**Role of Digital Supply Chain in promoting Sustainable Supply Chain Performance: The mediating of Supply Chain Integration and Information Sharing**

**Abstract**

**Purpose -** The study investigated the relationship between digital supply chain (DSC) and sustainable supply chain performance (SSCP) of SMEs via the lens of supply chain integration (SCI) and information sharing (IS). This study concentrates more on the mediating role of supply chain integration and information sharing in the link of digital supply chain and sustainable supply chain performance that no research mentioned before.

**Design/methodology/approach -** This research figures out how the digital supply chain impacts the performance of the organization and the supply chain. By employing a carefully designed questionnaire to gather data, a quantitative methodology was employed. Managers at the senior and medium levels were the responders who were targeted. There are 467 valid replies gathered from the primary survey. The data results were used in the analysis using Partial Least Squares Structural Equation Modeling (PLS-SEM).

**Findings** - The findings imply that SCI's function in the information-sharing process is crucial as it fosters cooperation, coordination, and connectivity throughout the digital supply chain. Furthermore, the study's conclusions offer helpful information on how businesses might enhance supply chain performance through information exchange. Businesses are constantly concentrating on the role that the digital supply chain plays as a catalyst for sustainable growth and are improving supply chain performance through supply chain integration and information exchange.

**Originality/value** – This study highlights the gaps and unexplored themes in the existing literature, catalogs the digital supply chain published in the main logistics journals, and helps people recognize and appreciate this kind of work. It also has the potential to contribute to future research on sustainable supply chain performance. Moreover, the novelty research is further reinforced by the coverage of the newfound merchaism, where SCI and IS mediate the relationship between DSC and SSCP, directly and positively enhancing SSCP.

**Keywords** Digital Supply Chain, Supply Chain Integration, Information Sharing and Sustainable Supply Chain Performance

**1.Introduction**

Numerous technological digitalisation, including Big Data, the Internet of Things, Blockchain, Cloud Computing platforms, Artificial Intelligence, Man-Machine Learning, and number of applications, aids improve the supply chain of any sector (Bughin *et al*., 2018). All industries are impacted by these innovations and digital shifts, and supply chains are no different. Supply chain digitalization now includes digital goods and services as well as supply chain management inside these rapidly evolving enterprises (Büyüközkan and Göçer, 2018). To reap the benefits of the digital supply chain, one must employ innovative strategies, such as digital transformation through technology. Stated differently, the digital supply chain may be defined as an innovative, intelligent, and value-added process that leverages new technologies and approaches—specifically, digital transformation—to generate network effects and competitive value (Büyüközkan and Göçer, 2018). Through digital changes, organizations may now take use of additional capabilities including near-field communication, location-based services, and barcode scanning (Ström *et al*., 2014). Smart technologies are a collection of features that are built into gadgets to allow intelligence and make these kinds of actions feasible. According to Yoo *et al,* (2010), these qualities enable devices to operate as programmable, addressable, sensible, communicative, memorizable, and associable. For organizations looking to transition to a digital supply chain, there is still a significant unrealized potential even though several organizations have acknowledged and proven the huge potential of digitization in supply chains (Büyüközkan and Göçer, 2018). Given the paucity of data about the ways in which digital transformation fosters more collaboration (Scuotto *et al*., 2017), further research is required to fully understand the function of smart technologies in the digital supply chain (Büyüközkan and Göçer, 2018).

In addition, insufficient information exchange, according to Singh *et al*. (2020), results in confusion and disagreements within the chain of supply, thereby undermining the ultimate goal of attaining outstanding outcomes. IS is a crucial feature of supply chain collaborations, according to Cao *et al* (2011), and as a result, partnerships within the supply chain can be built on using IS to gain a competitive edge. Research on supply chain visibility and its impact on improving supply chain procedures to achieve better competitive positions has been conducted extensively (Barrat and Oke, 2007; Williams *et al*., 2013; Caridi *et al*., 2014; Singh *et al*., 2019). This study is one of the few that includes IS as a variable in an attempt to determine its effects on supply chain visibility, collaboration, agility, and performance—even though information sharing predominated in the explanation of important concepts related to visibility, collaboration, and agility in previous research. Prakash and Pathak (2017) state that as a supply chain is maintained by the sharing of resources, money, and information between suppliers, producers, retailers, distributors, and customers, businesses are increasingly concentrating on supply chains and implementing strategies to strengthen those links.

Although DSC has been proved to have indirect effects on the company performance as well as a direct impact on 2 variables: SCI and IS, the mutual relationship of four variables has not been clarified in any research paper. Therefore, this research showed that SCI and IS play a key pivotal meditation in the link between DSC and SSCP. This study expands on the limited evidence currently available by providing insight into why in the evolving era of DSC, SCI and IS are impacting SSCP. In fact, there is little research regarding the effects of DSC on SSCP, as well as the mediating role of SCI and IS on the relationship between DSC and SSCP.

On the basis of the above arguments, this study's primary discovery and distinguishing feature is the fact that no prior literature has ever identified this process. Its application to businesses in emerging economies further emphasises how innovative this study is. Additionally, this paper explains how SCI leads to SSCP for firms in emerging economies and, more crucially, how SCI and IS lead businesses to attain SSCP. This helps fill in a gap in the research on the mediating effects of SCI and IS in promoting SSCP. Additionally, its use in developing nations highlights the distinctiveness of this research. This research targets to reply the following main questions:

*RQ1: How does digital supply chain (DSC) impact sustainable supply chain performance (SSCP)?*

*RQ2: How does supply chain integration (SCI) influence sustainable supply chain performance (SSCP)?*

*RQ3: Does supply chain integation (SCI) and information sharing (IS) mediate the relationship between digital supply chain (DSC) and sustainable supply chain performance (SSCP)?*

The recsearch results contribute that SCI plays a critical role in the information-sharing process by promoting connection, cooperation, and coordination across the digital supply chain. The study's findings also provide useful guidance on how companies might improve supply chain performance through information sharing. Companies are always focusing on how the digital supply chain can act as a catalyst for long-term growth and are enhancing supply chain efficiency by integrating their supply chains and exchanging information. According to Kim (2016), the future researches can be applied in firms in the service industry such as healthcare and finance. In addition, an inbound perspective in the supply chain could also be applied, with the supplier being the focal firm. Morever, Kim and Chai (2021) illustrated that proceed with research on the impact of digitalization in the new normal era caused by COVID-19. In addition, by combining digitalization and servitization, it intends to derive implications for the healthcare service industry was vital.

As a results, this research article not only contributes as a reference material for sustainable development methods in parallel with the digitalization of businesses, but also helps enrich academic research and serves as a foundation for future inheritance. This article is practical and urgent currently as Latin America SME’s is entering the digital transformation phase. SMEs are highly appreciated because they innovate and flexibly respond to new chances, helping to distribute products and services across the country and they create many working opportunities for women and young people (Walsh, J. 2023). Additionally, there is a great deal of division in the productive structure of SMEs in Latin America. While many SMEs are primarily focused on local markets and, at most, supply large international firms, some larger enterprises—mostly those in the natural resources and extractive industries—benefit from exposure to foreign markets (Vives, 2022). There is a potential area to develop digital and sustainable factors.

Additionally, this work makes a substantial contribution to the body of knowledge on DSC and SSCP. First, it adds to the body of knowledge by offering further concrete proof of how positively DSC affects SSCP. To further broaden the connection domain, SCI and IS are included into the DSC-SSCP relationship. Due to the paucity of studies on SCI and IS as moderators of DSC-SSCP interactions, this study's contribution is distinct. Additionally, SCI research is still in its infancy, and current literature mostly focuses on the concept's definition and evolution. Thirdly, the new scales of DSC, SCI, IS, and SSCP are made more diverse by this research.

In this study, there are six main components. Section 1 focuses on the overview of this study which relates to the information about its purpose, the range of its research, its contributions, and its uniqueness. A systematic review methodology-based research background is demonstrated in Section 2. In addition, the theoretical foundation for this research and the ideas around the variables in the research framework are covered in this part. Section 3 covers the theories before developing and outlining the structural model. After collecting data, the results are explained in Section 4. Section 5 proposed implementation for future research. In Section 6, conclusions and research directions are offered as well as mentions some limitations of this study.

**2. Review of literature**

*2.1. Foundational theories*

There were three supporting theories that were employed in this study: dynamic capability view (DCV) theory, legitimacy theory and technology.

According to the dynamic capability view (DCV) hypothesis, businesses should focus on developing their ability to recognize and incorporate changes in the global market and to take advantage of these shifts as either opportunities or hazards. The resources of the supply chain and its dynamic capacities, or how to assess and prepare for the reconfiguration and transformation of the new abilities of the supply chain, are mediated by new technologies. Furthermore, any unforeseen incident that has the potential to undermine the supply chain's sustainability qualifies as a disruption (Li *et al*., 2022; Ivanov *et al*., 2019). It might be portrayed as an unfavorable scenario or risk, and it can originate from previous events or be connected to brand-new ones (Zekhnini *et al*., 2022). These circumstances can be annoying and put the supply chain's resilience to the test (Rahman *et al*., 2022). Hence, in uncertain situations, the supply chain's agility and proactivity in anticipating impending disruptions is crucial because it can provide the chain with the time and advantage to respond and establish firewalls to stop ripple and domino effects and preserve supply chain resilience (Pattanayak *et al*., 2023; Singh *et al*., 2019).

In Barney's (1991) view, the resources of an organisation are crucial to maintaining a firm's competitive advantage. In this study, it is assumed that the SCI is a strategic resource of the company that is vital to maintaining a competitive advantage by supporting DSC initiatives and IS implementation to serve the needs of various stakeholders and address issues that are especially important to them. As a results, SCI will assist the company in maintaining a competitive edge, which will help SSCP. In addition, legitimacy, as defined by social values, norms, beliefs, and definitions, refers to the suitability and accuracy of a given entity's behaviour in society (Suchman, 1995). Legitimacy theory is used to clarify why businesses need to adhere to society norms and values and implement green business strategies (Gray *et al*., 1995).

*2.2. Digital Supply Chain (DSC)*

DSC is a group of systems that facilitate transactions and communication between global distribution firms and their supply chain partners, according to a study by Bhargava *et al*. (2013). To create learning, agile, and high-performing DSCs, suppliers, manufacturers, and customers must work together and integrate (Belinski *et al*., 2020; Tiwari, 2020). In addition, Schrauf and Bertram *et al*., (2016) asserted that digitization might alter supply chains to make them more accessible and reasonably priced in addition to making them more value. The results of these studies are consistent with the research conducted by Ching *et al*. (2018), which demonstrated that companies can enhance service quality rapidly by incorporating digital technologies into their supply chains. By establishing a digitalized and fully connected supply chain network, businesses can react to customer requests promptly and efficiently, which will ultimately boost efficiency.

*2.3. Supply Chain Integration (SCI)*

A crucial business process is supply chain management, which starts with consumers and ends with suppliers who offer goods, services, and information that benefit consumers and other stakeholders (Han and Huo, 2020; Jajja *et al*., 2018). SCI, an efficient supply chain management technique, is now crucial to enhancing performance and generating value, both of which are necessary for the success of individual businesses and the supply chain as a whole (Yu *et al*., 2021). It is frequently made to be used with shared management information systems. Integration of the supply chain is contingent upon several characteristics, including strengths, duration, scope, and depth. For the following steps to be completed, each of these requirements must be met (Ataseven and Nair, 2017). Supply chain integration requires a great deal of coordination, alignment, and internal and external cooperation to make sure that all parties is working efficiently toward the same goal (Yip and Niemeyer, 2015).

*2.4. Information Sharing (IS)*

Businesses are investing heavily in information technology because they need to be adaptable and quick to changes in the market (Yang *et al*., 2019). Businesses must have new and pertinent information created in the environment, as well as strategies for making decisions quickly based on this information, to react quickly to changes in the market (Yang *et al*., 2019). Information exchange facilitates supply chains' and businesses' ability to adjust to the changing features and dynamics of the competitive markets of today (Feizabadi *et al*., 2019; Fawcett *et al*., 2009). Dubey *et al*. (2018) state that in information to be deemed pertinent or crucial for supply chains to maintain their competitiveness, it must be written with excellence.

*2.5. Sustainable Supply Chain Performance (SSCP)*

An organization's ability to operate successfully depends in large part on SSCP. The timely and efficient supply chain evaluation facilitates the creation, implementation, and monitoring of plans (Gawankar *et al*., 2017). The increasing scope and volume of activities of supply chains is making it increasingly difficult to trace the events. Customers and purchasers will realize the full value of the goods and services if supply chains are open and disclose the numerous historical incidents linked to the products and services (Dickson, 2016). According to Kamble *et al*. (2018), all supply chain participants become equally important for integrating shared accountability and joint value generation.

**3. Hypotheses development**

*3.1. Digital Supply Chain and Sustainable Supply Chain Performance*

According to Junge and Straube (2020), the application of DSC may improve social and environmental sustainability. The beneficial effects of DSC use in supply chain logistics on sustainability were also proven by another study (Kayikci, 2018). It is notable that the study did not take into account the dimensions of digital manufacturing and digital logistics. Digital production may improve sustainable performance, as demonstrated by the application of learning algorithms in the agricultural supply chain (Sharma *et al*., 2020). According to Khanfar *et al*. (2021), the implementation of blockchain technology in digital manufacturing can enhance sustainability performance by fostering transparency, real-time information exchange, and traceability. These researchers looked at how using DSC affected sustainable performance in one of the primary supply chain operations. Thus, the following is the first research hypothesis proposed in this study:

**H1.** Digital Supply Chain (DSC) positively impacts Sustainable Supply Chain Performance (SSCP).

*3.2. Supply Chain Integration and Information Sharing*

Based on the results of SCI, proper supply chain connections built on strategic cooperation with supply chain partners may harness the flow of timely, accurate, and high-quality information (Li and Lin, 2006). Additionally, SCI fosters connections based on trust, which enhances information sharing (Kim, 2009). The strengthening of trust-based relationships between the parties, the lengthening of contracts between supply chain partners, the promotion of effective conflict resolution, the encouragement of customer responsiveness and flexibility, and ultimately the stimulation of a sense of belonging and willingness to share information all contribute to the flow of information (Yeung *et al*., 2009). Additionally, SCI gives a business the chance to concentrate on its core skills and area of expertise while seeking to connect with other supply chain participants who have a variety of resources, technological know-how, and expertise (Kim, 2009). When several parties with varying levels of experience and competence collaborate, a seamless or concealed map of information flow may be created, made possible by the connectivity that SCI fosters (Cheng *et al*., 2010). Therefore, a hypothesis is proposed that:

**H2.** Supply Chain Integration (SCI) positively impacts Information Sharing (IS).

*3.3. Supply Chain Integration as mediator in the association of Digital Suplly Chain and Sustainable Supply Chain Performance*

In particular, Haddud *et al*. (2017) have demonstrated that IoT technology directly affects both internal and external SCI when discussing the effect of I4.0 technologies. In addition, the rapid development of DSC has drastically changed how companies function and manufacture items, which speeds up the SCI process. Through networks that facilitate information sharing between suppliers and customers, information technology indirectly promotes system integration. This gives customers the opportunity to provide constructive feedback and aids suppliers in making more accurate estimates so they can deliver components and parts on schedule. Previous studies have shown that information technology may help to enhance and unite interorganizational systems and procedures in supply chain collaboration (Sanders, 2008; Chae., 2005). Moreover, operational and strategic coordination—two crucial elements of SCI—are made possible by information technology (Sanders, 2008). Supply chain cooperation can benefit from the favorable interaction impacts of spanning and outside-in information technology competence (Cai *et al*., 2016). Sharing information can encourage operational integration
(Evelyne, 2017). Based on this analysing, the hypothesis will be proposed:

**H3a.** Digital Supply Chain (DSC) positively impacts Supply Chain Integration (SCI).

Previous research indicates that SCI increases flexibility, decreases inventory, removes the bullwhip effect, improves distribution performance, and shortens cycle times (Zhao and Strotmann., 2008; Clark *et al*., 2000; Cousins *et al*., 2006). SCI in particular makes it possible for a centralized management strategy to be used throughout the extended value network composed of many partners, enabling businesses to attain higher SSCP. The task of optimizing the use of assets both internally and internationally is taken on by the integrated authority over processes and actors through the centralized handling of management, operation, and strategic decisions (Flynn *et al*., 2010). SCI uses SSCP to its benefit to convey greater adaptability, quicker turnaround times, more effectively inventory, and anticipated delivery through transparency displayed by the flow of information and products from the initial stage of purchasing raw materials to the end user (Panayides *et al*., 2009). Thus, SCI improves SSCP by delivering precise, trustworthy, and current information between supply chain partners both internally and externally inside each organization's operations. Therefore, the following hypothesis will proposed:

**H3b.** Supply Chain Integration (SCI) positively impacts Sustainable Supply Chain Performance (SSCP).

Supply chain process integration can be facilitated by digital infrastructure integration, as demonstrated by Rai and Sambamurthy (2006). The benefits of digital for customers and suppliers on customer-supplier coordination were noted by Huo *et al*. (2015). Higher information technology levels also reinforce safe and dependable supply chain operations and make it easier for partners in the chain to coordinate by enabling communication and transactions between geographically dispersed supply chain members (Cheng *et al*., 2010). Robust digital infrastructure made possible by SCI offers fast, precise, and trustworthy information, facilitating easy, affordable communication with less information ambiguity (Li *et al*., 2009). Finding the connection between SCI and SSCP, however, has not received much attention. However, empirical research indicates that for businesses to transfer the advantages of SCI into SSCP, appropriate supply chain relationships are necessary (Panayides *et al*., 2009). To attain a higher SSCP, this study specifically figured out the impact of cooperative, trust-based relationships that are collaborative and enabled by the SCI.

**H3.** Supply Chain Integration (SCI) has a significant mediating effect between Digital Supply Chain (DSC) and Sustainable Supply Chain Performance (SSCP).

*3.4. Information Sharing as mediator in the association of Digital Supply Chain and Sustainable Supply Chain Performance*

In addition, Berttram (2016) asserted that digitalization could alter supply chains to make them more accessible and reasonably priced in addition to making them more valuable. By establishing a digitalized and completely linked supply chain network, businesses can respond to client requests quickly and effectively, which will eventually boost productivity. Kinsey *et al*., (2015) asserts that DSC helps manufacturers to distinguish themselves within a more complicated web of partners, suppliers, and consumers by helping them define and understand customer behavior. However, DSC in manufacturing is essential, could refute these assertions. Only if the business accurately plans to send the crucial data along all stops within a networked system in real-time will the DSC be feasible. Furthermore, since all supply chain participants have access to the supply chain data infrastructure, DSC can uniquely help address problems pertaining to data reliability. Compared to other traceability systems, DSC offers more accurate, transparent, and safe information sharing (Iansiti and Lakhani, 2017). Thus, the following hypothesis will be put forth:

**H4a.** Digital Supply Chain (DSC) positively impacts Information Sharing (IS).

Supply chain partners can leverage IS to achieve a standardized information sharing platform by removing potential variability in the information exchanged. According to Liu (2009), SSCP is generally linked to metrics that show expenses, resource usage, and customer service. Shared information includes planning data, product and process information, organization forecasts, and more (Barlow *et al.*, 2005). As a result, parties that receive timely and accurate information are better equipped to plan their strategies and assign tasks to others, allowing for greater flexibility and responsiveness (Forslund *et al.*, 2007). Furthermore, IS plays a critical role in supporting companies in broadening their understanding base and, thus, dispersing the possible advantages of profit maximization across the organization (Ding *et al.*, 2011). Organizations that value their relationships with one another and are becoming more conscious of the advantages of accumulating knowledge as a result of cooperative knowledge sharing (Cheng *et al.*, 2010). Furthermore, supply chain partners are better able to overcome their anxieties of disclosing information and falling behind competitors due to the increased openness and mutually beneficial connections that IS develops (Zhou and Benton, 2007). As a result, we proposed the hypothesis:

**H4b.** Information Sharing (IS) positively impacts Sustainable Supply Chain Performance (SSCP).

In fact, few studies specifically look at IS's mediating role in the relationship between DSC and SSCP. In order to close this gap, the present study will investigate the connection between DSC and SSCP via IS mediation. IS aids organizations in making better decisions regarding ordering, capacity allocation, manufacturing, and material planning since it improves awareness of demand, supply, and inventory (Cheng *et al.*, 2011). In addition, supply chain stakeholder groups refine information in order to accomplish the shared objective of optimizing benefits, and managers weigh critical information to make the best choices (Abburu *et al*., 2020). All of these processes require seamless communication across the backbone of the digital ecosystem. The physical world's connectedness to networked systems and the interconnection between network ports across groups are key factors influencing the flexibility of information transfer (Napoleone *et al*., 2020). The implementation of DSC enhances the information processing capacity of the supply chain and promotes greater interoperability amongst organizations. Thus, the hypothesis will be proposed:

**H4.** Information Sharing (IS) has a significant mediating effect between Digital Supply Chain (DSC) and Sustainable Supply Chain Performance (SSCP).

*3.5. Proposed structural model*

Based on giving definitions of factors and building relationships between those factors. The research model will be proposed.

Digital Supply Chain (DSC)

Supply Chain Integration (SCI)

Information Sharing (IS)

Sustainable Supply Chain Performance (SSCP)

H1

H2

H3a

H3b

H3

H4a

H4b

H4

------------: Mediate Relationship

**Figure 1. Proposed Research Model**

**Source: Authors’ own compilation**

**4. Research approach**

*4.1. Target population and sampling procedure*

The anticipated demographic target audience for this study is manufacturing SMEs in emerging economies in Latin America area. According to Vives (2022), Latin American SMEs typically serve as lower capacity suppliers to larger, highly value-added companies. Furthermore, SMEs in Latin America tend to be "older" than in other regions due to a lower birth rate, a lack of innovation and technological advancement, and a focus more on commerce than manufacturing. However, with the development of technology, Latin America need to be transfer and apply digitalisation factors in manufacturing and processing organisations to gain sustainable development. Therefore, the study focuses on agri-food, health and humanitarian which are developing in Latin America. Managers in senior and intermediate positions make up the target audience, who are recruited via a professional social network. In this study, Google Forms was used as the primary resource for employee forms. Data was gathered from both people and corporations using Google Forms. Each respondent's contact information, position, gender, and job title are also included. Additionally, there is information about the company, including what sector it works in, the size it is, the requirements it has met, what kind of items it distributes, and other relevant details. This data has been handled discreetly by the research. Finally, a total of 467 samples were collected. Using the G\*Power Calculation software, the study found 467 participants (Hair *et al*., 2019).

*4.2. Survey instrument*

A questionnaire is the main tool used in this study to collect data. A questionnaire has been made using the items in the accompanying Table 1. In order to ensure that the survey questions are clear and that respondents can answer them, managers and testing are involved in the questionnaire validation process. The three sections of the questionnaire are as follows: Section 1 collected personal data from each responder, such as age, gender, job, and work experience. Even if the data was obtained in a previous step, the validation process is essential to the correctness of the report. Survey questions included in the second section of the project's questionnaire will be used to collect primary data. Survey questions included in the second section of the project's questionnaire will be used to collect primary data. In the final component of the questionnaire, open-ended questions about DSC, IS, SCI, and SSCP are asked with reference to manufacturing SMEs in the Latin America region.

As sample numbers rise, errors decrease. The research data was analyzed using PLS-SEM, and a sample size of at least 10 times the number of variables observed was selected. based on optimization in identifying the most significant factors and the interactions between them. Furthermore, this approach facilitates the computation and validation of the model's applicability. The scale in this study had 30 observed variables. The theoretical basis's summary of the contents and the outcomes of a conversation with 10 former managers and directors served as the foundation for the creation of the questionnaire. Table 1 demonstrates how the observable variables were translated and modified to make them grammatically, linguistically, and semantically appropriate for the situation at hand.

The purpose of this part is to assist readers comprehend the opinions of experts on this matter. Respondents are asked to choose the point on the 5-point Likert scale that best represents their opinions on the pertinent themes in order to complete the questionnaire.

**Table 1.** Constructs and items

|  |  |  |  |
| --- | --- | --- | --- |
| Constructs  | Items | Descriptions | References  |
| **Digital Supply Chain (DSC)** | DSC1 | Our organization uses real-time data analysis to track consumer interactions. | Raman *et al*. (2018) |
| DSC2 | Cloud computing allows our organization to communicate information. |
| DSC3 | The use of blockchain facilitates information exchange among suppliers and customers. |
| DSC4 | Utilizing robotics increases production capacity. |
| DSC5 | Our organization now employs robotics or intends to do so in the near future. |
| **Supply Chain Integration (SCI)** | SCI1 | We enjoy a high level of strategic alliance with our principal suppliers. | Kim and Chai, (2016) |
| SCI2 | We let our main suppliers know about our manufacturing schedules. |
| SCI3 | Our primary suppliers are informed about our inventory levels. |
| SCI4 | We communicate with essential suppliers at the highest corporate level on crucial topics. |
|  | SCI5 | With important suppliers, we have tightly linked information systems. |  |
| **Information Sharing (IS)** | IS1 | Information sharing is a tool used by supply chain to quickly communicate information with partners. | Yatuwa, (2020), Kim *et al*., (2021) |
| IS2 | Information sharing is a tool used by supply networks to quickly address members' shared demands. |
| IS3 | Information sharing is used in the supply chain to reduce information about communication distortion. |
|  | IS4 | Supply chain can use information exchange to understand market demand. |  |
|  | IS5 | Information sharing is used by supply chains to communicate partners' strategic direction. |  |
| **Sustainable Supply Chain Performance (SSCP)** | SSCP1 | Our productivity of both labor and machinery is exceeding its intended use. | Kim *et al*., (2020)Owago *et al*., (2021)  |
| SSCP2 | Our business is capable of optimizing manufacturing waste and defects to levels that are acceptable. |
| SSCP3 | Our business may provide our clients short delivery periods that they will find acceptable. |
| SSCP4 | When demand calls for it, our business can boost manufacturing capacity utilization. |
| SSCP5 | A more sustainable supply chain results in higher production profitability. |
| SSCP6 | Our business may reduce production costs by using a little amount of raw material inventories to create goods. |
| SSCP7 | The cost savings realized are far more valuable than anticipated. |

*Source: Author’s work*

*4.3. Data collection and analysis*

This inquiry employs a quantitative technique. Numerical data, mostly obtained via a questionnaire-based study, is the main source of information employed. The survey question has five potential responses, where 1 denotes "Strongly Disagree" and 5 denotes "Strongly Agree." A large proportion of survey respondents are eligible to respond to the questions because they hold management positions inside the organization. A digital questionnaire was emailed to participants who had been contacted previously in the survey process between August and November 2023. At the conclusion of the survey period, the study had 500 answers. Subsequently, the unsuitable response sheets were eliminated from the group. There were 467 valid answers gathered. The method of partial least squares structural equation modeling (PLS-SEM) was used to analyze the final data since it was hypothesized that this approach would provide the greatest fit for the current type of complicated model (Hair *et al*., 2017).

*4.4. Evaluation of the measurement model and the structural model*

The structural and measurement model has been assessed using the below methods. Therefore, Cronbach's alpha, factor loading, average variance extraction (AVE), composite reliability (C.R.), and the Fornell and Lacker criterion (Hair *et al*., 2019; Fornell and Larcker, 1981) are used to evaluate the scale's reliability, convergent validity, and discriminant validity. The structural model is examined using the metrics that are generated by bootstrapping, including path coefficients, t-statistics, p-values, and confidence intervals. The study's results are then examined in light of more current, pertinent studies.

VAF (variance accounted for) has reportedly been used by Hair *et al*. (2014) to assess IS and SCI's function as mediators in the relationship between DSC and SSCP. Accordingly, it is concluded that in cases where the VAF value is less than 20%, in cases where the VAF value is between 20% and 80%, and in cases where the VAF value is higher than 80%, IS and SCI are said to partially and entirely mediate the DSC-SSCP relationship, respectively.

*4.5. Variables and items*

The factors, components, and relevant sources from the research that formed the basis for the scale's development are listed in Table 1. The suggested scale for the relevant element in the present investigation is additionally being taken into account and modified to fit the aims of the research and the research setting.

**5. Results**

*5.1. Feature of sample*

Table 2 displays an illustration of the samples that were collected, categorized statistically. The study's expected demographic target audience is SMEs engaged in manufacturing in Latin American developing economies. A total of 467 member participated, which 48.4% was male and 51.6% was female. The wide rage of age was used to research that 16.7% responders were less than 35 years old, 22.9% from 35 to 44 years old, 35.5% from 45 to 54 years old and 25% respnders were older than 54 years old. The research focused on surveying subjects with many years of experience in the field of agri-food, health and humanitarian making an effort to collect architectural opinions and customer perspectives for the research. Survey results showed that 39.4% of survey subjects had less than 10 years of working experience, the remaining 60.6% had worked for 10 years. Additionally, the number of surveys in senior management positions is 81.8%.

Based on the available data, the study hypothesizes that the following list of typical features accurately describe the population under research.

**Table 2.** Sample characteristics

|  |  |  |
| --- | --- | --- |
| **Indexes** | **n = 467** | **Proportion (%)** |
| **Gender** |   |   |
| Male | 226 | 48.4 |
| Female | 241 | 51.6 |
| **Age**  |  |  |
| Less than 35 | 78 | 16.7 |
| From 35 to 44 years old | 107 | 22.9 |
| From 45 to 54 years old | 165 | 35.5 |
| Older than 54 years old | 117 | 25.0 |
| **Working seniority** (years) |  |  |
| Less than 3  | 82 | 17.6 |
| From 3 to 10 | 102 | 21.8 |
| From 11 to 15 | 106 | 22.7 |
| From 16 to 20 | 94 | 20.1 |
| More than 20 years | 83 | 17.8 |
| **Position** |  |  |
| Executive managers | 85 | 18.2 |
| Senior managers | 382 | 81.8 |
| **Industrial categorisation** |  |  |
| Agri-food | 279 | 59.7 |
| Health  | 89 | 19.1 |
| Humanitarian | 99 | 21.2 |
| **Company size**  |  |  |
| Small (10 – 50 staffs) | 157 | 33.6 |
| Medium (51 – 250 staffs) | 310 | 66.4 |

*Source: Authors’ work*

*5.2. Measurement model assessment*

The study depends on evaluating the convergent value, discriminant value, and scale reliability to assess the measurement model. The outcomes are displayed in the above Table 3. In terms of the scale's reliability, Cronbach's Alpha and composite reliability (C.R.) index findings demonstrate that the scale's reliability is beyond the suggested level, with both indexes surpassing 0.7 (Hair *et al*., 2019). This demonstrates the scales' dependability. Additionally, VIF is used to evaluate multicollinearity and overall statistical bias. According to Hair *et al*. (2019), a VIF of less than 3.0 suggests that multicollinearity or prevalent technique bias are not present in the related study. The obtained results showed that VIF values were smaller than 3.0, excepted for the variables DSC1, DSC3, DSC5, SCI4 the VIF index is higher than 3.0, but the index above the threshold is not too significant which confirms that no methodological bias or multicollinearity problems were present.

**Table 3.** Reliability, discriminant and convergent validity of the scale

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **Items** | **Factor loading** | **VIF of items** | **Cronbach’s Alpha** | **C.R****(rho\_a)** | **C.R****(rho\_c)** | **AVE** |
| **Digital Supply Chain (DSC)** | DSC1 | 0.891 | 3.277 | 0.889 | 0.902 | 0.920 | 0.698 |
| DSC2 | 0.719 | 1.542 |
| DSC3 | 0.907 | 3.583 |
| DSC4 | 0.758 | 1.742 |
| DSC5 | 0.885 | 3.021 |
| **Supply Chain Integration (SCI)** | SCI1 | 0.841 | 2.312 | 0.901 | 0.904 | 0.927 | 0.717 |
| SCI2 | 0.827 | 2.183 |
| SCI3 | 0.836 | 2.231 |
| SCI4 | 0.900 | 3.181 |
| SCI5 | 0.827 | 2.239 |
| **Information Sharing (IS)** | IS1 | 0.835 | 2.137 | 0.871 | 0.876 | 0.907 | 0.661 |
| IS2 | 0.845 | 2.294 |
| IS3 | 0.815 | 1.946 |
| IS4 | 0.844 | 2.259 |
| IS5 | 0.720 | 1.551 |
| **Sustainable Supply Chain Performance (SSCP)** | SSCP1 | 0.828 | 2.407 | 0.903 | 0.905 | 0.924 | 0.633 |
| SSCP2 | 0.724 | 1.748 |
| SSCP3 | 0.793 | 2.180 |
| SSCP4 | 0.798 | 2.231 |
| SSCP5 | 0.837 | 2.444 |
| SSCP6 | 0.774 | 2.357 |
| SSCP7 | 0.812 | 2.626 |

*Source: Authors’ work*

In addition, the examination of discriminant and convergent validity explicitly uses factor loading, average variance extract (AVE), and square AVE (Hair *et al*., 2014; Fornell and Larcker, 1981) to validate convergent validity. According to this study, all AVE values and loading factor values are more than 0.5. Therefore, it can be indicated that the convergence of this investigation is excellent.

**Table 4.** Fornell and Larcker criterion.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **DSC** | **IS** | **SCI** | **SSCP** |
| **DSC** | **0.836** |  |  |  |
| **IS** | 0.561 | **0.813** |  |  |
| **SCI** | 0.504 | 0.590 | **0.846** |  |
| **SSCP** | 0.559 | 0.617 | 0.616 | **0.796** |

 *Source: Authors’ work*

According to Fornell and Larcker (1981), which states that the root of the square of AVE for every single latent variable should be larger than the correlation with any other latent variable, the square root of AVE and correlations between latent variables of various kinds are used to evaluate discriminant validity. The results displayed in Table 4 indicate that the square roots of AVE are typically greater than the correlations of latent variables. Therefore, it may be concluded that the discriminant validity of this inquiry has been somewhat verified.

**Table 5.** Heterotrait-monotrait (HTMT)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **DSC** | **IS** | **SCI** | **SSCP** |
| **DSC** |  |  |  |  |
| **IS** | 0.635 |  |  |  |
| **SCI** | 0.561 | 0.665 |  |  |
| **SSCP** | 0.617 | 0.692 | 0.681 |  |

 *Source: Authors’ work*

The use of the more reliable Heterotrait-Monotrait Ratio of Correlations (HTMT) is made for evaluating discriminant validity. The results of the study, which are shown in Table 5, indicate that when the HTMT is less than 0.85\_a range suggested threshold values—a cautious benchmark—the discriminant validity is strengthened (Henseler *et al*., 2016).

*5.3. Goodness of fit (GoF)*

The study evaluated the applicability of the proposed model based on important indicators such as GoF (Wetzels *et al*., 2009) and SRMR (Hu and Bentler, 1999; Henseler *et al*., 2016). NFI (Hair *et al*., 2019) and R2 (Falk and Miller, 1992). The GoF index for this model is 0.52, although the accepted "large fit" threshold is 0.36 (Wetzels *et al*., 2009). Furthermore, the current study's model's SRMR index is 0.045 (<0.08), which is below Falk and Miller's (1992) acceptable level. The equivalent R2 indexes for the variables are IS (0.441 > 0.1), SCI (0.254 > 0.1), and SSCP (0.512 > 0.1). Thus, it seems that the current model fits the data well.

*5.5. Common method bias via harman test*

In the study, data were processed on SPSS 22.0 software, using EFA analysis, fixing one factor and not rotating the factor. The results of Harman's single-factor test using EFA show that a single factor explains 43.559% of the total variation. In this case, CMB is not a serious problem.

*5.6. Structural model assessment*

Table 6 illustrates the results from bootstrapping analysis of the structural model evaluation including path coefficients, T-statistics, P-values, and confidence intervals. Multicollinearity and common method bias tests were carried out before assessing the structural model. Additionally, Figures 2 and 3 below show the SEM results before and after bootstrapping.

The findings of the bootstrapping analysis are utilised to assess the structural framework and research hypothesis, as stated above in Table 6. The research hypotheses seem to be confirmed. The finding (β = 0.228, t = 4.399, p < .001) backs up and validates the hypothesis (H1) that there is a positive and significant link between DSC and SSCP. A comparable conclusion may be attracted for H2, H3a, H3b, H4a, H4b, because the findings are comparatively, (β = 0.412, t = 9.609, p < .001), (β = 0.504, t = 11.999, p < .001), (β = 0.326, t = 6.458, p < .001), (β = 0.353, t = 7.268, p < .001), (β = 0.297, t = 5.966, p < .001) which demonstrate a beneficial and noteworthy relationship between SCI and IS, DSC and SCI, SCI and SSCP, DSC and IS, IS and SSCP. Besides, Cohen's measure of impact, known as the f-square is used to evaluate the degree of influence of each independent variable on the dependent variable (Cohen, 1988). Results of Table 6 demonstrate that all the values are above 0.051, proving that most of the impacts are effective.

Along with the outcomes of the bootstrapping analysis, VAF was used to evaluate the mediation mechanism between SCI and SSCP in the relationship between DSC and SSCP. Based on the results, the relationship between DSC and SSCP is partially mediated by SCI and IS. Those results are consistent with the conclusion (β = 0.164, t = 5.861, p < .001, 20% ≤ VAF = 41.8% ≤ 80%), (β = 0.105, t = 5.551, p < .001, 20% ≤ VAF = 31.5% ≤ 80%). Therefore, the stated results confirm the validity of H3, H4.

**Table 6.** Bootstrapping results.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Hypothesis** | **Paths** | **Original Sample (O)** | **Sample Mean (M)** | **Standard Deviation (STDEV)** | **T statistics** | **f2** | **VAF** | **P values** |
| H1 | DSC -> SSCP  | 0.228 | 0.230 | 0.052 | 4.399 | 0.068 | N/A | 0.000 |
| H2 | SCI -> IS | 0.412 | 0.413 | 0.043 | 9.609 | 0.266 | N/A | 0.000 |
| H3a | DSC -> SCI | 0.504 | 0.505 | 0.042 | 11.999 | 0.340 | N/A | 0.000 |
| H3b | SCI -> SSCP | 0.326 | 0.327 | 0.050 | 6.458 | 0.132 | N/A | 0.000 |
| H3 | DSC -> SCI -> SSCP | 0.164 | 0.165 | 0.028 | 5.861 | N/A | 41.8% | 0.000 |
| H4a | DSC -> IS | 0.353 | 0.353 | 0.049 | 7.268 | 0.166 | N/A | 0.000 |
| H4b | IS -> SSCP | 0.297 | 0.296 | 0.050 | 5.966 | 0.101 | N/A | 0.000 |
| H4 | DSC -> IS -> SSCP | 0.105 | 0.104 | 0.019 | 5.551 | N/A | 31.5% | 0.000 |

 *Source: Author’s work*

**Figure 2. SEM testing diagram**

**Source: Authors’ own compilation**

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**Figure 3. SEM testing diagram after bootstrapping**

**Source: Authors’ own compilation**

*5.6. CMB test*

Besides applying the method of performing single-factor EFA analysis, CFA is also a factor in CMV testing. In recent research by Kock (2015), a very new way of testing CMV has been proposed when analyzing CMV analyzed by PLS-SEM, that is using the inner VIF index (often used to check multicollinearity). Accordingly, if all VIF indexes in the model are <3.3, the CMV problem is almost non-existent (Kock, 2015).

Based on the suggestion of Kock (2015), the study uses full collinearity test to determine CMB in PLS-SEM. The results of testing the variance inflation factor VIF of the latent variables are all less than 3.3 (Table 7). Therefore, CMB, if present, does not make a difference in the research results.

**Table 7.** Multicollinearity test by Inner VIF Values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **DSC** | **IS** | **SCI** | **SSCP** |
| **DSC** |  | 1.34 | 1.000 | 1.563 |
| **IS** |  |  |  | 1.788 |
| **SCI** |  | 1.34 |  | 1.643 |
| **SSCP** |  |  |  |  |

 *Source: Authors’ work*

**6. Discussion and implications**

*6.1. Discussion*

The direct relationships between DI, GI, GSCM, and SCP (H1, H3b, H4b), DI, GI, and SCP (H3a, H2), and DI to GSCM (H4a) are the ones that are the subject of this research. In the meantime, the study highlights the GI and GSCM's mediating function in the relationship between DI and SCP (H3, H4). The main contribution of this work is the identification of the mediating roles of the GI and GSCM variables in the DI and SCP interaction (H3, H4 are accepted).

DSC may increase energy efficiency, optimize logistical resources, and reduce distribution and transportation distances, Junge and Straube (2020) state that they did not examine the impact of other critical supply chain performance activities on sustainability. However, based on any companies in the supply chain sector are assessing if using big data technology will be financially feasible and are in the process of taking the initial steps to fully utilize its potential (Dhar *et al*., 2022). This research will support the hypothesis that DSC and SSCP have a positive association (H1). SCI, in particularly, strengthens the level of collaboration with external supply chain participants, so organizing firm-level strategies, procedures, and practices into cooperative, coordinated, and coordinated actions to accomplish information sharing across organizations (Li and Lin, 2006). Additionally, the positive influence link between SCI and IS (H2) this study finding will support the research by Yeung et al. (2009).

Additionally, the study's findings serve as one of the foundations for additional confirmation of DSC's beneficial effects on SCI (H3a). Additionally, using natural phytochemicals, the environmentally friendly method increases agricultural output (Sundararajan *et al*., 2024). When addressing the impact of I4.0 technologies, the findings corroborate and supplement the research conducted by Haddud et al. (2017), which showed that IoT technology directly influences both internal and external SCI. According to Kim and Chai (2016), healthcare firms' supply chains are particularly susceptible to the impact of shifting technology trends, and performance can be significantly impacted by digitalization. The capacity for sustainable growth is comparatively strong; as crucial elements of corporate governance, excellent internal control and external audits may support the ongoing enhancement of this capacity. Executives are more aware of the environment and the economy the more educated they are. The higher the debt-to-asset ratio and the larger the firms' capacity for sustainable development, the more earnings they will have available to pay off debt as pressure from relevant creditors mounts (Dhar *et al*,, 2022).

Furthermore, Panayides *et al.* (2009) study on SCI makes use of SSCP to communicate improved flexibility, faster response times, more efficient inventory management, and expected delivery through the openness of information flow and product flow from the point of raw material purchase to the final consumer (H3b). Accepted with support are H4a and H4b, which suggest that DSC may positively affect IS (Iansiti and Lakhani, 2017) and may be a predictor of improved supply chain performance (Sezen, 2008). Additionally, the analysis reveals the mediation function of IS and SCI in the association between DSC and SSCP (H3, H4 accepted), which appears to be a finding of limited prior research.

Additionally, Latin America presents incomparable variables (barriers) when attempting to convert an economic model from linear to circular. According to the perspective that the circular economy is essential in a world overtaken by environmental, social, and economic challenges, the circular economy for Latin America entails the pursuit of social equality (opportunities and values), a radical shift in the way wealth is created and goods and services are produced, distributed, and consumed, as well as the restoration of culture in order to instill the circular economy as a means of achieving sustainability (Betancourt and Zartha, 2020).

*6.2. Theoretical implications*

This research enhances the current literature on DCP and SSCP by addressing the paucity of empirical data on the mediation processes between SCI and IS. It emphasizes how higher SCI improve IS performance, which leads to long-term business success with a triple bottom line. The study backs up the claim stated in the literature on DSC and SSCP for SMEs in developing nations, which is that these variables need to be considered when managing corporate cultures and making choices to guarantee that company conduct complies with societal norms and values. The study offers a thorough model of the interaction between DSC and SSCP, emphasizing the wide-ranging effects of DSC on SSCP and enhancing DSC, SCI, IS, and SSCP in novel circumstances. This study emphasizes how crucial stakeholder interests and company legitimacy are to gaining sustainability and a competitive edge. It illustrates how sustained business advantage, enhanced environmental performance, and higher sustainability result from a long-term strategy for guaranteeing legitimacy and meeting stakeholder interests. The study indicates that DCP encourages SCI efforts and IS applications, which are business capacities that may improve an organization's sustainability and environmental performance. This supports the theory of the Responsible Business Model. The relevance of these activities, particularly for SMEs in emerging economies, is explained theoretically in this work.

*6.3. Managerial implications*

Through the mediation of SCI and IS, this study investigates how DSC improves sustainability for SMEs in emerging economies. It recommends that companies should integrate digitalization into their company culture, decision-making procedures, and goals for sustainable development. This strategy takes into account the concerns of stakeholders, sets businesses apart from rivals, gains the enterprise more social legitimacy, and enhances support from the general public. Long-term success in terms of revenue, profitability, clientele, market share, consumer- and eco-friendly product lines, and environmental efficacy is the outcome.

According to the study, SCI controls the interaction between DSC and SSCP, which enhances GSCM function. This is achieved by putting in place guidelines for quality, social, and environmental sustainability; a green distribution strategy; standard operating systems; qualified resources; assessment techniques; and state-of-the-art software. The study also reveals indirect connections between successful supply chain management and the economy, suggesting that IS might serve as a link in this regard. Businesses are highlighting the requirement of SCI and ecological responsibility while sourcing raw materials from suppliers as a result of environmental concerns. For businesses to maximize their operations and foster expansion, DSC is essential. To do this, companies should create a culture of technology that promotes employee creativity, innovation, openness, and information sharing. Setting digital goals, implementing internal communication channels, and providing staff with training on new technologies may all help achieve this. For a variety of sectors, digital platforms are crucial because they enable organizations to collect data, make strategic decisions, and reduce risk. Efficiency gains, cost savings, and competitive advantage are all possible with effective digital control for SMEs. DSC assists companies in identifying market niches, enhancing competencies, and fostering innovation. Building a good rapport with customers is essential. Enhancing digital platform accessibility is very beneficial to SMEs. DSC has the potential to revolutionize corporate development by fostering growth and producing exceptional outcomes. This article and related studies encourage Latin America SMEs to embrace digital platforms and enhance their capabilities to boost performance and achieve SCP.

**7. Conclusions and restrictions on the study's future scope**

*7.1. Conclusions*

The primary finding of the study is that DSC and SSCP are related through the mediation of IS and SCI. The results indicate that SCI and IS are somewhat mediating the relationship between DSC and SSCP. Specifically, the results of the bootstrapping approach research indicate that SCI partially mediates the relationship between DSC and SSCP. Similarly, IS mediates the relationship between DSC and SSCP to some extent. Together, SCI and IS act as a partial mediating factor in the link between DSC and SSCP. Based on the study's conclusions, significant stakeholders are advised to consider the following: SMEs should start by using information-sharing procedures. Digital supply chain strategies should thus be included into corporate cultures and decision-making processes inside organizations. Second, supply chain integration tactics ought to be freely adopted by SMEs. Additionally, a crucial approach should be incorporated with the DSC plan to promote SSCP toward a more sustainable future.

*7.2. Limitations for future scope of study*

In addition to the research's beneficial effects on academia and practice, this piece has several drawbacks. First off, the article's survey results are only approximations based on data collected from small and medium-sized enterprises (SMEs) in Latin America's developing economy. Future research will be conducted in economies and nations with varying degrees of advancement and typical characteristics. Second, as the qualitative technique is the primary approach used in this work, inheritance may enhance the research methodology in this area by combining other approaches.

Future study papers may take into account more variables connected to current economic growth practices, such as integrating AI into the operational model of businesses, in order to enhance the literature that is closely tied to the realities and objectives of each nation (Di Vaio et al., 2023).

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