

The Role of Green Initiatives, Digitalisation and Procedural Justice in Maturing Supply Chain Agility

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Abstract

While making an appeal to the institutional theory and the stakeholder theory, the study seeks to investigate the effects of three important drivers of supply chain agility, transcending multiple layers of external environment. A PLS-based structural equation model using a survey data obtained from 301 employees working in Logistics and Transportation sector reveals that green initiatives, digitalisation, and procedural justice that correspond to the physical, societal and the task environments subsequently amplify supply chain agility. Further, while employing environmental uncertainty as the critical moderating contingency, it has been found that the instrumentality of green initiatives and digitalisation in maturing supply chain agility gets enhanced with rising environmental dynamism. However, the moderation effect for the procedural justice could not be empirically substantiated. Besides contributing to the scholarly discourse by offering significant insights into new-fangled environmental contingencies of supply chain agility, the paper advances some useful implications for practitioners as well as suggestions for future research.

Keywords

Supply Chain Agility, Green Initiatives, Digitalisation, Procedural Justice, Environmental Dynamism, Institutional Theory, Stakeholder Theory

1. Introduction

With the advent of soaring globalization, though opportunities have abounded, but the uncertainties and risks associated with it have also increased manifold, necessitating the organizations to augment capabilities to respond quickly (generally referred to as agility) to the expected and/or unexpected disruptions, as a

failure in doing so may adversely impact the economic, social and sustainability bottom lines (Adobor & McMullen, 2018; Yaqub et al., 2023). However, globalization has not been the sole bolster to agility, disruptions caused by natural disasters (to include earthquakes, hurricanes, volcanic eruptions etc.), man-made disasters and/or the outbreak of global pandemics (such as Covid-19) by drastically affecting firms' performance in general and supply chain performance, in particular (Ivanov & Dolgui, 2020) have made supply chain agility a herald to even survival, let alone success. In other words, such Tempestuous circumstances pose significant challenges to the efficient and effective functioning of supply chains obligating agile responses to such disruptions so as not to let them undermine competitiveness. Being agile is evolving fast into a qualification attribute for supply chains to thrive as a competitive supplement to organizational performance (Blome et al., 2013; Brusset, 2016; Ngai et al., 2011; Swafford et al., 2006, 2008; Yusuf et al., 2014). The volatile and fraught global economy will continue to perturb supply chains in terms of vulnerability, ambiguity, and complexity, in the times to come. Hence, having globalized, leaner, just-in-time and agile supply chain networks would remain crucial to avert aversive supply chain performance outcomes in the face of rising environmental dynamism.

In turbulent environments, an organization's supply chain must be able to adapt and react flexibly and promptly when changes occur (Gligor et al., 2013). As a result, developing an agile supply chain capable of effectively responding to the potential threats and disruptions caused by the rising environmental uncertainty has emerged as a significant resource. Building agility is regarded as a critical strategic asset that allows the supply chains to anticipate, react, and act quickly in the context of unexpected situations (Seville et al., 2015). Supply chain agility (hereafter SCA) is a crucial concept for executives who wish to enhance their SC's capacity to handle any unexpected challenges (Jain et al., 2017). According to Hendry et al. (2019), SCA generally corresponds to the SC's capability to deal with instantaneous disruptive actions, hence regaining the previous level or an even better performance level. As such, SCA can be viewed as a situational capacity gained over time and through adaptations in response to a series of disturbances (Scholten et al., 2014). Firms need to keep ameliorating their supply chain operations and logistics management systems over time to ensure that the right goods consistently reach the right (internal and external) customers at the right time (Rejeb et al., 2021; Perussi et al., 2019; Treiblmaier, 2018; Treiblmaier et al., 2020).

The supply chain must be reflective of the requirements of the market and the business environment. Being agile remains a vital strategy for supply chains to provide the benefit of rapid responsiveness and flexibility to meet changing and unforeseen market demands (Raji et al., 2021). Therefore, its design must include flexible mechanisms to react effectively to the shifting dynamics of the business environment. To keep pace with disruptions caused by environmental dynamism is cardinal to enhancing organizational performance across all sec-

tors, and the supply chain remains absolutely no exception (Craighead et al., 2017). In a marketplace where environmental pressures continue to mount, it is essential for supply chains to have the ability to adapt rapidly and yield a quick and effective response to such external changes (Lee, 2002). Being able to handle this kind of high level of volatility and unpredictability means that companies need to demonstrate agility within their supply chains to deliver outstanding levels of value with innovative products, overcome any potential threat to business disruption, whilst maintaining an uninterrupted level of quality service to their clients. Accordingly, the interplay between external environment and supply chain agility has gained more popularity as more and more practitioners and researchers are progressively devoting their time, resources, and efforts to better comprehend and/or configure their supply chain in the face of rising environmental dynamism.

In recent times, the outbreak of COVID-19 and a need to confront it has piqued the interest of many researchers and practitioners alike to explore new and efficient ways of maturing supply chain agility (Ivanov & Dolgui, 2020). While making an appeal to institutional theory (DiMaggio & Powell, 1983) and the stakeholder theory (Freeman, 1984), the present study seeks to enrich the scholarly discourse on this environment-SCA interplay by investigating the impact of three leading contemporary pressures stemming from the three distinct layers of external environment in blooming SCA. More specifically, it seeks to first conceptualize and later empirically substantiate the contention of how green initiatives (physical environment), digitalization (societal environment) and procedural justice (task environment) could galvanize SCA under varying permutations of environmental dynamism. The study destines not only to contribute to theory through the development of broad based theoretical underpinning of key developments in contemporary business environment but also seeks to help practitioners in their quest to develop more efficacious mechanisms and instruments to enhance their competitive position through the flourishing of agility of their supply chains, for after all businesses are no longer in competition with each other as independent units, the battle lines are being increasingly drawn along the supply chain frontiers (Christopher & Towill, 2001). The novelty of this research lies in its inclusion of three highly contemporary issues/antecedents transcending multiple layers of external environment in explaining dynamics of supply chain agility, and that too from a South Asian perspective which is not being paid that significant attention in contemporary research despite region's profuse contributions in the global economy.

The subsequent segments of this paper are structured like so. The section underneath, besides presenting an account of the relevant literature, highlights some research gaps and subsequently outlines a theoretical framework to bridge these research gaps. Section three explains methodology of this research. Section four discusses analysis of the data as well as results ensuing from this analysis. Section five presents a discussion on the (empirically substantiated) cause and

effect relationships among the subject constructs. The final section discusses some theoretical and managerial implications besides highlighting certain limitations as well as some suggestions to the aspiring researchers.

2. Literature Review

A competitive advantage can be derived from a wide range of sources, for example, outstanding quality, sophisticated technology, rapid reaction to changing market needs, or differentiated products and services, though it is most sustainable when it is complex and hard to replicate (Chen, 2019). According to Fine (1999), businesses are no longer in competition with each other as fully integrated independent units, but the battle lines are being increasingly drawn along the supply chains (Christopher & Towill, 2001). Therefore, to stay competitive in contemporary business environments, firms need to cooperate, collaborate, and coordinate with actors in their supply chain networks for superior value co-creation (Van Hoek et al., 2001). Therefore, competitive advantage of a firm now revolves more around its capacity of designing, managing, leveraging and/or continuously adapting its supply chain partnerships especially when institutional and stakeholder pressures surmount (Lee, 2002). Being able to adapt to high volatility and unpredictability entails firms to demonstrate agility within their supply chains to deliver outstanding levels of value with innovative products, overcome any potential threat attributable to environmental disruptions, whilst maintaining an uninterrupted level of quality service to their clients. Companies need to keep upgrading (or reconfiguring) their supply chain operations and logistics management systems over time to guarantee that the right goods reach the right SC actors (suppliers, middlemen, customers) at the right time (Rejeb et al., 2021; Perussi et al., 2019; Treiblmaier, 2018; Treiblmaier et al., 2020; Yaqub et al., 2023).

Wheelen et al. (2018), while elaborating upon the impact of external environment on the choice of strategy, outline three layers of external environment namely physical, societal and task environments. The physical environment corresponds to physical resources, climate, and wildlife. The societal environment comprises social, cultural, political-legal changes and technological forces. The task environment includes various stakeholders (e.g., suppliers, shareholders, customers, middlemen, investors etc.) that could wield variant influences on organizational performance. Most of the researchers, while seeking to study influences of certain environmental contingencies, generally include factors from the same layer of the external environment. Studies involving influence transcending across multiple layers are scarce. This study seeks to make up for this deficiency by including three important developments in contemporary external environment that has constituted a significant chunk of the scholarly debate in recent years. Specifically, it seeks to investigate the instrumentality of green initiatives (physical/ecological), digitalization (societal/technological) and procedural justice (task) in maturing the much-needed supply chain agility under va-

rying permutations of environmental dynamism. The underpinning theoretical frameworks have been the institutional theory (DiMaggio & Powell, 1983) and the stakeholder theory (Freeman, 1984). The following section briefly explains both.

2.1. Institutional Theory

DiMaggio and Powell (1983) proposed the institutional theory that pinpoints the existence of three types of environmental pressures (namely, normative, coercive, and mimetic) that drive organizations to undergo a certain change to sustain their performance. The coercive pressures could be attributed to the formal or informal authority subjected to governmental laws, regulations and/or cultural and social expectations. The normative pressures stem from the demands/expectations of the market and stakeholders. The memetic pressures generally emanate from uncertainty that may induce organizations to imitate or model other successful organizations. These external pressures represent the basic factors behind organizations' isomorphic changes and their adoption of contemporary developments. Recent years have witnessed increased coercive pressure for sustainable business practices from the governments through enacting environment protection laws, regulations, and penalties for noncompliance. Second, the normative pressures caused by market, customers and other stakeholders demands for environmentally friendly products have augmented the coercive pressures for sustainability and/or green initiatives. Third is memetic pressure which causes the organizations to model other key organizations in implementing environmental or green initiatives to decouple uncertainty in their business environments (Sarkis et al., 2011). Similar pressures have urged organization to enhance their digital capabilities, that in this digital age have become a vital precondition for sustained competitiveness. Finally, in an age infested with outsourcing, Raab et al. (2018) note that organizations (co)-exist within a network of social entities and their (collective) performance is significantly affected by the quality of their social embeddedness (Yaqub & Mandurah, 2017). A profound need for creating a relational space characterizing fairness, mutuality and justice is cardinal to ensuring such quality of social and structural embeddedness, and there are all sorts of institutional pressures to ensure it, especially the procedural justice.

2.2. Stakeholder Theory

Proposed by Freeman (1984), stakeholder theory that centers upon the maximization of stakeholder value through meeting/exceeding their demands/expectations, has progressively grabbed a lot of attention in management research (Ameels et al., 2003). Munteanu et al. (2012) contend that, in a period of profound economic and social transformation, the stakeholder perspective is the most suitable framework for strategic thinking. In today's dynamic and competitive marketplace, time has become quite a significant competitive contingency on the mar-

ket performance (Stalk, 1988). In an age of time-bound competition, it is getting increasingly vital to be able to satisfy volatile demands/expectations of internal and external stakeholders all along the supply chain with utmost responsiveness, despite high variability (Stalk & Hood, 1990). Responding effectively to the stakeholder demands takes much more than just being fast. It also calls for a great deal of ability to maneuver, which is nowadays referred to as agility (Christopher, 2000). Being agile remains a vital strategy for supply chains to provide the benefits of rapid responsiveness and flexibility to meet changing and unforeseen market as well as stakeholders' demands (Raji et al., 2021). The supply chains must be robust to the changing requirements of the internal and external stakeholders. Therefore, SC design must include flexible mechanisms to react effectively to the shifting dynamics of the internal and external business environment. To keep pace with disruptions caused by environmental dynamism is rudimentary to enhancing organizational performance across all sectors, and the supply chain remains absolutely no exception (Craighead et al., 2020).

While making an appeal to both the institutional theory and the stakeholder theory, we have proposed a framework that elaborates upon the instrumentality of green initiatives, digitalization, and procedural justice in enhancing supply chain agility while taking environmental dynamism as the critical moderating contingency. The following section outlines the model and discusses the hypothesized cause-and-effect relationship among the subject constructs.

2.3. The Conceptual Model & Hypotheses of Study

As envisaged in Figure 1, while extending institutional theory and stakeholder theory to the SCM context, it has been hypothesized that increase in green initiatives, digitalisation and procedural justice enhance supply chain agility. However, the cause-and-effect relationships among the subject constructs may vary with the changing permutations of environmental dynamism.

The following sections elaborate further upon the nature and hypothesized relationships among the subject constructs.

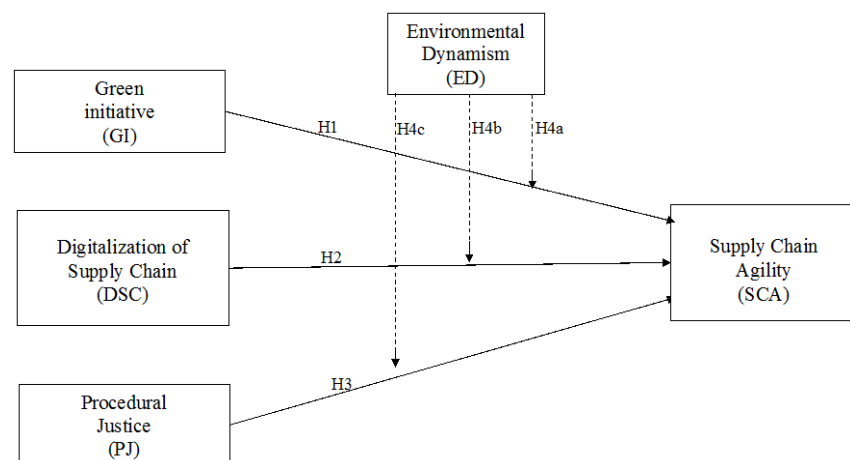


Figure 1. The conceptual model.

2.3.1. Supply Chain Agility: The Outcome

The concept of agility which generally refers to being swift, mobile and being able to respond quickly and smartly to sudden changes in the surrounding environment have been first mentioned by the Iacocca Institute (Jermisittiparsert & Srisawat, 2019). Agility of an organization corresponds to its capability to react to the market changes promptly and tellingly. It is a multidimensional concept that includes customer agility, internal and external agility, suppliers relationship agility and supply chain agility. Applying this notion to an organization's supply chain corresponds to the ability of its supply chain to respond rapidly, efficiently, and compellingly to the fast changes in the market dynamics and environment uncertainties. Irfan et al. (2019) describe SCA as the ability of the organization to respond and capitalize on the dynamic changes in the business environment. Ismail and Sharifi (2006) describe SCA in terms of "the capacity of the supply chain viewed in its entirety as well as its partners to quickly adapt the network and its operations to meet the dynamic and turbulent needs of the demand network". SC agility is sometimes confused with SC flexibility. However, the two are overlapping but distinct phenomenon. SC agility refers to the ability to respond to the unpredictable external environment such as market changes of supply and demand, whereas flexibility is referred to the ability of the supply chain to respond to the internal changes (Dhaigude & Kapoor, 2017; Irfan et al., 2019). Rajagopal et al. (2016) reveal SCA as the strategic ability of an organization to detect and respond to environmental changes. SCA is a strategic capability that enables firms to quickly detect and respond to internal and external changes by integrating supply chain relationships effectively (Braunscheidel & Suresh, 2009; Fayezi et al., 2016). It is represented by cognitive and physical skills that assist the firm to sense changes, opportunities, and challenges rapidly, access appropriate data, make effective responding decisions, quickly execute decisions, and adjust its set of supply chain strategies and operations to the extent required to apply the firm's strategy (Gligor et al., 2013). SCA has emerged as a critical prerequisite for surviving in a competitive and unpredictable environment (Brusset, 2016; Gligor et al., 2013; Kim & Chai, 2017).

2.3.2. Green Initiatives and SCA

Many researchers argue that institutional pressures influence supply chain management to pursue green initiatives (Vanalle et al., 2017; Zhu et al. 2013). Under intense institutional pressures, organizations employ their resources wisely and implement broader environmental practices to respond to their stakeholders and maintain a competitive advantage (Sarkis et al., 2011; Wu et al., 2012). In response to the amplified demand from regulatory and market authorities such as governments, consumers, public rights institutions and others, organizations have been progressively adopting "green" or environmental initiatives to fulfill their stakeholders' demands and enhance their environmental footprints. Consequently, green supply chain management (hereafter GSCM) has evolved as an approach to minimize environmental hazards and lessen various kinds of wastes

aiming at enhancing the environmental and operational efficiency of organizations (Vijayvargy et al., 2017). Accordingly, the application of GSCM has been receiving consistent attention alike from both industry and academia and many studies have been conducted to explore the impact of implementing GSCM on various aspects of organizational performance (Luthra et al., 2015). In Yu, Lo, & Li (2017)' opinion, it is reasonable to assume that top managers perceiving greater institutional and/or stakeholder pressures will endeavor to enhance firms' environmental performance through energy efficiency improvement, enhanced waste management, and increased use of recycled materials (Sarkis et al., 2011). The organizations also benefit from the consequent enhancement in stakeholder relations, reputation, and brand value (Seles et al., 2018).

GSCM is viewed as an advancement of the traditional supply chain management concept, within which various practices and activities are implemented to decouple or reduce the harmful impact of business operations on the environment. As such, GSCM involves embedding the environmental issues into the supply chain management with the purpose of balancing the environmental and economic performances to enhance the overall sustainability of organizations (Shafique et al., 2017). GSCM practices can be categorized into internal and external GSCM practices. The first category involves activities and practices that are implemented and managed by a single organization which constitutes eco-design and internal environmental management, these are local procedures of GSCM. However, external GSCM activities call for green initiatives sparked integration and cooperation with SC partners, to include green environmental cooperation activities, green purchasing, and reverse logistics (Ahmed & Najmi, 2018; Bon et al., 2018; Roehrich et al., 2017; Zhu et al., 2012). GSCM incorporates the environmental consciousness into supply chain operations and decisions with the aim of satisfying stakeholders, reducing negative impacts of operations, and enhancing organizations' sustainability performance (Malviya & Kant, 2017).

Many researchers argue that institutional pressures influence supply chain management to pursue green practices (Vanalle et al., 2017) that may prove to be instrumental in enhancing SCA. Raj, Agrahari, and Srivastava (2020) found that green procurement enhance SCA through responsive and efficiency, the two crucial constituents of SCA. Sheu, Chao, & Hu, (2005) and Nyaga & Acoura (2020) highlight that organizations seeking to meet their SCA goals need to adopt green practices like eco design & packaging, and green procurement. Filho et al. (2019) found that adopting green practices besides minimizing harmful ecological and social effects enhances speed and quality of delivery services. Concomitantly, Chogo & Kitheka (2019) and Mukherjee (2019) found that green purchasing and eco design & packaging enhance timeliness and flexibility of SC. Klevås (2005) notes that eco design & packaging enhances SCA as they have potential to influence all logistic activities. Yang et al. (2020) argue that green supply chain integration impacts SCA by enabling an SC-wide integration of scattered resources in addition to promoting trust and interaction among SC

partners that facilitate flow of information, another enabling condition for firms to make and orchestrate effective plans to respond to rising dynamism in the markets (Khanuja & Jain, 2022). Finally, Zhang et al. (2022) found a positive effect of green internal, supplier and customer integration in enhancing supply chain agility. In consonance with the above-mentioned scholarly discourse, we hypothesize.

H1: Green initiatives from firms positively influence the agility of their supply chains.

2.3.3. Digitalization & SCA

Some research describes SCA through the level of integration among various independent entities. These entities include the organization itself and its suppliers of products and services, the distribution delivery, logistics and warehousing as well as distribution channels. This integration can take place in two directions, the first one is the forward direction of products and the second one is the backward direction of information. To achieve SCA, organization needs to establish high degree of confidence between the supply chain network that include suppliers and partners. Therefore, the entire supply chain network should enhance their information systems and emphasize on the role of inventory and warehousing capacity to be able to respond rapidly to the changes in the volume and variety of the market demand. This allows the supply chain organization to seize the market opportunities and to mitigate the threats from the market uncertainties (Bidhandi & Valmohammadi, 2017).

SCA can be classified into two categories. The first one is related to ability to response as well as the speed of response of the supply chain. The second one is related to the ability to sense the changes in the market and the ability of the organization to deal with those changes. To sense and detect changes in the market demand and supply conditions, many researchers have emphasized the role of technologies such as information technology, automated manufacturing technologies, software technologies for resource planning etc. Researchers argued that technological advances have important role to build and enhance integration among the supply chain network (Aslam et al., 2021; Hald & Kinra, 2019; Pettit et al., 2019). Besides, these technological advances help in building the trust and confidence among the supply chain network even though they are disparate entities and are separated geographically. Through an integration of information technology firms can achieve superior virtual integration among their supply chain networks (Dhaigude & Kapoor, 2017).

The integration of contemporary digital technologies (sometimes referred to as I 4.0) may enable supply chains in yielding a real-time quick response to the environmental disruptions through amplified visibility and traceability, digitalization and disconnection of the supply chain, enhanced data protection, and smart contracting. Cloud computing and blockchain technology could cultivate SCA though enhanced visibility, predictability, and adaptability (Pettit et

al., 2019). BCT could also boost SC agility and productivity by enabling the implementation of smart contracts between supply chain partners (Ivanov & Dolgui, 2020). Many studies mention that real-time information sharing is highly critical if an organization seeks to take its supply chain to the next levels of agility, especially through nurturing good relationships with its SC partners e.g., suppliers, customers, third party logistics, subcontractors, and outsourcing, just in time JIT and E-procurement (Hald & Kinra, 2019; Kshetri, 2018; Mylrea & Gourisetti, 2017; Queiroz, Telles, & Bonilla, 2020). Moreover, reduced lead times, increased planning and flexibility are all facilitated significantly by real-time information sharing through enhanced digitalization of supply chains (Aslam et al., 2021). Suppliers, consumers, 3PLs, subcontractors, outsourcing, and e-procurement benefit from the cybersecurity dimension, which offers a safe transaction platform and increases trust among supply chain stakeholders (Cole, Stevenson, & Aitken, 2019; Hald & Kinra, 2019; Kim & Shin, 2019). Improved virtualization of supply chain activities, by integrating emerging I 4.0 technologies, allows smooth inter-company collaboration, real-time accessibility to process or product details for all involved parties in the system (Brettel et al., 2014), that in turn could aggrandize supply chain agility. Quite concomitantly, we hypothesize.

H2: Digitalization of supply chains has a significant positive effect on supply chain agility.

2.3.4. Procedural Justice & SCA

To keep up with fast-paced changes and competition, companies have begun to recognize the need to work more closely and actively with their SC partners. Mandal (2015) maintains that SCA can not be achieved without effective supply chain collaborations. Quality of social and structural embeddedness has significant bearing on the much-needed sharing of information, resources, and competencies among supply chain partners for agile responses to environmental changes (Braunscheidel & Suresh, 2009; Dubey et al., 2017; Sangari & Razmi, 2015; Yaqub & Mandurah, 2017). Christopher (2000) contends that the key to achieving sustainable competitive advantage in today's dynamic global business environment lies in the ability to harness the individual capabilities and skills of each network member to respond more effectively to the changing requirements of the global market. However, both the Institution theory (Meyer & Rowan, 1977) and the social exchange theory (Homans, 1958) maintain that collaborative behaviors are moderated by social conditions of exchange. Hence, for the SC networks to yield desired levels of agility, supportive social conditions need to culminate the prevalence of procedural justice remains one of necessary (though not sufficient) conditions.

Culmination of procedural justice that seeks to ensure fair procedures in collaborative processes corresponding to conflict resolution, resource allocation, incentivization etc. could boost quality of social embeddedness and consequent

cooperation among key SC stakeholder (Yaqub, 2009; Yaqub & Mandurah, 2017). Being an enabling condition in developing, nurturing, and maturing SC stakeholders relations, procedural justice increases efficacy of supply chains in yielding an effective, integrated, and adaptive response the environmental disruptions. The role of procedural justice in various constituent SC contexts has been examined by previous researchers. del Río-Lanza et al. (2009) examined the role of procedural justice in enhancing customer responsiveness in service delivery firms. Aref & Redzuan (2009) claimed that procedural justice has a positive influence on customer satisfaction through procedurally just complaint handling (Aref & Redzuan 2009). Boyd et al. (2007) examined and corroborated the efficacy of procedural justice in the context of global supply chains. Finally, Lee and Back (2006) provided further empirical evidence on similar interactions through their longitudinal study conducted in tourism context.

***H3:** There is a significant positive relationship between procedural justice and supply chain agility.*

2.3.5. Environmental Dynamism (ED) as the Moderator

According to the contingency principle, organizations must adjust their systems to their environment to achieve high efficiency (Donaldson, 2001; Sousa & Voss, 2008). To differentiate between various contexts, it is necessary to map the internal and external environmental factors that can affect productivity and efficiency of the organizational systems, structures, and procedures. According to strategic management theory, companies must consider and integrate implications from their environments in order to survive and succeed, as environments provide a backdrop for their operations and behaviors (Porter, 1985). It is critical to recognize that environments are composed of multiple dimensions, types, and layers with distinct characteristics with varying degrees of change that may exert varying degrees of influence on an organization's operations and behaviors (Miller & Friesen, 1983). While investigating the relationships between environments and strategy-making, Miller and Friesen (1983) identified three distinct facets of environmental change i.e., dynamism, uncertainty, and hostility. Environmental dynamism refers to the frequency and intensity of environmental change (Dess & Beard, 1984), environmental complexity corresponds to the heterogeneity or variety of environmental factors (Dess & Beard, 1984; Child, 1972), while environmental hostility refers to the danger that unfriendly competition poses to firms' environments (Tajeddini & Trueman, 2016). Considering environmental dynamism as to be the most relevant facet of environmental turbulence to our study context, we have used it as the critical contingency moderating effects of green initiatives, digitalization and procedural justice on supply chain agility hypothesizing that the instrumentality of the three drivers of SCA increases with the rising environmental dynamism. As such, we hypothesize.

***H4a:** Environmental dynamism moderates the relationship between green initiative and supply chain agility.*

H4b: *Environmental Dynamism moderates the relationship between SC digitalisation and supply chain agility.*

H4c: *Environmental dynamism moderates the relationship between procedural justice and supply chain agility.*

3. Research Methodology

3.1. Measurements

Supply chain agility has been measured through seven items, adapting scales used by Qrunfleh and Tarafdar (2013), and Soares et al. (2017). The construct *Green Initiatives* has been operationalised as a higher order construct through 11 first order indicators while employing scales used by Hsu et al. (2013). The *Digitalisation* construct has been gauged through five items adapting scale used by Saraph et al. (1989). The construct *Procedural Justice* has been measured using 10 items that were used by Kim and Chai (2019). Finally, the moderating condition *Environmental Dynamism* has been operationalised through four items proposed by Wamba et al. (2020). The responses in all these measurements have been recorded on 5-point Likert scales.

3.2. Data Collection

A survey using a structured questionnaire was conducted to collect data from 310 employees working in multiple firms belonging to the transportation and logistics sector of Pakistan. This sector has been selected for its perceived higher relevance to the conceptualized interactions among the causes and effects in the context of our study. Since it is quite difficult to obtain a sampling frame for such data due to the reluctance of firms in sharing such information, therefore respondents were selected using snowball sampling. Moreover, as it is not customary for the business executives to participate in online surveys in Pakistan, therefore data has been collected through the personal investigation method, using a team of students from higher education institutions operating in the relevant areas. A brief introduction of the questionnaire about the nature and scope of the study has been integrated in the measurement instrument. Employees were assured that the study exhibits purely academic purposes, and their information would not be shared with any third party. After their consent, they were asked to fill out the questionnaires. They were appreciated for their time and contribution to the data collection efforts of the researchers. 310 filled in questionnaires were received, out of which nine were inappropriate to be included in further analysis. Hence, ultimate analysis was carried out on 301 data points.

3.3. Data Analysis

Smart PLS 3.0 was used to analyze the data collected through survey. Following Hair et al. (2022), PLS Algorithms and Bootstrapping were framed to evaluate the reliability and (convergent & discriminant) validity of the measurement model, as well as main effects, and the moderating effects hypothesized in the

structural model. Further, for the predictive relevance of the test, the PLS blind-folding calculations were employed in this research. A series of analyses have been carried out to test the hypotheses. First, individual item reliability is assessed through factor analysis. Second, internal consistency reliability has been measured through Cronbach's alpha and composite reliability. Third, convergent validity is gauged through average variance extracted (AVE) scores. Fourth, discriminant validity is assessed through Fornell-Larcker (hereafter F-L) criterion and HTMT ratio scores. Finally, following PLS-based regression approach, the analysis of the main effects, mediation as well as moderation effects have been performed (Hayes, 2022). PLS-SEM is a suitable instrument for analyzing multiple regression equations simultaneously. The findings emerging from this analysis are presented through the next sections.

4. Results

4.1. Assessment of the Measurement Model

The appraisal of an auxiliary model entails analyses of reliability and validity, which are generally estimated by examining indicator reliability, internal consistency (i.e., construct reliability), and convergent & discriminant validity. Statistics contained in **Table 1** reflect a profound conformance of the measurement model to all thresholds of acceptability.

4.1.1. Item & Construct Reliability

The assessment of indicator reliability involves scrutinizing standardized factor loadings against an acceptable threshold of ≥ 0.707 (Fornell & Larcker, 1981; Hair et al., 2022). All individual indicators are reliable as their standardized factor loading fall in the range from 0.75 to 0.80. The t -values for all loadings are also significant (at $p < 0.001$), showing adequate item reliability (Sanchez-Franco & Roldán, 2010). The assessment of internal consistency of all the indicators depends on joint reliability, which is assessed by examining two common types of construct reliability: Cronbach's alpha (α) and composite reliability (C.R) with a threshold score of ≥ 0.70 for joint reliability (Hair et al., 2022). With both α and C.R. indices falling in the ranges of 0.73 - 0.85, and 0.84 - 0.91 subsequently shows acceptable levels of internal consistency of items, thus confirming adequate reliability.

4.1.2. Convergent & Discriminant Validity

An estimation of convergent validity is generally obtained through average variance extracted (AVE), which reflects enormity of a construct in explaining variance of its indicators. Fornell and Larcker (1981) recommend a reference value for this index as ≥ 0.50 . In this study, all AVE values range from 0.64 to 0.71, suggesting that each construct features sufficient convergent validity (Hair et al., 2022). Finally, the assessment of discriminant validity involves examining F-L criterion and the Heterotrait-Monotrait (HTMT) scores. According to F-L criterion,

Table 1. Measurement model statistics.

Constructs	Items	Loadings	α	C.R.	AVE
Supply Chain Agility (SCA)	SCA1	0.735	0.924	0.939	0.668
	SCA2	0.831			
	SCA3	0.876			
	SCA4	0.854			
	SCA5	0.85			
	SCA6	0.84			
	SCA7	0.811			
Digitalisation of SC (DSC)	DSC1	0.797	0.891	0.921	0.7
	DSC2	0.733			
	DSC3	0.881			
	DSC4	0.891			
	DSC5	0.87			
Procedural Justice (PJ)	PJ1	0.913	0.864	0.916	0.785
	PJ2	0.865			
	PJ3	0.878			
Green Initiative (GI)	G1	0.785	0.918	0.928	0.542
	G2	0.749			
	G3	0.712			
	G4	0.744			
	G5	0.699			
	G6	0.746			
	G7	0.68			
	G8	0.794			
	G9	0.776			
	G10	0.697			
	G11	0.702			
Environmental Dynamism (ED)	ED1	0.661	0.82	0.881	0.651
	ED2	0.858			
	ED3	0.842			
	ED4	0.85			

the square root of every construct's AVE must exceed square of its largest correlations with fellow constructs in the research model. Relevant statistics about the indicators of both types of reliability and validity are contained in **Table 1** & **Table 2**.

Table 2. Assessment of discriminant validity.

Constructs	ED	GI	PJ	SCA	DSC
ED	0.807				
GI	0.766	0.736			
PJ	0.198	0.285	0.886		
SCA	0.302	0.345	0.645	0.829	
DSC	0.201	0.27	0.775	0.769	0.837

GI: Green initiative, DSC: Digitalisation of SC, PJ: Procedural Justice, SCA: SC Agility, ED: Environmental Dynamism.

4.2. Assessment of the Structural Model

4.2.1. The Direct Effects

As could be seen in **Table 3**, H1 is supported ($\beta = 0.146$, $t = 3.138$, and $p < 0.002$) corroborating significance of the relationship between GI and SCA. H2 is also supported empirically ($\beta = 0.305$, $t = 5.529$, and $p < 0.000$) attesting to a significant positive relationship between DSC and SCA. Finally, the results also show that H3 is also supported ($\beta = 0.133$, $t = 2.670$, and $p < 0.008$), so there is a significant positive relationship between PJ and SCA.

4.2.2. The Moderating Effects

The relevant statistics for the moderating effects' analysis are presented in **Table 4**.

According to the results of H4(a) is supported ($\beta = 0.113$, $t = 2.163$, and $p < 0.031$), proving that there is a significant moderating role of ED in the relationship between GI and SCA. Secondly, according to the results of H4(b) is also supported ($\beta = 0.150$, $t = 2.726$, and $p < 0.007$), showing that ED also moderates the impact of DSC on SCA. However, a Rejection of H4 (c) implies that moderation effect of ED on the relationship between PJ and SCA could not be empirically substantiated.

5. Discussion

Fundamental environmental concerns, arguably, set the ultimate parameters for the effective management and performance of supply chains and as such define the form, scope and nature of SC collaborations, interactions and/or exchanges among its various constituents. Referring specifically to the external environment for supply chains, several ecological, societal and/or task/industry factors impact who is involved in supply chains, where value-adding activities are located, the way they are coordinated or administered, as well as their development and growth. Rapid environmental changes or disruptions magnify uncertainty, a failure to respond/adapt quickly and effectively to it could take a significant toll on the supply chain performance. Hence, organizations need to reshape, reconfigure, or adapt, especially their hybrid SC networks to the opportunities and threats emanating from environmental dynamism, complexity, and

Table 3. Assessment of the direct effects.

Hypotheses	Structural Path	B	S.D	t-value	p-value	Result
H1	GI -> SCA	0.146	0.046	3.138	0.002	Supported
H2	DSC -> SCA	0.305	0.055	5.529	0.000	Supported
H3	PJ -> SCA	0.133	0.055	2.670	0.008	Supported

GI: Green initiative, DSC: Digitalisation of Supply Chain, PJ: Procedural Justice, SCA: Supply Chain Agility.

Table 4. Assessment of the moderating effects.

Hypotheses	Path	β	S.D	t-value	p-value	Result
H4a	GI -> ED -> SCA	0.113	0.052	2.163	0.031	Supported
H4b	DSC -> ED -> SCA	0.150	0.055	2.726	0.007	Supported
H4c	PJ -> ED -> SCA	0.047	0.048	0.982	0.327	Not Supported

GI: Green initiative, DSC: Digitalisation of Supply Chain, PJ: Procedural Justice, SCA: SC Agility, ED: Environmental Dynamism.

uncertainty. A continuous enhancement in SC networking capabilities with an intent to make them more agile, responsive, and robust could go a long way in enhancing firm performance in general, and supply chain performance, in particular. SC agility together with SC flexibility and responsiveness has gained vital importance in the present times marked with high dynamism, complexity, uncertainty, and hostility attributable to a plethora of factors encompassing internal and external environments for both the hierarchical or collaborative SC networks.

To build a competitive advantage, supply chains will have to become “agile”, “aligned” and “adaptive”, also known as triple A (Lee, 2004). The supply chain’s “agility” addresses the supply chain’s speed of reaction to changes in the short term due to uncertainties experienced within sources both upstream and downstream in the supply chain. Consequently, this refers to the supply chain’s readiness to handle unanticipated movements of market needs and its ability to turn them into opportunities so that it can achieve competitive advantage within a dynamic and volatile business climate. For organizations to establish supply chain agility, they should have some capabilities. Firstly, organization should have the ability to sense and probe market to detect the early signs of the market changes. Secondly, organization should have an information system that enable the organization to establish the virtual integration among the network of suppliers, partners, distributors, and logistics where the information about the market and products can flow rapidly and accurately downstream of the supply chain network. Thirdly, organization should have the ability to establish and maintain a reliable, efficient, and effective network of suppliers and partners. While making an appeal to the institutional theory and stakeholder theory, we

conceptualized that all these three capabilities could profoundly be augmented with the firms' adoption of green initiatives, digitalization and creating a relational space characterizing fairness and justice. We further hypothesized that the instrumentality of these capabilities matured due to the institutional pressures and higher stakeholder orientation increases with the rising dynamism in the environment. The empirical evidence corroborated all our hypothesized relationships except the moderation of environmental dynamism on the link between procedural justice and SCA.

In response to the amplified pressures from the regulatory and market authorities such as governments, consumers, public rights institutions and others, organizations have been increasingly adopting "green" or environmental initiatives to fulfill their stakeholders' demands and enhance their environmental footprints. Nowadays, the business environment is being reshaped by the rising demand on organizations to address the triple bottom line (Profit, People, Planet) that has ameliorated their roles as contributors to the social and environmental aspects of their communities beside their roles as economic contributors. In addition, the rising global awareness of the harmful impact of the supply chains on the ecology and environment has caused the development of managerial efforts that aim to enhance the environmental performance of organizations while achieving the target financial and market objectives. Accordingly, green supply chain management (GSCM) has evolved as an approach to minimize environmental hazards and lessen various kinds of wastes aiming at enhancing the environmental and operational efficiency of organizations. Adopting green initiatives like green procurement, eco design & packaging, recycling, reverse logistics all have significant potential to boost supply chain agility.

The emergence of innovative digital technologies has dramatically revolutionized the field of business. As a result, many businesses are moving towards automation and/or digitalization of their supply chains by implementing and using emerging technologies to seize opportunities and/or respond quickly and effectively to the threats emanating from environmental disruptions. As global companies seek to outperform their competitors by attracting more customers, they are forced not only to integrate new digital technologies (sometimes referred to as I 4.0) to their supply chains, but also to develop capabilities to leverage them. With the arrival of the fourth industrial revolution, new technologies are being introduced almost every day, radically reshaping the way humans work and live. While the main enablers and characteristics of Industry 4.0 are transforming the essence of global supply chains, it is crucial to emphasize that managing the digitalization of supply chains requires more than just keeping the same manner of running traditional supply chain in place and just digitizing all the flows of knowledge and information. Companies are increasingly integrating Blockchain technology, Internet of Things and Big Data to enable lean and adaptive processes to be facilitated across operations and supply chains. Companies use these technologies to increase the agility of their supply chains, which means speeding up

the manufacturing and distribution of products to their customers, minimizing their costs, increasing their responsiveness and being more flexible, resulting in greater efficiency. Consequently, it is important to emphasize that the entire chain structure, processes, management components and operations are transforming due to the emerging and tailor-made markets that require quick responses. Through integration of cutting-edge technologies, companies can optimize their processes. The integration of these technologies into the supply chain allows manufacturers and retailers to develop adaptable, collaborative ecosystems where they continuously interoperate with each other, and ensure a faster, more efficient, and more agile supply chain.

SCs have become increasingly complex in their way of connecting business partners, promoting cooperation, disseminating creativity, enabling data-driven decision-making, and tracking activities instantly. It is essential that SC partners collaborate strongly when it comes to supply chain agility. An integral determinant of successful SC collaboration could be the quality of structural and social embeddedness. Without culmination of trust-inspired commitment among the supply chain partners, it would be difficult to collaborate strongly and maximize mutual gains through cocreation of value, and to ensure fairness and justice (especially the procedural justice) in role sharing, conflict resolution, reward-sharing etc. is an important driver of creating a relational space capable of inspiring stronger supply chain wide commitments.

Finally, environmental dynamism that captures the essence of environmental change strongly moderates the impact of green initiatives and digitalization on supply chain agility attesting to a greater need for the two as the changes surmount. The moderation of ED for the procedural justice could not be empirically corroborated which means that it is going to stay an important precondition for SCA, no matter the degree of environmental change.

6. Conclusion

6.1. Summary

While making an appeal to the Institutional theory and Stakeholder theory, the study sought to investigate the instrumentality and complementarity between critical drivers of supply chain agility that have been pertaining to three different layers of external environment. It has been found that institutional pressures and stakeholder orientation induce firms to integrate green initiatives, digitalisation and procedural justice in their supply chains that contribute to their agility while responding to the challenges stemming from environmental disruptions. The impact of digitalisation on SCA has been found to be stronger compared to the other two. It has further been found that the instrumentality of digitalisation and green initiatives is moderated by environmental dynamism with the moderating effect being stronger for the digitalisation. The same could however not be corroborated for the procedural justice.

6.2. Theoretical Contributions

This study is one of the rarest endeavours to investigate complementarity among drivers of supply chain agility that transcend different layers of external environment. Moreover, as the study combines key phenomenon belonging to the ecological, technological, and social domains, it has a great deal potential to offer insights grounded in conceptual and contextual diversity. Use of environmental dynamism as moderator in investigating the impact of especially procedural justice and digitalisation of supply chain to boost supply chain agility is unprecedented and makes yet another contribution to expand body of the knowledge in this tradition. Another contribution of this study stems from its use of Southeast Asian data that cements the generalization of theories developed in the West to the other cross cultural and/or regional contexts.

6.3. Managerial Implications

As evidenced through this study that supply chain managers need to adopt more green initiatives, digitalisation, and procedural justice to boost their capabilities of yielding agile responses to the environmental disruptions, especially where dynamism is higher. An integration of emerging I 4.0 technologies such as Blockchain Technology (BCT), Big Data Analytics (BDA), Internet of Things (IoT) and Artificial Intelligence (AI) could especially prove to be very useful in such a quest. Moreover, SC managers needs to endure a collaborative environment characterising sufficient procedural justice since the same has been found to be highly pertinent even fi things are going somewhat stable.

6.4. Limitations & Suggestion for Future Research

Like all research, our study is also not without limitations. Firstly, our design is primarily cross-sectional, which may not be best suited for causal inferences. However, based on theoretical reasoning and strong empirical findings, we are appreciative of the explanatory value of our findings. Secondly, same source data raises concerns of self-report bias. Futures research may test this model and/or its extensions using longitudinal designs. Moreover, cross-cultural examination can provide interesting insights into how developing countries such as Pakistan compare to developed nations in this context. The same could be extended to industrial settings contexts as well. The use of mediating and/or additional moderating variables can further offer some important insights into the dynamics of supply chain agility.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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