Q1	0.862	0.051	0.805	0.892
	Q190Q2	0.931	0.052		

Control Measure Items

Previous research found that firm size could influence the variance of direct relationships as larger organizations have higher resource commitments and are more responsive (Morgan et al., 2018). Thus, we use firm total employees to control for organizational size (Wu, 2020). To assess potential firm size, the square root of AVEs was computed to compare correlations between variables (Fornell et al., 1981).
Insert Table 2: Correlation and descriptive statistics

TABLE 2 Correlation and descriptive statistics

	Latent variable	No. of items	Mean	SD	1	2	3	4	5
1	Agility	8	3.606	0.715	(0.718)				
2	Visibility	7	5.163	1.360	0.491	(0.908)			
3	Traceability	8	4.964	1.240	0.552	0.151	(0.867)		
4	Fulfillment Performance	6	5.427	1.127	0.443	0.459	0.543	(0.771	
5	RFID	2	3.972	1.606	0.321	0.390	0.322	0.216	(0.897)

Notes.
1. SD = standard deviation, 2. Diagonal elements display the square root of AVE. All correlations are significant at $p<0.01$

Data Analysis

We employed structural equation modeling (SEM) to test the proposed model in Figure 1. The two-step model-building approach recommended by Anderson and Gerbing (1988) was adopted in this study. The first step analyzed the measurement model, which specifies the relationships between the observed variables (indicators) and latent variables (factors). This step aims to assess the measurement quality of constructs (reliability and validity) by using the confirmatory factor analysis (CFA) approach. The structural equation model assesses both the direct and indirect relationships among the latent variables (Byrne, 1998; Wisner 2003). Confirmatory factor analysis (CFA) was performed on all scales to assess the measurement quality of constructs. RFID, Visibility, Traceability, Agility, and Fulfillment Performance are five constructs considered in the measurement model. The major fit indices of the measurement model include chi-square (χ^2), the ratio of chi-square divided by degree of freedom (χ^2 / df), comparative fit index (CFI), and root mean square residual (RMSE). The resulting χ^2= 1304.695, df =517, χ^2 / df = 2.52, which is within recommended range 1 and 3; (CFI)= 0.929, which is larger than the recommended cutoff value of 0.90 (Hu and Bentler, 1999); (SRMR)= 0.062, which is less than the recommended value 0.08, hence the measurement model is deemed satisfactory (Hu and Bentler, 1999). The fit statistic indicates that the model fit is adequate based on the cutoff values proposed by Iacobucci (2010).

The measurement fit of the constructs was examined by assessing convergent, discriminant validity, and composite reliability. First, the convergent validity of the measurement model was assessed by examining the standardized factor loading of each construct. As shown in Table 1, standardized factor loadings for all measurement items range from 0.60 to 0.93, which is larger than the recommended minimum value of 0.50 (Chin, 1998), indicating a reasonable convergent validity of measurement items for each construct. Second, discriminant validity could be achieved if the square root of the average variance extracted estimate (AVE) for each construct is larger than the correlations between the construct and other constructs (Fornell and Larcheker 1981; Chin, 1998). Table 2 presents the squared root of AVE on the diagonal, which was greater than the correlation between the constructs, indicating that each construct is more related to its own measures than to other constructs, providing support for discriminant validity among the constructs (Chin, 1998). Finally, composite reliability was assessed to measure the internal consistency of the construct. As shown in Table 1, the resulting CR for each construct is above the recommended value of 0.80 (Gefen et. 2000), adequately demonstrating measurement reliability for all constructs. Taken together, the evidence supports the reliability of the constructs and their measurement items. Table 2 provides the means and standard deviations of the constructs, along with correlations between them. Overall, all constructs are qualified for use in testing and evaluating our hypothesis.

RESULTS

In order to test the proposed model, structural equation modeling was used as the appropriate statistical method. We use the Mplus 8 (Muthen and Muthen, 2017) tool to estimate structural models with

TABLE 3 Assessment of Model

Latent factor	Visibility	Traceability	Agility	Fulfillment Performance	Hypotheses assessment
RFID	0.233**	0.330***	0.137 (p=0.064)	-0.012	H_{1a},H_{1c} supported H_{1b} partially supported
Visibility	-	-	0.235** (p<0.01)	0.202 *	H_{2a},H_{3a} supported
Traceability	0.499***	-	0.366**	0.344 **	H_{2b},H_{3c} supported
Agility	-	-	-	0.147 (p=0.071)	H_{3b} Not supported

Notes: Table reports standardized coefficients. *p<0.05;**p<0.01;***p<0.001

Maximum likelihood estimation. Our analysis also assessed the mediated relationship between variables using the bootstrapping method (Preacher and Hayes, 2008; Shrout and Bolger, 2002). Our mediated process model approach indicates a mediation effect from RFID to Supplier Traceability to operational

responsiveness, agility. The effect is fully mediated as the direct effect is not significant, but the indirect effect is significant. Indirect and direct effects for the bootstrapped model using 5,000 bootstrap samples are included in Table (4).

TABLE 4 Structural equation model result with mediation effect

Structural path	Effect	SE	t-value	p-value
				0.038
RFID-VS-FP	**0.047**	0.023	2.077	0.153
RFID-VS-AG-FP	0.008	0.006	1.428	0.001
RFID-TC-FP	**0.114**	0.036	3.186	0.108
RFID-TC-AG-FP	0.018	0.011	1.606	0.146
RFID-TC-VS-AG-FP	0.006	0.004	1.453	0.001
RFID-TC-AG	**0.121**	0.035	3.471	0.014
RFID-TC-VS-AG	**0.039**	0.016	2.463	0.019
RFID-VS-AG	**0.055**	0.023	2.341	

Notes: The table reports standardized coefficients. VS, Visibility, TC, Traceability, AG, Agility, FP, Fulfillment Performance.

The results of hypothesis testing are outlined in Table 3. The findings supported the first three hypotheses about RFID. H_{1a} states that RFID is positively related to traceability. The study supports this relationship as the path coefficient is 0.330, the t-ratio is 4.876 and p<0.01. H_{1b} states that RFID is positively related to organizational transparency visibility. The current study finds empirical support for this relationship as the path coefficient is 0.383, the t-ratio is 5.858 and p<0.01. This indicates that RFID has direct effect on organizational transparency visibility. H_{1c} states that RFID is related to agility because of the lack of information integration process. The study finds no support for this relationship as no significant path from RFID to Agility exists. This finding reinforces our belief that RFID leverages the supply chain responsiveness operation dimension through the integration of real-time information into transparency capability. Both dimensions of transparency, stakeholder Visibility ,and supplier traceability, have a positive relationship with agility, providing support for H_{2a} and H_{2b}, indicating that having stakeholder visibility and supplier traceability in the supply chain
will improve response speed to market. H_{3a} is supported that the supplier traceability dimension of supplier transparency is positively related to order fulfillment quality. We find evidence to support H_{3b} that the shareholder visibility dimension of supplier transparency is positively related to order fulfillment quality. H_4 states that agility is positively related to fulfillment performance achieved by the firms represented in our sample. Surprisingly, the study marginally supports this relationship as the path coefficient is 0.147, the t-ratio is 1.921, and p=0.055.

DISCUSSION AND CONCLUSION

This research provides empirical evidence to support that the suppliers within a supply chain allow firms to leverage big data benefits via its transparency across the supply chain (Richey et al., 2016). The result indicates that firms implementing joint information-sharing solutions with suppliers, such as RFID, provide themselves with a plethora of information, but that information should be transmitted within the supply chain by assimilating continuous and thoughtful feedback during the implementation process (Morgan et al., 2018; Adam et al., 2014). In other words, investing in information technology that provides accurate, timely, complete, and usefully formatted information does not alone appear to

directly influence an organization's ability to respond to the change occurring in the business environment. The stakeholders' visibility, another dimension of transparency, obtained by assimilating timely RFID information and stakeholder feedback reduces uncertainty and creates a shared understanding of information. The obtained greater transparency allows stakeholders to see further along an organization's supply chain (Carter and Rogers, 2008), providing a holistic view of supply chain operations and enabling firms to monitor operation activities and manage supply chain risks.
This research also clarifies the link between IT implementation and performance outcomes. Our research examined the direct and indirect effects of transparency on operational supply chain performance, including order quality, and delivery. This result indicates that the specific information must be processed and shared among internal supply chain stakeholders, like suppliers, to become more actionable. The information communicated in this way enables supply chain partners to enhance supplier transparency. The mediating effect of partner transparency between RFID and fulfillment performance indicates the facilitating role of transparency. Such studies are important, given the rapid growth in technologies that are aiming to support huge advances in supply chain transparency.

Implication for Theory

The results of this study make several contributions to the literature. This study investigated how supply chain responsiveness is created through SCT, built by technology (RFID). In contributing to the responsiveness view, our study examines how firms in a partnership can achieve operational responsiveness (short-term process adjustments in the supply chain) through supplier traceability and stakeholder visibility. The findings indicate that SCT is an antecedent of SCA in a supply chain context. A supplier can be a significant source of knowledge to help develop the capability to enable responsiveness. Recent studies have empirically examined the impact of visibility on supply chain responsiveness strategic and policy dimensions, adaptability, and flexibility (Morgan et al., 2023), but not on agility. We further extend the responsiveness View study by using RBV to explore the antecedents of supply chain responsiveness. Our study suggests a significant positive relationship between SCT and agility, extending the SC responsiveness literature (Richey et al., 2022).
The second contribution lies in using RBV and the dynamic capability view to investigate the effect of supply chain agility on supply chain performance. RBV approach focuses on explaining sustainable competitive advantage. Our study's specific motivation is to understand the process required when IT is utilized to provide SCT. As well as to understand the value that was derived by providing SCT. Answering these questions involves reflection on SCT in practice by examining specific use cases of RFID. The third contribution lies in providing an understanding of the value creation of transparency. Our study underscores that visibility and traceability serve as two dimensions of SCT. A company can develop traceability by using technology for more accurate data collection. Once a company successfully develops the traceability capability, sharing information about its supply chain with stakeholders becomes a critical decision point regarding the transparency a firm aims to provide (Morgan et al., 2023). Traceability can enhance visibility. Company needs to coordinate and deploy a plan to leverage the available information to relevant stakeholders. If a disruption occurs due to threats in the supply chain, firms can communicate with stakeholders about the interruption and quickly pivot their operation processes to achieve responsiveness. Thus, SCT provides managers with information and visibility to work with supply chain partners to achieve supply chain responsiveness.

Implications for Practice

The current study may provide insights to managers contemplating investing in IT to improve supply chain transparency and, subsequently, their supply chain operational responsiveness. Our study offers several useful directions to supply chain and logistics managers involved in the supply chain design. First, the result of the study can be utilized to understand how resources can be selected and used to achieve supply chain transparency. Sharing accurate and relevant information would contribute to better supplier traceability, and integrating stakeholder insights leads to stakeholder visibility. Coordinating and applying strategy to communicate SCT to stakeholders effectively is critical to achieving SCT. Companies under pressure to disclose their supply chain practice can gain insight about how to develop it. The alignment of SCT to the company's larger set of goals is critical to emphasize because managers need to decide what information should be disclosed (Sodhi and Tang, 2019). The visibility aspect of SCT is associated with internal and external communication to stakeholders about various aspects of supply chain information (Morgan et al., 2018). Firms considering how to utilize that information for internal decision-making should be aware that the content and extent of information disclosed should be consistent with the company's broader stakeholder management strategy.

Our results illustrate differential effects on supplier traceability and stakeholder visibility on supply chain agility, providing an enhanced understating of how managers can use SCT and combine those two dimensions. This study offers guidance to organizations and their top managers regarding the resources needed to create supply chain transparency that impacts supply chain operational responsiveness and, therefore, their capability to be responsive and provide better fulfillment performance in the competitive market. The result supports that a firm with IT use enables a supply chain to be more agile through supplier traceability and stakeholder visibility. It also gives managers a use case that demonstrates how to enhance supply chain responsiveness using IT. As one example, adopting RFID can achieve supply chain transparency via supplier traceability and stakeholder visibility capability. For small companies, especially those who can only afford RFID, the study highlights how SCT can be leveraged to allow them to develop supply chain responsiveness capability. Managers should approach SCT with the understanding that they should carefully consider the value creation of SCT to ensure alignment with strategic planning and appropriate corporate managerial action.

Limitations and Future Research

The limitations and future research directions are outlined. First, our research utilized SCT to explain the operational dimension of the responsiveness view. Our study focuses on applying process-oriented adjustment of agility rather than strategic adjustments of adaptability and flexibility (Richey et al., 2022). Future research could investigate other dimensions of Responsiveness, such as adaptability, flexibility, and improvisation to understand better how organizations build superior responsiveness (Richey et al., 2023). Our study utilized cross-sectional data to test research hypotheses. For future research, we recommend further collecting data from longitudinal studies to confirm our conclusions and account for other factors. It may be useful to conduct our study in specific sectors to understand the role of supply chain transparency and its role in creating operational responsiveness in the supply chain. Examining SCT through the use of RFID is a limiting factor. Companies can leverage SCT with other technology. It would be helpful for future studies to contrast how resources are orchestrated for SCT with other technology, such as blockchain, artificial intelligence, or without technology. This study addresses how RFID can facilitate SCT; a successful implementation requires the integration of technology across all members of the supply chain because RFID has been mature enough for us to test the effect without any lagging effect due to IT integration.

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