current perspective on business operations

e-ISSN: 3125-1323

ARTICLE

Advancing Frugal and Supply Chain Innovation Through Analytics Adoption

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Abstract
This study aims to explore how institutional pressures influence the adoption of supply chain analytics (SCA) and to assess its effects on supply chain (SC) innovation and frugal innovation. In addition, the research investigates the relationship between SC innovation and frugal innovation. Data were gathered from manufacturing firms operating in Jordan and analyzed using Partial Least Squares (PLS) path analysis. The results reveal that coercive pressure does not have a significant impact on SCA adoption, whereas normative and mimetic pressures positively and significantly encourage its implementation. The findings further indicate that SCA adoption contributes significantly to both SC innovation and frugal innovation. Moreover, SC innovation is found to positively influence frugal innovation. These results enrich the existing literature by providing deeper insights into the interconnections among institutional pressures, SCA adoption, SC innovation, and frugal innovation. The study highlights that recognizing the influence of institutional pressures on SCA adoption can help organizations strengthen innovation capabilities, enhance competitiveness, and achieve sustainable growth in an increasingly dynamic supply chain environment.

Keywords: Institutional pressures; supply chain analytics; supply chain innovation; frugal innovation; manufacturing industry.

Academic Editor: Daniel Wang

Received: April 28, 2026 | Revised: May 22, 2026 | Accepted: June 10, 2026 | Published: June 22, 2026

Citation: Nur'aini, Z., & Octaviani, A. (2026). Advancing frugal and supply chain innovation through analytics adoption. *Current Perspective on Business Operations, 2*(3), 292–306.

1. Introduction

The contemporary business environment is characterized by rapid change, increasing uncertainty, and growing competitive pressures, compelling organizations to continuously improve the effectiveness of their supply chain operations. Under such conditions, firms are required to strengthen their innovative capabilities to proactively respond to environmental disruptions and sustain long-term competitiveness.

Understanding the institutional forces that shape organizational decisions and behaviors has therefore become increasingly important, as these forces influence how firms adapt and implement strategic changes in response to evolving market conditions (Kamboj & Rana, 2023). The dynamic and unpredictable nature of modern business environments highlights the critical role of innovation in supply chain management. Supply chain innovation (SCI) refers to an organization's ability to develop and implement novel practices, processes, technologies, and strategies through collaboration among supply chain partners, enabling firms to respond effectively to changing market demands and operational challenges (Wong & Ngai, 2019; Tagscherer & Carbon, 2023).

Innovation is generally regarded as a firm's capability to generate transformative solutions that enable adaptation to disruptions and emerging opportunities. According to the Bank of America Institute (2022), increasing scarcity of natural resources, technological assets, and human capital will intensify future business challenges, making innovation a strategic necessity. Traditionally, innovation research has focused on high-end innovation, which emphasizes superior quality, advanced design, and enhanced customer value (Weyrauch & Herstatt, 2017; Kun, 2022). This type of innovation is commonly directed toward customers with strong purchasing power who seek exclusivity and differentiation (Zhang, 2018). In contrast, frugal innovation focuses on achieving substantial cost reductions, minimizing resource consumption, and delivering affordable solutions without sacrificing core functionality. Consequently, frugal innovation has emerged as an attractive approach for organizations operating under resource constraints and uncertain economic conditions.

At the same time, digital transformation has fundamentally altered how organizations conduct business, interact with stakeholders, and manage supply chain activities. Rather than serving merely as a supporting function, digital technologies have become a central component of organizational innovation and competitive strategy. Digitalization enables firms to collaborate more effectively with supply chain partners, access diverse information sources, and identify emerging opportunities for innovation (Yaseen et al., 2022). Through enhanced connectivity and information sharing, organizations can improve decision-making processes and foster stronger collaboration throughout the supply chain network.

Within this context, supply chain analytics (SCA) has emerged as a critical capability that enables organizations to extract valuable insights from large volumes of supply chain data and support data-driven decision-making. Understanding the factors that influence SCA adoption and its subsequent impact on innovation outcomes has therefore become an important area of inquiry for both researchers and practitioners. Previous studies have highlighted the role of analytics capabilities in enhancing supply chain resilience, performance, and innovation (Fantazy & Tipu, 2024; Hasan et al., 2024; Iftikhar et al., 2024). Recent research has also emphasized the need to investigate the institutional dimensions that encourage organizations to adopt analytics technologies and utilize them effectively within supply chain operations (Bhatti et al., 2024; Lee et al., 2024). Despite growing scholarly interest, existing literature provides limited evidence regarding how institutional pressures influence SCA adoption. Most prior studies have concentrated on organizational, technological, and environmental determinants while overlooking the role of coercive, normative, and mimetic pressures as external drivers of adoption decisions.

Furthermore, while the literature increasingly recognizes the importance of supply chain analytics in supporting organizational innovation, empirical evidence regarding its influence on both supply chain innovation and frugal innovation remains limited. Scholars have called for further investigation into how advanced analytics capabilities contribute to innovation outcomes amid increasingly complex supply chain environments and rapidly evolving technological developments (Bag & Rahman, 2024; Singh et al., 2024). In addition, studies examining frugal innovation within supply chain contexts remain scarce, and little is known about the potential relationship between supply chain innovation and frugal innovation. As organizations continue to face disruptions, uncertainty, and resource constraints, understanding these relationships becomes essential for both theoretical advancement and managerial practice.

To address these research gaps, this study investigates three key questions. First, do institutional pressures, including coercive, normative, and mimetic pressures, influence the adoption of supply chain analytics? Second, does supply chain analytics adoption contribute to supply chain innovation and frugal innovation? Third, does supply chain innovation facilitate the development of frugal innovation? To answer these questions, this study integrates Institutional Theory (DiMaggio & Powell, 1983) and Dynamic Capabilities Theory (Teece et al., 1997). Institutional Theory explains how coercive, normative, and mimetic pressures shape organizational behaviors and strategic decisions, whereas Dynamic Capabilities Theory emphasizes an organization's ability to acquire, integrate, and reconfigure internal and external resources in response to changing environments (Takahashi & Sander, 2017; Ogunrinde, 2022). By combining these theoretical perspectives, this study seeks to provide a comprehensive understanding of how institutional forces drive supply chain analytics adoption and how these capabilities subsequently foster supply chain innovation and frugal innovation.

2. Literature Review and Hypothesis Development

This study is grounded in Institutional Theory and Dynamic Capabilities Theory to examine how institutional pressures influence supply chain analytics (SCA) adoption and how SCA contributes to supply chain innovation (SCI) and frugal innovation (FI). Big Data Analytics (BDA) has attracted growing attention from scholars and practitioners because of its ability to enhance business performance in competitive and rapidly changing environments (Naeini et al., 2019; Abou Kamar, 2021). In supply chain contexts, physical, financial, and informational flows connect multiple firms and operations involved in sourcing, production, storage, transportation, and distribution (Fosso Wamba & Akter, 2019; Asmussen & Møller, 2020). Well-informed analytical decisions improve supply chain planning and operations, making analytics capabilities essential for both strategic and operational supply chain management (Chen et al., 2015; Kalaitzi & Tsolakis, 2022). Prior research shows that integrating BDA into supply chain management improves market responsiveness, supports proactive decision-making, and helps firms extract valuable insights from large datasets, including customer purchasing patterns, demand forecasts, inventory levels, and transportation routes (Aamer et al., 2020; Abou Kamar, 2021; Asmussen & Møller, 2020; Lai et al., 2023). However, rapid advances in SCA require further research on the drivers and outcomes of SCA adoption, particularly its role in strengthening supply chain innovation and frugal innovation.

Institutional Theory explains how external pressures shape organizational behavior, structure, and strategic decisions, including the adoption of digital technologies (Kauppi & Luzzini, 2021; Kitsis & Chen, 2021). These pressures include coercive, normative, and mimetic forces. Coercive pressures arise from regulations, standards, and formal requirements imposed by governments, industry bodies, or powerful stakeholders (DiMaggio & Powell, 1983). Mimetic pressures occur when firms imitate successful competitors, partners, or industry leaders to reduce uncertainty and maintain competitiveness (Villena & Dhanorkar, 2020). Normative pressures emerge from professional norms, industry expectations, social values, and shared standards regarding appropriate organizational behavior (DiMaggio & Powell, 1983; Kauppi & Luzzini, 2021). Although existing studies have highlighted the role of institutional pressures in digital transformation (Kalaitzi & Tsolakis, 2022; Lopez-Morales et al., 2023), empirical research linking institutional pressures directly to SCA adoption remains limited. Previous studies have discussed institutional forces in relation to BDA adoption and supply chain initiatives (Fosso Wamba & Akter, 2019; Büyüközkan & Güler, 2021; Bag et al., 2021;

Shahzad et al., 2022; Hasan et al., 2024), yet few have examined how coercive, normative, and mimetic pressures drive SCA adoption.

SCA refers to the application of BDA techniques, tools, and capabilities to collect, process, and analyze data from supply chain members and operations in order to generate insights and improve supply chain performance (Fosso Wamba & Akter, 2019; Asmussen & Møller, 2020). It involves descriptive, predictive, and prescriptive analytics applied to data obtained from suppliers, manufacturers, logistics providers, distributors, and customers (Büyüközkan & Güler, 2021; Kalaitzi & Tsolakis, 2022; Dubey et al., 2022). Despite the recognized importance of analytics capabilities in supply chain management, limited empirical research has examined the determinants and outcomes of SCA adoption (Dubey et al., 2022; Shamout, 2023). Existing studies have commonly relied on the Resource-Based View, Dynamic Capabilities Theory, or Technology–Organization–Environment framework (Chen et al., 2015; Shamout, 2019; Fosso Wamba & Akter, 2019; Kamboj & Rana, 2023), leaving institutional explanations of SCA adoption underexplored.

Supply chain innovation refers to the development and implementation of new strategies, technologies, ideas, practices, and services that improve how supply chains operate and create value (Wong & Ngai, 2019; Gloet & Samson, 2022; Lai et al., 2023). It enables firms to enhance customer value, operational efficiency, resilience, and sustainability through collaboration, visibility, and agility (Karaman Kabadurmus, 2020; Pedroza-Gutiérrez & Hernández, 2020; Hopkins, 2021). While prior studies have explored organizational and interorganizational determinants of supply chain innovation, empirical research examining the role of SCA in generating supply chain innovation remains scarce (Abourokbah et al., 2023; Alsmairat, 2023). Frugal innovation, meanwhile, refers to the development of simple, cost-effective, and resource-efficient solutions, particularly for underserved or price-sensitive markets (Shibin et al., 2018). It emphasizes essential functionality, affordability, and acceptable performance while minimizing resource consumption (Weyrauch & Herstatt, 2017; Zhang, 2018). Although technological development has encouraged firms to adopt frugal innovation mechanisms (Zhang, 2018; Qu et al., 2023), and prior studies suggest that digitalization may enhance frugal innovation (Khanal et al., 2022; Nassani et al., 2022), the role of SCA in frugal innovation remains largely unexplored.

Based on these theoretical arguments, this study proposes that coercive, normative, and mimetic pressures significantly influence SCA adoption. Coercive pressures may encourage firms to adopt SCA to comply with regulatory requirements, stakeholder expectations, and industry standards (Asmussen & Møller, 2020; Ogbuke et al., 2022; Liu et al., 2022; Jeske & Calvard, 2020). SCA also helps firms improve transparency, accountability, and sustainability reporting, which are increasingly required by investors, customers, and regulators (Hämäläinen & Inkinen, 2019; Zhu et al., 2018).

H1. *Proposes that coercive pressures significantly impact SCA adoption.*

Normative pressures may also lead firms to adopt SCA because industry norms, customer expectations, professional standards, and collaborative supply chain practices encourage data-driven decision-making and operational efficiency (Kauppi & Luzzini, 2021; Herden, 2020; Shafiq et al., 2020; Khan et al., 2023; Hoehle et al., 2018; Büyüközkan & Güler, 2021).

H2. *Proposes that normative pressures significantly impact SCA adoption.*

Mimetic pressures may further encourage firms to imitate competitors or industry leaders that successfully use analytics to improve decision-making, legitimacy, collaboration, and market responsiveness (Jardim et al., 2021; Lopez-Morales et al., 2023; Liu et al., 2022; Dubey et al., 2019; Asmussen & Møller, 2020). Thus, H3. *Proposes that mimetic pressures significantly impact SCA adoption.*

This study also proposes that SCA contributes to both supply chain innovation and frugal innovation. From the Resource-Based View, SCA can be regarded as a valuable strategic resource that enables firms to optimize supply chain operations and develop innovative processes and products (Takahashi & Sander, 2017; Dubey et al., 2019; Kamboj & Rana, 2023). From Dynamic Capabilities Theory, SCA enhances firms' ability to integrate, reconfigure, and deploy internal and external competencies in response to environmental changes (Teece et al., 1997; Gupta et al., 2020). By generating real-time insights, identifying inefficiencies, improving collaboration, and supporting data-driven decision-making, SCA enables firms to develop innovative supply chain solutions (Fosso Wamba & Akter, 2019; Gloet & Samson, 2022; Büyüközkan & Güler, 2021; Kalaitzi & Tsolakis, 2022; Zhu et al., 2018). Therefore,

H4. *Proposes that SCA significantly impacts supply chain innovation.*

SCA may also strengthen frugal innovation by helping firms identify cost-saving opportunities, reduce waste, improve resource efficiency, understand customer needs, and manage risks in resource-constrained environments (Barbosa et al., 2018; Shibin et al., 2018; Zhang, 2018; Asmussen & Møller, 2020; Khanal et al., 2022; Shamout, 2023).

H5. *Proposes that SCA significantly impacts frugal innovation.*

Finally, supply chain innovation may foster frugal innovation by improving procurement, logistics, inventory control, waste reduction, and collaborative problem-solving across supply chain partners (Wong & Ngai, 2019; Lee, 2019; Hopkins, 2021; Gloet & Samson, 2022; Hu & Zhang, 2023; Qu et al., 2023). Accordingly, H6 proposes that supply chain innovation significantly impacts frugal innovation. The proposed research framework is presented in Figure 1.

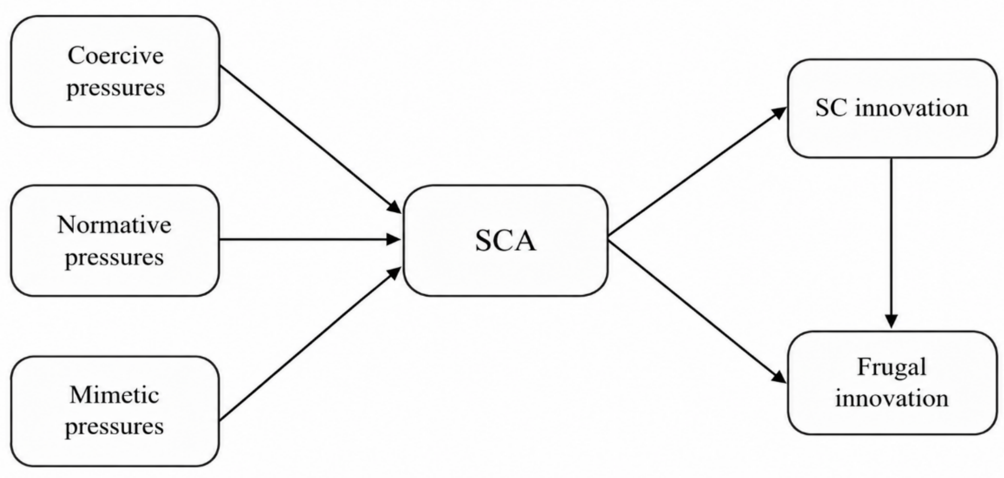

Figure 1. Research Model

3. Research Methods

To empirically test the proposed hypotheses, this study employed a survey-based quantitative research design. The questionnaire was developed using validated measurement items from previous studies. Institutional pressures were adapted from Villena and Dhanorkar (2020) and Kauppi and Luzzini (2021); SCA was adapted from Shamout (2019) and Kalaitzi and Tsolakis (2022); supply chain innovation was adapted from Karaman Kabadurmus (2020) and Abourokbah et al. (2023); and frugal innovation was adapted from Kun (2022) and Yousaf et al. (2022). The measurement sources are summarized in Table 1, while the full questionnaire items are presented in Table 2.

Table 1. Sources of Measurement Items

Constructs	Authors
Institutional Pressures	Villena and Dhanorkar (2020); Kauppi and Luuzini (2021)
SCA	Shalmout (2019); Kalaitzi and Tsolakis (2022)
SC Innovation	Karaman Kabadurmus (2020); Abourokbah et al. (2023)
Frugal Innovation	Kun (2022); Yousaf et al. (2022)

Table 2. Questionnaire Items

Constructs	Codes	Statements
Coercive Pressure	CP1	Our company feels obliged to adopt specific supply chain practices due to regulatory requirements.
	CP2	Non-compliance with industry standards would have negative repercussions on the company.
	CP3	External stakeholders exert pressure to conform to specific supply chain practices.
	CP4	Our company believes that failure to adopt certain supply chain practices may damage its reputation.
	CP5	Adhering to industry guidelines is considered essential to maintain legitimacy.
Normative Pressure	NP1	Our company feels morally obliged to adopt sustainable supply chain practices.
	NP2	Following industry norms and guidelines is important for the company to be seen as a responsible corporate citizen.
	NP3	Ethical supply chain practices are vital for long-term success.
	NP4	Pressure from customers and stakeholders leads to prioritizing sustainability in the supply chain.
	NP5	The company acknowledges a duty to align its supply chain practices with societal expectations.
Mimetic Pressure	MP1	Our company imitates the successful supply chain practices of its competitors.
	MP2	Industry leaders’ decisions influence our company’s adoption of supply chain practices.
	MP3	The company considers other companies within its sector for guidance on supply chain practices.
	MP4	Top management believes that adopting practices similar to competitors would enhance performance.
	MP5	Imitating successful supply chain practices reduces uncertainty and enhances the organization’s legitimacy.
SCA	SCA1	Our company utilizes data analysis tools to evaluate supply chain performance.
	SCA2	Predictive analytics is leveraged by the company to forecast market demand.
	SCA3	Data visualization techniques are employed by our company to detect bottlenecks in the supply chain.

Constructs	Codes	Statements
	SCA4	Real-time data analysis enhances our supply chain decisions.
	SCA5	Machine learning algorithms are employed to optimize supply chain operations.
SC Innovation	SCI1	The company actively explores new methods to enhance its supply chain processes.
	SCI2	Top management encourages employees to propose innovative ideas to improve the supply chain.
	SCI3	The company actively seeks emerging technologies and trends to enhance its supply chain operations.
	SCI4	A culture of experimentation and risk-taking is embraced by the company in the context of supply chain innovation.
	SCI5	Collaboration with external partners is pursued by the company to co-create innovative supply chain solutions.
Frugal Innovation	FI1	The company concentrates on developing cost-effective solutions to meet the requirements of price-sensitive customers.
	FI2	The organization prioritizes simplicity and resource efficiency in its product/service development processes.
	FI3	Our company actively explores ways to reduce waste and minimize resource consumption in the supply chain.
	FI4	Underserved markets are targeted by the company with affordable and value-driven offerings.
	FI5	Our company encourages creativity and resourcefulness in finding frugal solutions to customer problems.

The questionnaire was reviewed by three academic experts specializing in BDA, enterprise innovation, and supply chain management to ensure item clarity, relevance, consistency, and logical coherence. To reduce common method bias, respondents were assured of anonymity and confidentiality. In addition, a full collinearity test was conducted following Kock (2015), and all variance inflation factor (VIF) values were below the recommended threshold of 3, indicating that common method bias was not a serious concern. All items were measured using a five-point Likert scale.

The empirical setting of this study is the Jordanian manufacturing sector, which provides an appropriate context for examining institutional pressures, SCA adoption, supply chain innovation, and frugal innovation. Manufacturing firms typically operate complex and diverse supply chains that require advanced analytics tools to improve forecasting, risk management, supply planning, efficiency, and responsiveness (Dubey et al., 2019; Mageto, 2021; Bag et al., 2021). Data were collected from Jordanian manufacturing companies across multiple industries. After preliminary contact, 22 companies agreed to participate. Respondents included managers, directors, and department heads involved in supply chain management, logistics, procurement, production, IT, quality, customer service, and R&D. Data collection was conducted through printed questionnaires and online forms distributed by email from 6 December 2023 to 4 February 2024, resulting in 231 valid responses. The profile of participating companies and respondents is shown in Table 3.

Table 3. Profile of Companies and Respondents

Companies	No	%	Participants	No	%
Industry			**Department**		
Food and beverage	4	18	Supply chain	38	16

Companies	No	%	Participants	No	%
Pharmaceutical	4	18	Logistics	35	15
Chemical	3	14	Procurement/purchasing	21	9
Healthcare	3	14	Production	32	14
Building materials	2	9	IT	34	15
Industrial machinery and equipment	2	9	Quality	18	8
Electronics	1	5	Customer services	14	6
Others	3	14	Research and development	19	8
			Others	20	9
Firm Age			**Experience**		
>10	5	20	>10 years	63	27
10–20	14	60	10–20 years	113	49
<20	3	10	<20 years	55	24
Firm Size			**Gender**		
>250 employees	3	10	Male	148	64
250–500 employees	11	50	Female	83	36
<500 employees	8	40			
Total	**22**	**100**	**Total**	**231**	**100**

4. Results

The collected data were analyzed using SmartPLS version 4.0 to evaluate the proposed research model and test the hypotheses. The PLS-SEM procedure consisted of two main stages. First, the measurement model was assessed to examine the reliability and validity of the constructs. Second, the structural model was evaluated to test the hypothesized relationships among institutional pressures, supply chain analytics (SCA), supply chain innovation, and frugal innovation.

The measurement model was evaluated using item factor loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). Following Hair Jr et al. (2014), convergent validity was assessed through factor loadings, CR, and AVE. Most measurement items showed factor loadings above the recommended threshold of 0.60, indicating acceptable convergent validity. However, one item from coercive pressure (CP3) and one item from supply chain innovation (SCI3) were removed because they did not meet the required loading criteria. The Cronbach's alpha values for all constructs exceeded 0.70, confirming adequate internal consistency and reliability. In addition, all CR and AVE values were above the recommended threshold of 0.50, further supporting the convergent validity of the measurement model. The reliability and validity results are presented in Table 4.

Table 4. Validity and Reliability Results

Construct	α	CR	AVE
Coercive Pressure	0.777	0.863	0.678
Normative Pressure	0.825	0.884	0.657
Mimetic Pressure	0.806	0.874	0.635
SCA	0.790	0.854	0.540
SC Innovation	0.800	0.870	0.626
Frugal Innovation	0.825	0.851	0.534

Discriminant validity was evaluated using the Fornell–Larcker criterion (Fornell & Larcker, 1981). The results indicate that the square root of the AVE for each construct was higher than its correlations with other constructs, confirming that the constructs are empirically distinct. Therefore, the measurement model satisfies the requirements for discriminant validity. The results are shown in Table 5.

Table 5. Discriminant Validity Results

No.	Construct	1	2	3	4	5	6
1	Coercive Pressure	**0.823**					
2	Normative Pressure	0.267	**0.811**				
3	Mimetic Pressure	0.497	0.509	**0.797**			
4	SCA	0.420	0.599	0.690	**0.735**		
5	SC Innovation	0.615	0.317	0.450	0.546	**0.791**	
6	Frugal Innovation	0.326	0.398	0.472	0.415	0.421	**0.731**

After confirming the adequacy of the measurement model, the structural model was assessed through path coefficient analysis. The results indicate that institutional pressures collectively explain 56.6% of the variance in SCA adoption. Furthermore, SCA explains 29.9% of the variance in supply chain innovation and 22.6% of the variance in frugal innovation. These values indicate that the proposed model has adequate explanatory power in predicting SCA adoption and innovation outcomes.

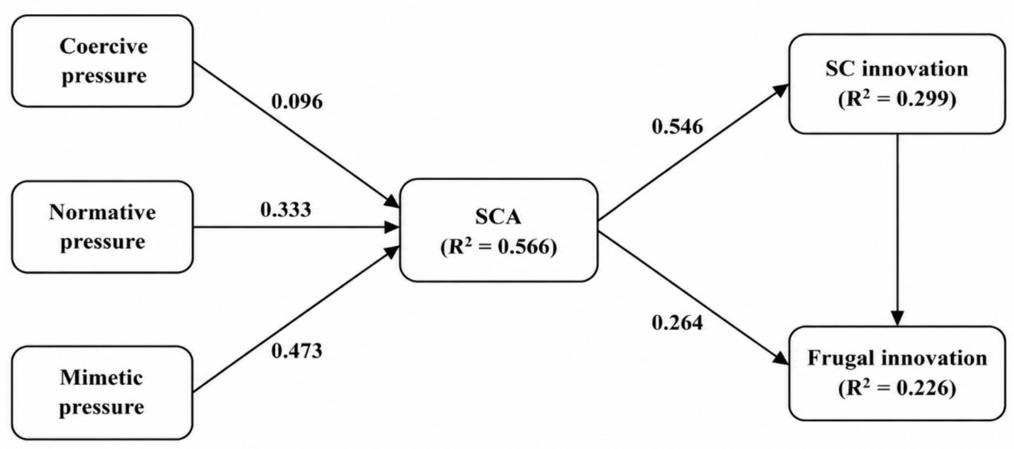

Figure 2. Path Coefficient Analysis

The detailed hypothesis testing results are presented in Table 6. The findings show that coercive pressure does not have a significant effect on SCA adoption; therefore, H1 is not supported. In contrast, normative pressure and mimetic pressure significantly influence SCA adoption, supporting H2 and H3. The results further indicate that SCA significantly enhances both supply chain innovation and frugal innovation, confirming H4 and H5. Finally, supply chain innovation has a significant positive effect on frugal innovation, thereby supporting H6.

Table 6. Hypothesis Testing Results

Paths	p-value	β-value	t-value	The Result
Normative pressures → SCA adoption	0.000	0.333	3.791	Accepted
SCA → SC innovation	0.000	0.546	6.601	Accepted
SCA → Frugal innovation	0.008	0.264	2.643	Accepted
SC innovation → Frugal innovation	0.010	0.276	2.567	Accepted
Mimetic pressures → SCA adoption	0.036	0.473	5.453	Accepted
Coercive pressures → SCA	0.209	0.096	1.256	Not supported

5. Discussion

The findings of this study provide several important insights into the adoption of supply chain analytics (SCA) and its implications for innovation. First, the results indicate that coercive pressure does not significantly influence SCA adoption, leading to the rejection of H1. This finding contrasts with previous studies that reported a significant role of coercive forces in encouraging the adoption of big data analytics and digital supply chain technologies (Dubey et al., 2019; Bag et al., 2021; Gupta et al., 2020; Lopez-Morales et al., 2023). A possible explanation is that SCA adoption is not yet strongly mandated by regulatory authorities in many industries. In the absence of explicit legal requirements or formal compliance obligations, organizations may not perceive sufficient external pressure to invest in advanced analytics capabilities. Furthermore, differences in regulatory intensity across industries may influence the extent to which coercive forces shape digital technology adoption decisions.

Second, the results demonstrate that normative pressure significantly influences SCA adoption, supporting H2. This finding is consistent with Institutional Theory, which argues that organizations tend to conform to prevailing norms, professional standards, and industry expectations to gain legitimacy and maintain competitiveness (DiMaggio & Powell, 1983). The result is also aligned with previous studies emphasizing the importance of industry standards, professional networks, and best practices in encouraging the adoption of advanced digital technologies within supply chains (Kauppi & Luzzini, 2021; Shahzad et al., 2022). As organizations observe increasing expectations from customers, suppliers, and industry associations regarding data-driven decision-making, they become more inclined to implement analytics capabilities to sustain their competitive position.

Third, the findings confirm that mimetic pressure significantly affects SCA adoption, supporting H3. This result reinforces the argument that organizations often imitate successful competitors and industry leaders when facing uncertainty related to technological investments (Dubey et al., 2019; Kauppi & Luzzini, 2021). Consistent with Institutional Theory, firms frequently adopt practices that have already demonstrated success among peer organizations in order to reduce risk, enhance legitimacy, and accelerate implementation processes (DiMaggio & Powell, 1983). The findings further support previous research suggesting that imitation of best practices facilitates analytics adoption and strengthens organizational competitiveness (Jeske & Calvard, 2020; Bag et al., 2021).

The study also reveals that SCA has a significant positive impact on supply chain innovation, supporting H4. This finding is consistent with the Resource-Based View (RBV), which considers analytics capabilities as strategic resources that enable firms to generate valuable insights, improve operational efficiency, and foster innovation (Dubey et al., 2019; Kamboj & Rana, 2023). The result confirms previous studies indicating that analytics technologies facilitate the identification of inefficiencies, optimization opportunities, and innovative solutions across supply chain processes (Büyüközkan &

Güler, 2021; Kalaitzi & Tsolakis, 2022; Shamout, 2023). Through the effective use of analytics, organizations can transform large volumes of supply chain data into actionable knowledge that supports innovative operational practices and strategic decision-making.

Furthermore, the results indicate that SCA significantly influences frugal innovation, supporting H5. This finding can be explained through the lens of Dynamic Capabilities Theory, which highlights the importance of organizational capabilities in adapting to environmental changes and resource constraints (Fosso Wamba & Akter, 2019; Daneshvar Kakhki et al., 2023). By identifying inefficiencies, reducing waste, improving resource utilization, and supporting cost optimization, SCA enables firms to develop affordable and value-oriented solutions without sacrificing quality (Büyüközkan & Güler, 2021). In addition, analytics-driven collaboration with suppliers and customers provides valuable information that facilitates the development of resource-efficient products and services tailored to market needs (Shafiq et al., 2020).

Finally, the findings confirm that supply chain innovation significantly contributes to frugal innovation, supporting H6. This result aligns with previous studies demonstrating that innovative supply chain practices enhance logistics efficiency, inventory management, procurement effectiveness, and overall operational flexibility (Lee, 2019; Gloet & Samson, 2022). Through collaborative innovation, organizations can access new knowledge, technologies, and resources that support the development of affordable and sustainable solutions for underserved markets (Hopkins, 2021). Moreover, enhanced supply chain agility enables firms to respond rapidly to market changes and customer demands, thereby facilitating the creation of frugal innovations that maximize value while minimizing resource consumption (Shibin et al., 2018; Karaman Kabadurmus, 2020).

These findings contribute to the literature by extending Institutional Theory and Dynamic Capabilities Theory in the context of supply chain analytics adoption and innovation. The study demonstrates that normative and mimetic pressures are more influential than coercive pressures in encouraging the adoption of advanced analytics capabilities. Furthermore, the findings highlight the strategic role of SCA as a mechanism for enhancing both supply chain innovation and frugal innovation. From a managerial perspective, organizations should invest in analytics infrastructure, data-driven decision-making capabilities, and collaborative relationships with supply chain partners to strengthen innovation outcomes and improve long-term competitiveness. Policymakers may also encourage analytics adoption through industry-wide initiatives, knowledge-sharing platforms, and supportive digital transformation policies that facilitate innovation and sustainable business development.

6. Conclusions

This study examined the relationships among institutional pressures, supply chain analytics (SCA), supply chain innovation (SCI), and frugal innovation by integrating Institutional Theory and Dynamic Capabilities Theory into a unified research framework. Specifically, the study investigated the influence of coercive, normative, and mimetic pressures on SCA adoption, as well as the subsequent effects of SCA on SCI and frugal innovation. The findings reveal that coercive pressure does not significantly influence SCA adoption, whereas normative and mimetic pressures play significant roles in encouraging organizations to adopt SCA. These results suggest that industry norms, professional expectations, and competitive imitation are more influential than formal regulatory requirements in shaping analytics adoption decisions.

The study further demonstrates that SCA significantly enhances both SCI and frugal innovation. Through improved data-driven decision-making, organizations can identify operational inefficiencies, strengthen collaboration among supply chain partners, and generate innovative solutions that improve performance while reducing resource consumption. In addition, SCI was found to have a significant positive effect on frugal innovation, indicating that innovative supply chain practices facilitate the development of affordable, resource-efficient, and value-oriented products and services. Overall, the findings highlight the strategic importance of SCA as a capability that supports supply chain innovation and promotes frugal innovation, thereby enabling organizations to strengthen competitiveness and achieve sustainable growth in increasingly dynamic business environments.

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