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Assessing the Impact of Green Digital Transformational Leadership on Supply Chain Resilience and Transformation: A Case Study Approach

Mahdi Ahangari [1]

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A B S T R A C T

This study examines the impact of green digital transformational leadership (G-DTL) on supply chain resilience and digital transformation with respect to the mediating role of green logistics management (ALGM), green digital capabilities (G-DAC), and green supply chain digital transformation (G-DSCT). The statistical population consisted of supply chain professionals in Iran, a country that is pursuing the greening of industries due to environmental challenges. Given the high dispersion of the target population, data collection was conducted through the social network LinkedIn, and ultimately, 200 valid responses were received. Structural equation modeling using the Partial Least Squares (PLS) method was employed to test the nine research hypotheses. The results showed that G-DTL has a positive and significant effect on ALGM, G-DAC, G-DSCR, and G-DSCT, confirming the important role of green digital leadership in strengthening organizational capabilities and supply chain resilience. Furthermore, ALGM has a positive effect on G-DAC and G-DSCT, and G-DAC and G-DSCR positively influence G-DSCT, indicating a close relationship between green actions, digital capabilities, and supply chain transformation. Nevertheless, the effect of ALGM on G-DSCR was not significant, indicating the existence of possible moderating factors. The findings suggest that supply chain managers enhance their organization's resilience and sustainable performance by implementing green digital strategies, and this study contributes to the development of the scientific literature on green leadership, digital capabilities, and supply chain resilience.

Keywords

Green Supply Chain, Supply Chain Resilience, Sustainability, Green Transformational Leadership

1. Master of Industrial Engineering, School of Industrial Technologies, Urmia University of Technology, Urmia, Iran. mahdiahangry@gmail.com

1. Introduction

With increasing environmental pollution and numerous economic challenges, greening the supply chain has become a crucial issue for companies. However, greening the supply chain has become a major challenge for companies (Han & Li, 2025). Companies face challenges such as global integration, unpredictable demand patterns in emerging markets, and additional operational costs. Additionally, one of the significant obstacles to GSCM is the limited availability of environmental technologies and the high costs associated with these requirements (Yadav et al., 2020b). In the past, the Industrial Revolution saved humans from hunger and poverty, but this event was accompanied by widespread environmental destruction, which has negatively impacted the economic successes of the revolution. In addition to resource constraints, companies must also cope with regulations related to waste reduction and environmental compliance (Riaz et al., 2024).

Many authors have reviewed studies on digital transformation in SCM. For example, Manavalan and Jayakrishna (2019) examined the role of Industry 4.0 in SCM, and Ben-Daya et al. (2019) examined the role of the Internet of Things. However, in 2018, Büyüközkan and Göçer examined digital supply chains. Currently, digital technologies have emerged as a way to achieve sustainable development, seeking to solve environmental and economic problems through innovation (Saraji et al., 2021; Bican & Brem, 2020; Kunkel & Tyfield, 2021). Digital technologies play a crucial role in resource management and environmental pollution control (Killian & Kozek, 2018). In advanced economies such as the European Union, the United States, and Canada, AI and blockchain have played a significant role in issues including energy consumption and pollution control (Li et al., 2023). With sensor networks and data analysis, these technologies can predict changes and play a role in protecting the environment (Yang & Huang, 2020). These technologies also contribute to the transportation sector by creating intelligent logistics systems that reduce order demand and energy consumption (Papa, 2023). As environmental damage increases, companies and their stakeholders increasingly aim to protect the environment in their supply chains. This situation has led companies to pursue profit maximization and GSCM (Ugarte et al., 2016). Therefore, this study seeks to assess the impact of Green Digital Transformational Leadership on Supply Chain Resilience and Transformation: A Case Study Approach.

1.1. Sustainable supply chain management

In recent years, advances in SSCM have made it a strategic approach that allows companies to create a competitive advantage by using renewable energy and thereby reducing fossil fuel consumption (Nascimento et al., 2019). Many researchers have sought to create a better understanding of this issue by offering various definitions of the supply chain. In 2008, Seuring and Müller defined SCM, which emphasized the importance of managing the supply chain with flows of materials, information, and capital with social, economic, and environmental considerations to achieve sustainable development. With SSCM, organizations can attain greater economic benefits by mitigating negative environmental impacts (Sharma et al., 2020). To develop the SSCM concept, the two concepts of GSCM and CLSCM have been widely applied (Tsai et al., 2021). CLSC is a chain that considers both the flow from production to consumption and the reverse flow from consumption back to production. The goal is to maximize value throughout the entire product life cycle by recycling used products (Guide & Wassenhove,2009). GSCM incorporates environmental thinking throughout the whole product life cycle, from design to end-of-life management (Srivastava,2007). Researchers such as Walley and Whitehead (1994) have pointed out the cost of complying with environmental issues and have pointed out that companies cannot both comply with environmental issues and maximize profits (Carter & Rogers, 2008).

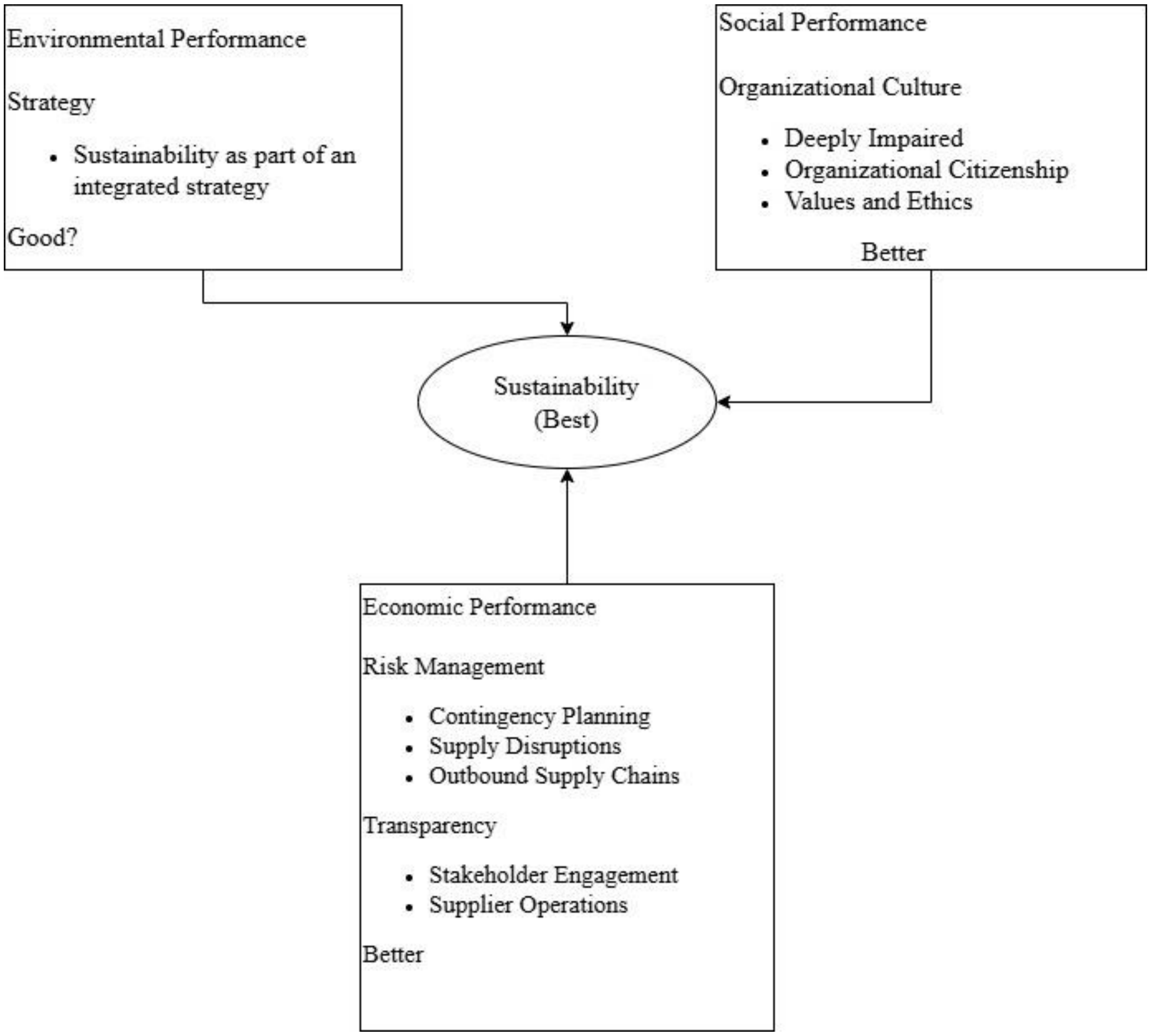

Figure 1. Sustainable supply chain management. Adapted from Carter and Rogers (2008).

1.2. Supply chain resilience and sustainability

In the wake of events such as the COVID-19 pandemic and the war in Ukraine, supply chain resilience has become a major priority for all stakeholders. In recent years, this topic has garnered increasing attention from researchers (Doetsch & Huchzermeier, 2024). Despite the relative novelty of the literature in this area, key definitions and stages of resilience have been discussed (Behzadi et al., 2020). Cohen and colleagues define supply chain resilience as the ability to cope with change by reengineering the supply chain (Cohen et al., 2021, 2022b). The supply chain resilience literature identifies three main components: preparedness before a disruption occurs, actions during a disruption, and recovery after a disruption (Doetsch & Huchzermeier, 2024). 20 years of research have demonstrated that sustainability encompasses all three dimensions: social, economic, and environmental (Elkington, 1998).

Table 1. Overview of Key Studies on the SCRE–SCS Relationship

Author(s) / Year	Approach	Type of SCRE–SCS Relationship	Key Findings / Insights
Rajesh (2021)	Theoretical (Institutional, Stakeholder, Complexity)	Conflict (short-term)	SCRE emphasizes flexibility, while SCS emphasizes efficiency – potential short-term

Author(s) / Year	Approach	Type of SCRE–SCS Relationship	Key Findings / Insights
			misalignment.
Ponomarov & Holcomb (2009)	Conceptual	Complementary	Both flexibility and efficiency are integral to resilience.
Zavala-Alcívar et al. (2020)	Empirical	Negative impact	Environmental and economic sustainability strategies may reduce SC resilience.
Soni & Jain (2011)	Explanatory	Sustainability → Resilience	Adhering to sustainability standards mitigates risks (e.g., reputational)
Miller & Engemann (2019)	Analytical	Sustainability → Resilience	Identifies three mechanisms through which sustainability enhances resilience.
Papadopoulos et al. (2017)	Empirical	Resilience → Sustainability	Resilience can drive sustainable practices.
Abdel-Basset & Mohamed (2020)	Conceptual	Bidirectional	Risk management is a common driver for both SCRE and SCS.
Silva et al. (2023)	Metaphorical / Conceptual	Synergistic	SCRE and SCS act as "dance partners" – mutually reinforcing during crises.

1.3. Digital Transformation in Supply Chain Management

Supply chain management has undergone a fundamental evolution with the emergence of digital technologies. These technologies have emerged as a strategic priority in companies due to the significant changes in customer and market needs (Sahoo et al.,2023). The Internet of Things, which enables product traceability throughout the supply chain (Razak et al.,2023), and big data and artificial intelligence, which analyze vast amounts of information to provide actionable insights to reduce costs and improve supply chain performance, are a set of technologies in the supply chain (Unal et al.,2022). The benefits of digital transformation in SCM include real-time data analysis, demand forecasting, inventory management, and production planning, which ultimately lead to cost savings (Maheshwari et al.,2023). Organizations enhance organizational responsiveness to disruptions in SC through digital transformation (Enrique et al., 2022). Despite the many opportunities for digital transformation, some obstacles impede its successful implementation. Concerning sharing information in the supply chain, there are particular concerns regarding data privacy and disclosure. Additionally, the shortage of specialized personnel is another obstacle facing organizations (Nguyen et al., 2023; Alabi et al.,2022).

Table 2. Dimensions of Digital Transformation in Supply Chain Management

Dimension	Description	Key References
Conceptual Labels	Different streams include Industry 4.0, Supply Chain 4.0, IoT-enabled supply chains, and digital/digitized supply chains. All are encompassed under the term *Smart Supply*	Manavalan & Jayakrishna (2019); Frederico

Dimension	Description	Key References
	Chain.	et al. (2020); Meindl et al. (2021)
Smart Supply Chain (Definition)	A technological construct resulting from the digital transformation of SCM, leveraging digital technologies to enhance operations and integration.	Benitez et al. (2022); Frank et al. (2019)
Strategic Level	Focuses on the firm's digital transformation strategy in SCM, aligning supply chain goals with real-time data flows. Requires clear linkage between technologies, outcomes, and performance.	Benitez et al. (2022); Nasiri et al. (2020); Davenport & Westerman (2018)
Operational Level – Base Technologies	Cross-functional digital technologies like IoT, cloud computing, big data, AI, and blockchain. These enable real-time data sharing and integration.	Frank et al. (2019); Aryal et al. (2018); Meindl et al. (2021)
Operational Level – Front-end Technologies	Technologies for execution-level tasks: robotics, 3D printing, AR, simulation, etc. Used for process optimization, quality control, and logistics efficiency.	Dalenogare et al. (2018); Hohn & Durach (2021); Birkel & Müller (2020)
Transparency & Integration	Smart supply chains promote transparency, improve buyer–supplier relationships, and optimize decision-making through better data visibility.	Frank et al. (2019); Müller et al. (2020)

1.4. Research Objectives and Hypotheses

The theoretical framework of this paper is grounded in the impact of green digital transformational leadership on the supply chain. Therefore, this study seeks to explore the relationship among Green digital transformational leadership (G-DTL), Algorithmic management (ALGM), Green digital absorptive capacity (G-DAC), Green digital supply chain resilience (G-DSCR), and Green digital supply chain transformation (G-DSCT). Accordingly, the following hypotheses are proposed to empirically test these relationships:
H1: G-DTL has a positive effect on ALGM.
H2: G-DTL has a positive effect on G-DAC.
H3: G-DTL has a positive effect on G-DSCT.
H4: G-DTL has a positive effect on G-DSCR.
H5: ALGM has a positive effect on G-DAC.
H6: ALGM has a positive effect on G-DSCT.
H7: ALGM has a positive effect on G-DSCR.
H8: G-DAC has a positive effect on G-DSCT.
H9: G-DSCR has a positive effect on G-DSCT.

2. Research methodology

2.1. Measurement scales

The questionnaire used as the primary data collection tool in this study comprised two main sections. The first part examined demographic information, and the second part examined domain-specific items related to the study constructs. The questionnaire employed in this study was adopted from Alabdali et al. (2025) and is openly accessible for readers interested in the complete instrument. "The questionnaire included the following constructs: Green Digital Transformational Leadership (G-DTL) with 6 items (Y.S. Chen & Chang, 2013); Algorithmic Management (ALGM) with 5 items (Parent-Rocheleau et al., 2024); Green Digital Absorptive Capacity (G-DAC) with 4 items (Gluch et al., 2009); Green Digital Supply Chain Transformation (G-DSCT) with 6 items (Nasiri et al., 2020; Frank et al., 2019); and Green Digital Supply Chain Resilience (G-DSCR) as measured by Chunsheng et al. (2019), El-Baz & Ruel (2021), and El-Baz et al. (2023)."A seven-point Likert scale was also employed to record responses (Fornell & Larcker, 1981).

2.2. Sampling and data collection

The statistical population of this study comprised supply chain professionals in Iran. Amid environmental challenges, Iran is actively pursuing the greening of its industries. Access to the target population was limited due to high dispersion among participants; therefore, the author utilized the social network LinkedIn to collect data. A large number of questionnaires were distributed, resulting in 200 valid responses being collected.

Table 3. Analysis of the respondents' profiles and demographics

Respondents (N = 200)	#	%		#	%
Gender					
Male	141	70.5			
Female	59	29.5			
Age			Department		
20-30	46	23.0	Operations	33	16.5
31-40	77	38.5	Logistics	37	18.5
41-50	50	25.0	Procurement	32	16.0
Over 51	27	13.5	Warehouse	21	10.5
Experience			Quality	23	11.5
Less than 1 year	13	6.5	Planning	26	13.0
2-5	39	19.5	Customer Service	28	14.0
6-10	54	27.0	Industry		
11-15	34	17.0	Food and Beverage	34	17.0
16-20	31	15.5	FMCG	36	18.0
Over 21	29	14.5	Retail	32	16.0
Education			Aviation	16	8.0
High school or less	5	2.5	Manufacturing	41	20.5
Diploma	13	6.5	Healthcare	24	12.0
Bachelor's	87	43.5	Telecom	17	8.5
Master's	62	31.0	Organization Size		
Ph.D.	33	16.5	Less than 100	37	18.5
Occupational Level			101–500	60	30.0
Entry level	37	18.5	501–1000	57	28.5
Specialist / Supervisor	72	36.0	1001–5000	33	16.5
Manager / Senior Manager	57	28.5	More than 5000	13	6.5
Director / Executive	34	17.0			

3. Results

3.1. Measurement Model

To examine the validity and reliability of the constructs, the indicators in the table below were used. The values in the table show that the Cronbach's alpha values for all constructs were above the acceptable limit. Furthermore, all composite reliability values were high. In addition, all AVE values exceeded 0.5, which indicates high consistency among the constructs. Therefore, convergent validity is confirmed for all constructs.

Table 4. Construct Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
ALGM	0.958	0.963	0.968	0.857
GDAC	0.961	0.962	0.972	0.896
GDSCR	0.949	0.950	0.963	0.868
GDSCT	0.967	0.968	0.973	0.859
GDTL	0.968	0.968	0.974	0.861

3.2. Discriminant Validity

The Fornell–Larcker Criterion was used to examine the discriminant validity. The results show that the square root of AVE is, in many cases, greater than the correlation of that construct with other constructs. Hence, the discriminant validity is acceptable.

Table 5. Fornell-Larcker Criterion

	ALGM	GDAC	GDSCR	GDSCT	GDTL
ALGM	0.926				
GDAC	0.825	0.947			
GDSCR	0.827	0.939	0.932		
GDSCT	0.888	0.939	0.937	0.927	
GDTL	0.835	0.946	0.932	0.922	0.928

3.3. Model Fit

Based on the results of the fit indices, the model demonstrates an excellent fit. The SRMR value is 0.031, which is below the 0.08 threshold and indicates a good model fit. The d_ULS (0.314) and d_G (0.584) indices are also at low levels, suggesting a minimal difference between the observed and estimated correlation matrices. Also, the NFI value of 0.918 indicates a good fit of the structural model. In summary, the model fit indices suggest that the measurement and structural models fit the empirical data well, and that path analysis and hypothesis testing can proceed.

Table 6. Model_Fit

	Saturated Model	Estimated Model
SRMR	0.031	0.031
d_ULS	0.308	0.314
d_G	0.573	0.584
Chi-Square	651.344	659.833
NFI	0.919	0.918

3.4. Hypotheses Testing

After confirming the measurement model and ensuring the validity and reliability of the constructs, the structural model was evaluated to test the research hypotheses. The results of the path analysis indicate that almost all hypothesized relationships in the model, except one, were statistically significant and confirmed at the 95% confidence level.

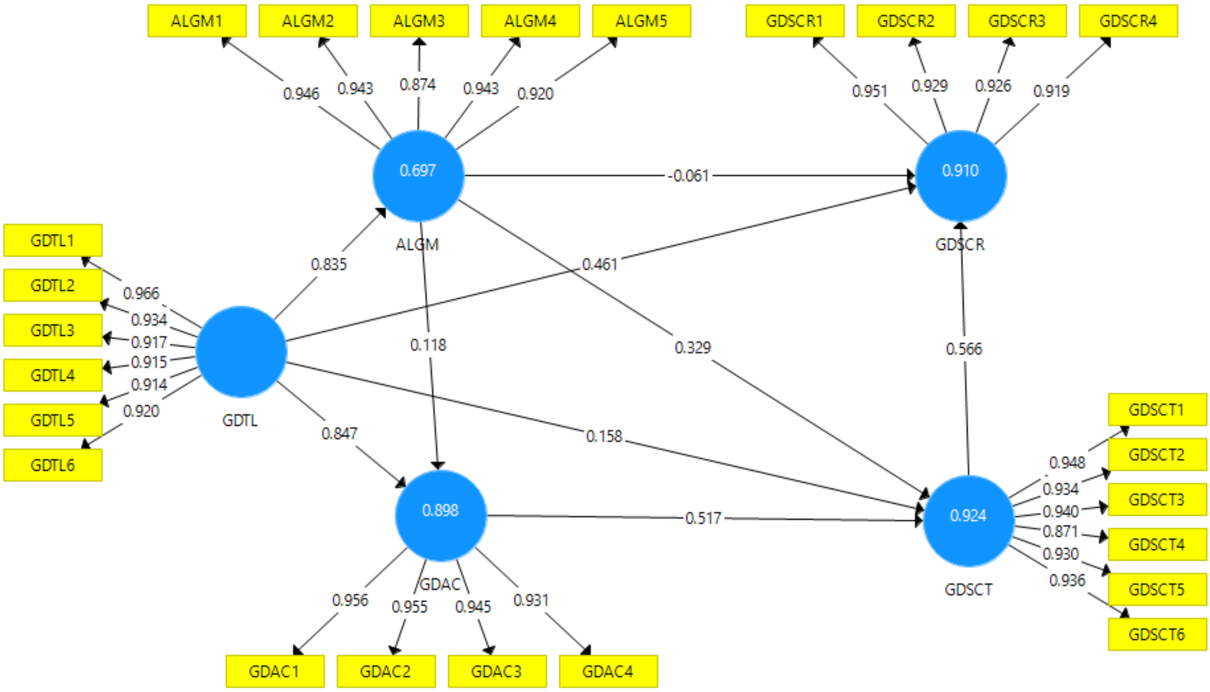

Figure 2. Measurement model

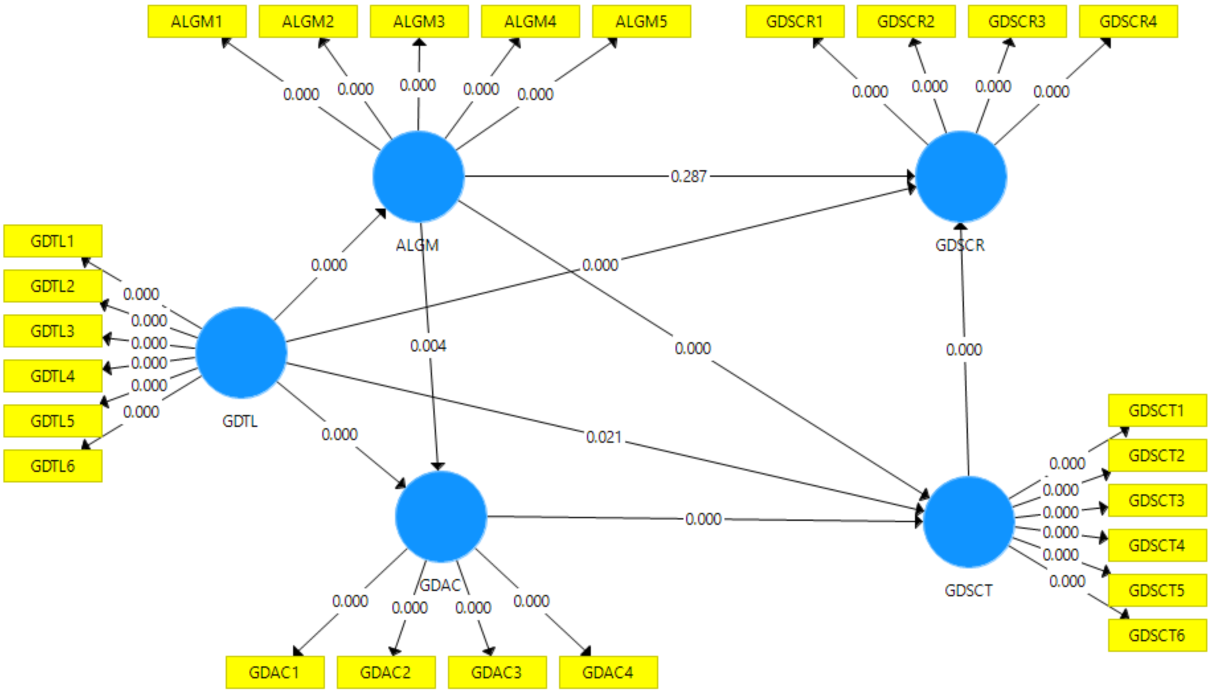

Figure 3. Structural model

Table 7. Path Coefficients, T-Statistics, and P-Values in the PLS Model

Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics	P Values	Statistical Result
ALGM -> GDAC	0.118	0.122	0.037	3.175	0.002	Significant
ALGM -> GDSCR	-0.061	-0.059	0.052	1.156	0.248	Not Significant

Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics	P Values	Statistical Result
ALGM -> GDSCT	0.329	0.329	0.038	8.644	0.000	Significant
GDAC -> GDSCT	0.517	0.518	0.068	7.642	0.000	Significant
GDSCT -> GDS...	0.566	0.560	0.081	6.971	0.000	Significant
GDTL -> ALGM	0.835	0.833	0.028	30.281	0.000	Significant
GDTL -> GDAC	0.847	0.844	0.034	24.695	0.000	Significant
GDTL -> GDSCR	0.461	0.466	0.069	6.683	0.000	Significant
GDTL -> GDSCT	0.158	0.158	0.066	2.400	0.017	Significant

4. Discussion

In this study, the impact of green digital leadership (G-DTL) on a number of key supply chain variables, including green resource management (ALGM), green digital capabilities (G-DAC), green digital resilience capacity (G-DSCR), and green digital supply chain capabilities (G-DSCT), was investigated. The results of PLS analyses show that most of the relationships between variables are statistically significant, indicating the importance of green digital leadership in improving resilience and digital transformation in the supply chain.

4.1. Hypothesis Testing

Hypothesis 1: G-DTL has a positive effect on ALGM. The results showed that G-DTL has a significant effect on ALGM (path coefficient 0.835; T-Statistic = 30.281; p-value < 0.001). This finding confirms that green digital leadership plays a direct role in enhancing green resource management processes. Prior research has also shown that transformational leadership can increase the adoption of green technologies and better resource management.

Hypothesis 2: G-DTL has a positive effect on G-DAC. The analyses showed that G-DTL has a positive and significant effect on G-DAC (path coefficient 0.847; T-Statistic = 24.695; p-value < 0.001). This indicates that green digital leadership is able to strengthen green digital capabilities in organizations, which can be especially effective in facing environmental challenges and competitive market needs.

Hypothesis 3: H3: G-DTL has a positive effect on G-DSCT. Green digital leadership also has a positive and significant effect on G-DSCT (path coefficient 0.158; T-Statistic = 2.400; p-value = 0.017). Despite being statistically significant, it is weaker compared to other relationships, which may indicate that improving green digital capabilities in the supply chain requires other factors that are not directly affected by green digital leadership.

Hypothesis 4: H4: G-DTL has a positive effect on G-DSCR. The results showed that G-DTL has a significant effect on G-DSCR (path coefficient 0.461; T-Statistic = 6.683; p-value < 0.001). This finding aligns with prior studies on the relationship between digital leadership and supply chain resilience and indicates the importance of green leadership in strengthening resilience and responding to potential crises.

Hypothesis 5: ALGM has a positive effect on G-DAC. This relationship was also confirmed (path coefficient 0.118; T-Statistic = 3.175; p-value = 0.002), indicating that improving green resource management processes can lead to increased green digital capabilities in organizations. This may be especially important in complex and global supply chains that demand optimal resource management and the integration of new technologies.

Hypothesis 6: ALGM has a positive effect on G-DSCT. A significant effect was also observed in this hypothesis (path coefficient 0.329; T-Statistic = 8.644; p-value < 0.001). These results indicate that green resource management can have an impact on strengthening green digital capabilities in the supply chain, which in turn will help increase productivity and reduce costs.

Hypothesis 7: ALGM has a positive effect on G-DSCR. However, for this hypothesis, the results showed that there is no significant relationship (path coefficient -0.061; T-Statistic = 1.156; p-value = 0.248). This finding may be because the effect of ALGM on supply chain resilience may be influenced by external factors such as macro policies, environmental regulations, or other organizational strategies.

Hypothesis 8: G-DAC has a positive effect on G-DSCT. The results showed that G-DAC has a positive and significant effect on G-DSCT (path coefficient 0.517; T-Statistic = 7.642; p-value < 0.001). This result indicates that green digital capabilities directly affect green digital capabilities in the supply chain and contribute to more effective use of digital technologies in promoting supplier resilience and transformation.

Hypothesis 9: G-DSCR has a positive effect on G-DSCT. This hypothesis was also confirmed (path coefficient 0.566; T-Statistic = 6.971; p-value < 0.001), indicating that green digital resilience can positively influence green digital capabilities in the supply chain.

5. Conclusion

This study investigated the impact of green digital leadership (G-DTL) on resilience and digital transformation in the supply chain, and the results showed that green digital leadership can have a significant impact on several aspects of these processes. Analyses using the PLS method showed that G-DTL directly and positively affects green resource management processes (ALGM), green digital capabilities (G-DAC), green digital resilience capacity (G-DSCR), and green digital supply chain capabilities (G-DSCT).

The results of this study showed that green digital leadership not only positively impacts digital capabilities and resilience of supply chains, but also plays an important role in digital transformation in these chains by strengthening green resource management processes. In particular, the positive and significant relationship between G-DTL and ALGM, G-DAC, and G-DSCR is of great importance and emphasizes the need to pay attention to green leadership in the digital processes of suppliers and business partners.

Furthermore, this research found evidence that green digital leadership can directly contribute to increasing resilience and improving green digital capabilities in the supply chain, which is of great importance in today's challenging and evolving world. At the same time, it is worth noting that in some relationships, such as the effect of ALGM on G-DSCR, non-significant results were observed, which may be due to various reasons, such as the need to interact with other managerial and environmental factors.

The results also recommend that managers and decision-makers across industries pay particular attention to developing and strengthening green digital leadership to improve resilience and green digital capabilities in the supply chain. These actions can help reduce negative environmental impacts, improve crisis response, and increase competitiveness.

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Conflicts of Interest

The author declares no conflicts of interest.

Data availability

Data will be made available on request.

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Notes

The author used advanced artificial intelligence tools to assist in checking grammar and improving the language clarity of the manuscript.

References

Abdel-Basset, M., & Mohamed, R. (2020). A novel plithogenic TOPSIS–CRITIC model for sustainable supply chain risk management. *Journal of Cleaner Production, 247*, 119586. https://doi.org/10.1016/j.jclepro.2019.119586

Alabdali, M. A., Yaqub, M. Z., & Windsperger, J. (2025). Green digital leadership and algorithmic management for sustainable supply chains: A serial mediation model. *International Journal of Information Management Data Insights, 5*(1), 100343. https://doi.org/10.1016/j.jjimei.2025.100343

Alabi, T. M., Aghimien, E. I., Agbajor, F. D., Yang, Z., Lu, L., Adeoye, A. R., & Gopaluni, B. (2022). A review on the integrated optimization techniques and machine learning approaches for modeling, prediction, and decision making on integrated energy systems. *Renewable Energy, 194*, 822-849. https://doi.org/10.1016/j.renene.2022.05.123

Aryal, A., Liao, Y., Nattuthurai, P., & Li, B. (2018). The emerging big data analytics and IoT in supply chain management: A systematic review. *Supply Chain Management: An International Journal, 25*(2), 141–156. https://doi.org/10.1108/SCM-03-2018-0149

Behzadi, G., O'Sullivan, M. J., & Olsen, T. L. (2020). On metrics for supply chain resilience. *European Journal of Operational Research, 287*(1), 145–158. https://doi.org/10.1016/j.ejor.2020.04.040

Ben-Daya, M., Hassini, E., & Bahroun, Z. (2019). Internet of things and supply chain management: A literature review. *International Journal of Production Research, 57*(15/16), 4719–4742. https://doi.org/10.1080/00207543.2017.1402140

Benitez, G. B., Ferreira-Lima, M., Ayala, N. F., & Frank, A. G. (2022). Industry 4.0 technology provision: The moderating role of supply chain partners to support technology providers. *Supply Chain Management: An International Journal.* Advance online publication. https://doi.org/10.1108/SCM-07-2020-0304

Bican, P. M., & Brem, A. (2020). Digital business model, digital transformation, digital entrepreneurship: Is there a sustainable "digital"? *Sustainability, 12*(5239). https://doi.org/10.3390/su12135239

Birkel, H. S., & Müller, J. M. (2020). Potentials of Industry 4.0 for supply chain management within the triple bottom line of sustainability – A systematic literature review. *Journal of Cleaner Production, 289*, 125612. https://doi.org/10.1016/j.jclepro.2020.125612

Büyüközkan, G., & Göçer, F. (2018). Digital supply chain: Literature review and a proposed framework for future research. *Computers in Industry, 97*, 157–177. https://doi.org/10.1016/j.compind.2018.02.010

Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: Moving toward new theory. *International Journal of Physical Distribution & Logistics Management, 38*(5), 360–387. https://doi.org/10.1108/09600030810882816

Chen, Y. S., & Chang, C. H. (2013a). The determinants of green product development performance: Green dynamic capabilities, green digital transformational leadership, and green creativity. *Journal of Business Ethics, 116*, 107–119. https://doi.org/10.1007/s10551-012-1452-x

Chunsheng, L., Wong, C. W. Y., Yang, C. C., Shang, K. C., & Lirn, T. C. (2019). Value of supply chain resilience: Roles of culture, flexibility, and integration. *International Journal of Physical Distribution & Logistics Management, 50*, 80–100. https://doi.org/10.1108/IJPDLM-02-2019-0041

Cohen, M. A., Cui, S., Doetsch, S., Ernst, R., Huchzermeier, A., Kouvelis, P., Lee, H. L., Matsuo, H., & Tsay, A. A. (2021). Putting supply chain resilience theory into practice. *Management and Business Review, 2*(3), 7–17.

Cohen, M. A., Cui, S., Doetsch, S., Ernst, R., Huchzermeier, A., Kouvelis, P., Lee, H. L., Matsuo, H., & Tsay, A. A. (2022). Understanding global supply chain design & resilience: Theory, practice, and the knowing-doing gap. In H. L. Lee, R. Ernst, A. Huchzermeier, & S. Cui (Eds.), *Creating value with operations analytics* (pp. 287–311). Springer. https://doi.org/10.1007/978-3-031-08871-1_14

Dalenogare, L. S., Benitez, G. B., Ayala, N. F., & Frank, A. G. (2018). The expected contribution of Industry 4.0 technologies for industrial performance. *International Journal of Production Economics, 204*, 383–394. https://doi.org/10.1016/j.ijpe.2018.08.019

Davenport, T. H., & Westerman, G. (2018). Why so many high-profile digital transformations fail. *Harvard Business Review, 9*, 15.

Doetsch, S., & Huchzermeier, A. (2024). The intersection of supply chain resilience and sustainability from a theoretical and practical perspective: An integrated framework. *Journal of Cleaner Production, 484*, Article 144306. https://doi.org/10.1016/j.jclepro.2024.144306

El-Baz, J., & Ruel, S. (2021). Can supply chain risk management practices mitigate the disruption impacts on supply chains' resilience and robustness? Evidence from an empirical survey in a COVID-19 outbreak era. *International Journal of Production Economics, 233*, Article 107972. https://doi.org/10.1016/j.ijpe.2020.107972

El-Baz, J., Ruel, S., & Fozouni Ardekani, Z. F. (2023). Predicting the effects of supply chain resilience and robustness on COVID-19 impacts and performance: Empirical investigation through resources orchestration perspective. *Journal of Business Research, 164*, Article 114025. https://doi.org/10.1016/j.jbusres.2023.114025

Elkington, J. (1998). Accounting for the triple bottom line. *Measuring Business Excellence, 2*(3), 18–22. https://doi.org/10.1108/eb025539

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*, 39–50. https://doi.org/10.1177/002224378101800104

Frank, A. G., Dalenogare, L. S., & Ayala, N. F. (2019). Industry 4.0 technologies: Implementation patterns in manufacturing companies. *International Journal of Production Economics, 210*, 15–26. https://doi.org/10.1016/j.ijpe.2019.01.004

Frederico, G. F., Garza-Reyes, J. A., Anosike, A., & Kumar, V. (2020). Supply chain 4.0: Concepts, maturity and research agenda. *Supply Chain Management: An International Journal, 25*(2), 262–282. https://doi.org/10.1108/SCM-09-2018-0339

Gluch, P., Gustafsson, M., & Thuvander, L. (2009). An absorptive capacity model for green innovation and performance in the construction industry. *Construction Management and Economics, 27*, 451–464. https://doi.org/10.1080/01446190902896645

Guide, V. D. R., & Van Wassenhove, L. N. (2009). The evolution of closed-loop supply chain research. *Operations Research, 57*(1), 10–18. https://doi.org/10.1287/opre.1080.0628

Han, H., & Li, J. (2025). Leveraging industry 4.0 technologies for sustainable supply chain management: A systematic review. *Cleaner Logistics and Supply Chain, 16*, 100246. https://doi.org/10.1016/j.clscn.2025.100246

Hohn, M. M., & Durach, C. F. (2021). Additive manufacturing in the apparel supply chain – impact on supply chain governance and social sustainability. *International Journal of Operations & Production Management, 41*(7), 1035–1059. https://doi.org/10.1108/IJOPM-09-2020-0654

Killian, Z. M., & Kozek, M. (2018). Comprehensive smart home energy management system using mixed-integer quadratic programming. *Applied Energy, 222*, 662–672. https://doi.org/10.1016/j.apenergy.2018.04.020

Kunkel, S., & Tyfield, D. (2021). Digitalisation, sustainable industrialisation and digital rebound—Asking the right questions for a strategic research agenda. *Energy Research & Social Science, 82*, 102295. https://doi.org/10.1016/j.erss.2021.102295

Li, W., Xiao, X., Yang, X., & Li, L. (2023). How does digital transformation impact green supply chain development? An empirical analysis based on the TOE theoretical framework. *Systems, 11*(416). https://doi.org/10.3390/systems11080416

Maheshwari, P., Kamble, S., Belhadi, A., Venkatesh, M., & Abedin, M. Z. (2023). Digital twin-driven real-time planning, monitoring, and controlling in food supply chains. *Technological Forecasting and Social Change, 195*, 122799. https://doi.org/10.1016/j.techfore.2023.122799

Manavalan, E., & Jayakrishna, K. (2019). A review of Internet of Things (IoT) embedded sustainable supply chain for Industry 4.0 requirements. *Computers & Industrial Engineering, 127*, 925–953. https://doi.org/10.1016/j.cie.2018.11.030

Meindl, B., Ayala, N. F., Mendonça, J., & Frank, A. G. (2021). The four smarts of Industry 4.0: Evolution of ten years of research and future perspectives. *Technological Forecasting and Social Change, 168*, 120784. https://doi.org/10.1016/j.techfore.2021.120784

Miller, H. E., & Engemann, K. J. (2019). Resilience and sustainability in supply chains. In G. A. Zsidisin & M. Henke (Eds.), *Revisiting supply chain risk* (pp. 251–263). Springer. https://doi.org/10.1007/978-3-030-03813-7_15

Müller, J. M., Veile, J. W., & Voigt, K.-I. (2020). Prerequisites and incentives for digital information sharing in Industry 4.0 – An international comparison across data types. *Computers & Industrial Engineering, 148*, 106733. https://doi.org/10.1016/j.cie.2020.106733

Nascimento, D. L. M., Alencastro, V., Quelhas, O. L. G., Caiado, R. G. G., Garza-Reyes, J. A., Lona, L. R., & Tortorella, G. (2019). Exploring Industry 4.0 technologies to enable circular economy practices in a manufacturing context: A business model proposal. *Journal of Manufacturing Technology Management, 30*(4), 607–627. https://doi.org/10.1108/JMTM-03-2018-0071

Nasiri, M., Ukko, J., Saunila, M., & Rantala, T. (2020). Managing the digital supply chain: The role of smart technologies. *Technovation, 96–97*, 102121. https://doi.org/10.1016/j.technovation.2020.102121

Nguyen, D. K., Broekhuizen, T., Dong, J. Q., & Verhoef, P. C. (2023). Leveraging synergy to drive digital transformation: A systems-theoretic perspective. *Information & Management, 60*(7), 103836. https://doi.org/10.1016/j.im.2023.103836

Papa, A. (2023). Digital technologies and sustainability—Identified synergies, challenges and anticipated impact on the transportation business segment. *Journal of Research Innovation and Sustainability in Society, 5*, 72–75. https://doi.org/10.52323/jriss.v5i1.132

Papadopoulos, T., Gunasekaran, A., Dubey, R., Altay, N., Childe, S. J., & Fosso Wamba, S. (2017). The role of big data in explaining disaster resilience in supply chains for sustainability. *Journal of Cleaner Production, 142*, 1108–1118. https://doi.org/10.1016/j.jclepro.2016.03.059

Parent-Rocheleau, X., Parker, S. K., Bujold, A., & Gaudet, M. C. (2024). Creation of the algorithmic management questionnaire: A six-phase scale development process. *Human Resource Management, 63*, 25–44. https://doi.org/10.1002/hrm.22185

Ponomarov, S. Y., & Holcomb, M. C. (2009). Understanding the concept of supply chain resilience. *The International Journal of Logistics Management, 20*(1), 124–143. https://doi.org/10.1108/09574090910954873

Rajesh, R. (2021). Optimal trade-offs in decision-making for sustainability and resilience in manufacturing supply chains. *Journal of Cleaner Production, 313*, 127596. https://doi.org/10.1016/j.jclepro.2021.127596

Razak, G. M., Hendry, L. C., & Stevenson, M. (2023). Supply chain traceability: A review of the benefits and its relationship with supply chain resilience. *Production Planning & Control, 34*(11), 1114-1134. https://doi.org/10.1080/09537287.2021.1983661

Riaz, M., Wu, J., Sherani, S. A., & Chang, S. (2024). Assessing the role of organizational strategic factors in stimulating green innovation performance: Moderating effects of green absorptive capacity. *Business Process Management Journal, 30*(4), 1013–1043. https://doi.org/10.1108/BPMJ-12-2023-0967

Sahoo, S. K., Goswami, S. S., Sarkar, S., & Mitra, S. (2023). A review of digital transformation and Industry 4.0 in supply chain management for small and medium-sized enterprises. *Spectrum of Engineering and Management Sciences, 1*(1), 58–70. https://doi.org/10.31181/sems1120237j

Saraji, M. K., Streimikiene, D., & Kyriakopoulos, G. L. (2021). Fermatean fuzzy CRITIC-COPRAS method for evaluating the challenges to Industry 4.0 adoption for a sustainable digital transformation. *Sustainability, 13*(9577). https://doi.org/10.3390/su13179577

Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production, 16*(15), 1699–1710. https://doi.org/10.1016/j.jclepro.2008.04.020

Sharma, R., Jabbour, C. J. C., de Sousa, L., & Jabbour, A. B. (2020). Sustainable manufacturing and Industry 4.0: What we know and what we don't. *Journal of Enterprise Information Management, 34*(1), 230–266. https://doi.org/10.1108/JEIM-01-2020-0024

Silva, M. E., Pereira, M. M., & Hendry, L. C. (2023). Embracing change in tandem: Resilience and sustainability together transforming supply chains. *International Journal of Operations & Production Management, 43*(1), 166–196. https://doi.org/10.1108/IJOPM-04-2022-0274

Soni, U., & Jain, V. (2011). Minimizing the vulnerabilities of supply chain: A new framework for enhancing the resilience. In *Proceedings of the 2011 IEEE International Conference on Industrial Engineering and Engineering Management* (pp. 933–937). IEEE. https://doi.org/10.1109/IEEM.2011.6118140

Srivastava, S. K. (2007). Green supply-chain management: A state-of-the-art literature review. *International Journal of Management Reviews, 9*(1), 53–80. https://doi.org/10.1111/j.1468-2370.2007.00202.x

Tsai, F. M., Bui, T. D., Tseng, M. L., Ali, M. H., Lim, M. K., & Chiu, A. S. (2021). Sustainable supply chain management trends in world regions: A data-driven analysis. *Resources, Conservation and Recycling, 167*, 105421. https://doi.org/10.1016/j.resconrec.2021.105421

Ugarte, G. M., Golden, J. S., & Dooley, K. J. (2016). Lean versus green: The impact of lean logistics on greenhouse gas emissions in consumer goods supply chains. *Journal of Purchasing and Supply Management, 22*(2), 98–109. https://doi.org/10.1016/j.pursup.2015.12.004

Unal, P., Albayrak, Ö., Jomâa, M., & Berre, A. J. (2022). Data-driven artificial intelligence and predictive analytics for the maintenance of industrial machinery with hybrid and cognitive digital twins. In *Technologies and applications for big data value* (pp. 299–319). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-78307-5_14

Valle Enrique, D., Visintainer Lerman, L., de Sousa, P. R., Benitez, G. B., Charrua Santos, F. M. B., & Frank, A. G. (2022). Being digital and flexible to navigate the storm: How digital transformation enhances supply chain flexibility in turbulent environments. *International Journal of Production Economics, 250*, 108668. https://doi.org/10.1016/j.ijpe.2022.108668

Yadav, G., Luthra, S., Jakhar, S. K., Mangla, S. K., & Rai, D. P. (2020). A framework to overcome sustainable supply chain challenges through solution measures of Industry 4.0 and circular economy: An automotive case. *Journal of Cleaner Production, 254*, 120112. https://doi.org/10.1016/j.jclepro.2020.120112

Yang, J., Li, X., & Huang, S. (2020). Impacts on environmental quality and required environmental regulation adjustments: A perspective of directed technical change driven by big data. *Journal of Cleaner Production, 275*, 124126. https://doi.org/10.1016/j.jclepro.2020.124126

Zavala-Alcívar, A., Verdecho, M.-J., & Alfaro-Saiz, J.-J. (2020). A conceptual framework to manage resilience and increase sustainability in the supply chain. *Sustainability, 12*(16), 6300. https://doi.org/10.3390/su12166300