Let's Start!

The Role of Digitalization in Strengthening Supply Chain Resilience and Efficiency in the Consumer Goods Industry

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ABSTRACT

This study explores the implications of digital technologies to support supply chain activities in the Fast-Moving Consumer Goods (FMCG) industry, in relation to building resilience and efficiency during global health crises, specifically pandemics. A quantitative, descriptive methodology was used by conducting a closed-ended questionnaire with the supply chain managers and IT personnel within the FMCG sector. Each questionnaire was distributed using a purposive sampling collection strategy. We assessed the role of Industry 4.0 technologies, which include the Internet of Things (IoT), blockchain, and big data, on resilient and efficient supply chain operations amid disruptions. The findings indicate that digitalization assists in increasing the supply chain's operational readiness and performance during the crisis period. Although there are challenges with the adoption of digital technologies, such as barriers of financial investment and organizational resistance, there are reliable digital technology solutions available to support resilient and sustainable supply chain models. Future competencies will be seen as using digitally integrated supply chains to support business sustainability in disruption-effective contexts. One limitation of this study is the generality regarding a relatively small sample size and a relatively cross-sectional methodology. Factors such as organizational culture and leadership were not examined in depth. Future research designs, should well as longitudinal research, should consider more dimensions to broaden understanding. FMCG companies and policymakers should invest in real-time visibility, planning, and analytics systems and program changes to support their employees; they should also focus on supporting blockchain adoption, incentives for SMEs, and finding safer cybersecurity solutions, if possible, to move digital supply chains faster.

Keywords: Digitalization, Supply Chain Resilience, Supply Chain Efficiency, Fast-Moving Consumer Goods, Supply Chain Management.

1. Introduction

In today's world, business industries worldwide are experiencing technological

disruptions unlike anything we have seen before that are reshaping how organizations do business. One of the industries that is most impacted is the supply chain, which is a crucial aspect of productivity, competitiveness, efficiency, and customer satisfaction. The supply chain used to be a straightforward process, but now, it is no longer just a linear process; it is a dynamic and complex network that, to survive in an increasingly volatile market, should balance both efficiency and reactivity (Ali et al., 2022). With the increasing pressure of globalization, rapidly shorter product life cycles, and stagnant consumer expectations, supply chains now require even more agility, resilience, and sustainability. The scope of modern technologies has been impacted by the breadth of technology from the Internet of Things (IoT), blockchain, big data analytics, and artificial intelligence, which are rapidly changing the parameters of operation for traditional supply chain management (Anser et al., 2025; Anser et al., 2024).

Modern retailers typically keep low inventory levels to save costs, resulting in an increased level of risk in their business during torture periods. In combination with demand volatility and globalized business operations, this can complicate demand forecasts and production planning by a significant margin (S. Gupta et al., 2020). Given these issues, supply chain digitization has evolved into an important enabler to mitigate the impacts of these problems, and because of improved visibility, the ability to predict changes and trends, and the ability to coordinate and analyze decision-making. Furthermore, the transition from traditional manufacturing to intelligent and sustainable manufacturing would fall under the notions of digitalization and Industry 4.0, which focuses on developing digital technologies and the use of data analytics, leading to the strategic importance of digitalization.

The COVID-19 pandemic has highlighted many weaknesses in global supply chains, especially in sectors like FMCG, which require speed, reliability, and high turnover, all of which were lacking. Lockdowns, border restrictions, and logistical bottlenecks caused unparalleled disruptions, resulting in stockouts and delays, and unpredictable demand patterns (Khan et al., 2024; Farooq & Ahmad, 2023; Farooq et al., 2023). For FMCG firms, the stakes were higher for these reasons; many of their products, like food, hygiene products, and household supplies, were essential during the crisis. Resilient supply chains

were therefore those able to withstand shocks while maintaining service levels, and minimizing operational risks, whereas efficient supply chains were those able to optimise costs and meet customer needs despite crippling constraints.

When organizations are faced with disruption, digitalization has been identified as one of the primary enablers of supply chain resilience, allowing companies to adapt faster and more effectively. Digital technology provides real-time insights and predictive capabilities that help companies anticipate issues, improve route planning, and make swift decisions to optimally reconfigure their supply chains (Memon et al., 2025; Javaid et al., 2022; Naeem et al., 2025,a,b,c). In the FMCG sector, especially, where margins are fluid, and demands for products may change on a whim, the implementation of digital tools will serve as a critical barrier for any level of business disruption escaping into a costly and highly damaging market vulnerability.

FMCG sellers offer a particularly relevant context to address the impact of digital transformation on supply chain management, given their unique characteristics. The supply chain characteristics of the FMCG sector offer frequent product turnover, often short shelf life, and large distribution patterns across unlimited geographies, requiring an elevated level of forecast accuracy and logistical/procedural execution. Even a minor lag in two separately staged delivery channels can cause a stream of delays across downstream supply channel activity, leading to a deviation in a single supplier's service costs or performance, potentially elevating downstream issues to concurrent significant damages affecting producers. Digitalization also represents a necessary strategic change, because of the centralizing nature of the FMCG distribution structure, even negligible reductions in efficiency using digital tools can result in major multiplier changes to the service delivery costs.

While it is recognized that the positive attributes of digital transformation are vast, many organizations face challenges that make complete digitalization increasingly difficult. The critical factors that remain barriers to full digitalization include capital investment, capital requirements, organizational resistance to change, data security, and retraining employees to work alongside new technology (Naeem et al., 2024; Shaikh et al., 2025). Furthermore, as a result of the COVID-19 pandemic, organizations have revealed gaps in

their adoption efforts, as many organizations were unable to implement the needed systems quickly enough in order to mitigate disruption faced as a result of the pandemic. This can be seen as a stress test for organizations, where the pandemic acted as a stimulus to the use of digital supply chains in the FMCG sector.

The literature gap on the relationship between digitalization, supply chain resilience, and operational efficiency in the FMCG sector, during pandemic scenarios, remains notable from an academic standpoint. In the literature, applications of Industry 4.0 in manufacturing and logistics have been predominantly researched, but there have been limited studies showing the relationship between these technologies applied under extreme conditions, such as a market disruption. The gap outlined demonstrates the importance of not only providing theoretical understanding for academic purposes, but to providing a grounded possible application to practitioners or professionals as part of their organizational learning. As a result, this research will be driven by the following research objectives: To understand the challenges to the uptake of digital technologies in FMCG supply chains. To assess the extent to which these digital technologies affect resilience and efficiency during pandemics. To develop a set of practical approaches to overcome these adoption challenges, leveraging case studies and best practices. To understand the economic and operational benefits of digitalisation in the FMCG environment under crises.

These objectives are supported by a number of guiding research questions: What are the key barriers (technical, financial, and organisational) to adopting digital technologies in FMCG supply chains?. How do we make it easier to adopt and transition to digital supply chains?. What are the implications of digital technologies on resilience and efficiency during pandemics?. Which supply chain operations were most significantly influenced by digitalisation in FMCG?. How does the systematic adoption of current technologies improve the capability of FMCG supply chains?

The importance of this study stems from its contribution to theory and practice. From a theoretical perspective, it adds to the literature on digital transformation and supply chain resilience, as well as providing a conceptual framework for how technology will influence the efficiency vs adaptability debate. Practically, it has developed actionable

recommendations that FMCG firms can apply to ensure continuity in their supply chains during disruptive events. These recommendations are timely, especially with the increasing likelihood of global interruptions caused by pandemics, geopolitical tensions, natural disasters, and the like. The scope of this study is confined to the FMCG sector and related to the impact of digital technologies that could improve supply chain resilience and efficiency during pandemics. Technologies that will be examined include IoT, blockchain, and big data analytics, under the Industry 4.0 umbrella. The study will consider barriers to the technological adoption of this technology and strategies for overcoming these barriers. Finally, it has been hypothesized that the results can be used by FMCG organizations for their roadmap towards future-proofing their supply chains against large-scale disruption.

1.1   2. Literature Review

The leap from traditional supply chain approaches to digitalized models has been one of the watershed moments in FMCG paradigms. Indeed, Gupta et al. (2022) point to Industry 4.0 technologies like IoT, Blockchain, and big data analytics, swapping static linear supply chains for more adaptive, network models. While the aforementioned technologies enhance flexibility and visibility in supply chains, we noted their implementation can be constrained by high implementation costs, as well as people and process readiness. This creates a tension in the literature: while the digital transformation is framed as inevitable, empirical studies of the digital transformation of supply chains show that adoption rates vary by firm, with smaller FMCG firms being relegated to catch-up. Despite positioning digitalization as a solution to inefficiencies, the extent to which mature organizational and financial readiness is implemented can alter the overall effectiveness of the solution.

Digital technologies are frequently referred to as possibilities for efficiency enhancements; however, the extent of these efficiencies varies. Kamakela et al. (2023) suggest that IoT and AI can be used to create efficiencies in logistics optimization and asset health management. Lohmer et al. (2020) reinforce that, to resilience in crisis, digital technologies can facilitate real-time monitoring and provide logistics resiliency. Nevertheless, there are diverging definitions of digital technology efficiencies. Some

work refers to efficiency gains in awareness of company performance, efficiencies in disrupted planning, and thus cost reductions, increased forecast accuracy, et cetera, while other studies refer to resilience efficiencies associated with resilience strategies to deal with disruption. The scholarly discussion remains unresolved; how do these efficiencies interact? Is resilience inherently a benefit of efficiency? Or is it a trade-off? This lack of clarity and resolution is ripe for empirical testing in fast-moving consumables (FMCG) supply chains.

Digitalization often presents itself as a variable for profitability and growth. In their work, Aliahmadi et al. (2022) demonstrate that technology acceptance acts to increase market share and financial performance, especially in times of crises. The complications do highlight that the broader research often brings up some unintended consequences of digital content: the digital transformation process ends up displacing workers, may increase the organization's or procurement cybersecurity risks, and heightens gaps between resource-rich and resource-poor organizations. The foundational duality adequately identifies the needed complex awareness of digitalization, where not all adoption automatically leads to sustainability; however, its advantage would be affected by organizational flexibility and the degree of engagement in open innovation.

Despite the clear benefits of digitalization in terms of decision making and moving towards the goal of engaging customers (Singh et al., 2023; Ivanov & Dolgui, 2019), research literature places a greater emphasis on barriers to adoption. It has been highlighted that barriers to capital & cultural resistance are an identified problem (Gupta et al., 2021), along with many other barriers such as complicating a digitalization solution into current organizational structures (Baryannis et al., 2019) or from the vulnerabilities of cybersecurity (Pereira & Frazzon, 2020). The literature is focused on detailing the challenges, when emerging research suggests (Khayer et al., 2023) firms can build on barriers/challenges to opportunities if firms are investing in digitalization and applying strategic change management. Undoubtedly, there is an imbalance between descriptive accounts of challenges with limited empirical accounts of solutions, with this mismatch indicating a research gap.

Even Ivanov (2022) uses and Schianchi (2023) puts forward theoretical models including

Mixed-Integer Linear Programming as it applies to digitally enabled supply chains indicating predictive analytics desired outcomes yet most of the models proposed are theoretical models of particular interest to the FMCG during crises, with little applied or experiential nature to validate the implications of a digitalization process, the referenced discipline rationale is helpful using the Technology–Organization–Environment (TOE)-like models as a lens, but again, the applied experimental tests during pandemic, disruptions, or reasoning processes provide little value. There is a case or rationale for the exploration of how digitalization improves the efficiency and resilience of an organization in the FMCG context. The literature has arrived at a confluence regarding the potential of digitalization but it diverges in terms of its actual value in a crisis. The main gaps include: (i) little evidence of the efficiency–resilience trade-off, (ii) too few studies on SMEs in comparison to multinational FMCG firms, and (iii) limited longitudinal insights regarding how digital uptake supports sustained performance beyond the immediate disruptions. Addressing these gaps will shed light on the genuine role of digital technologies in FMCG supply chains, especially in the case of pandemics.

H1: Digital investments positively influence supply chain efficiency in the FMCG sector by improving cost optimization and operational flexibility.

H2: Digital technologies significantly enhance supply chain resilience in the FMCG sector, particularly under disruptive conditions such as pandemics and geopolitical unrest.

H3: There is a complementary relationship between supply chain efficiency and resilience, mediated by the adoption of technologies such as IoT, blockchain, and AI.

H4: The impact of digital technologies on supply chain performance is moderated by crisis conditions, with stronger effects observed during pandemics compared to stable periods.
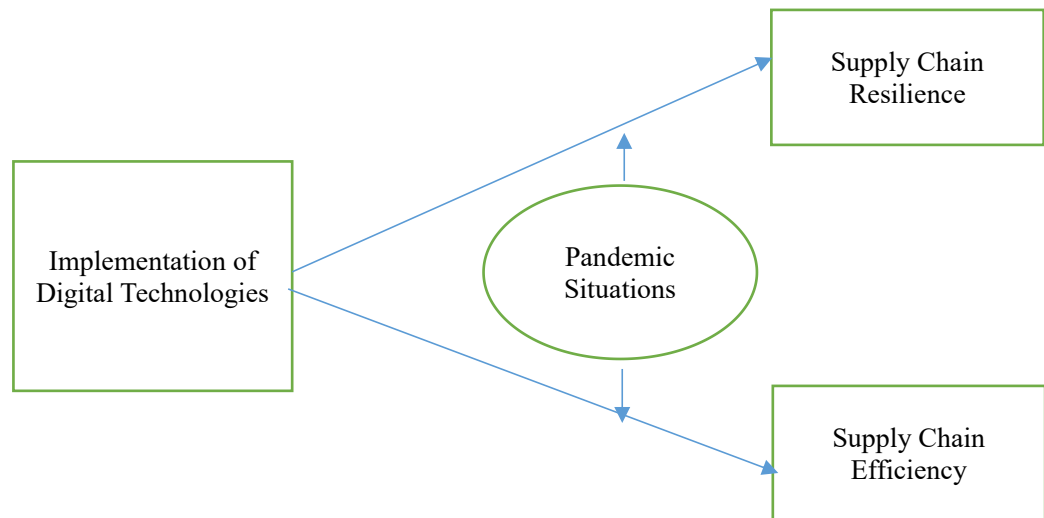
Figure I Conceptual Framework

3. Research Methodology

3.1 Research Approach

The quantitative analysis is utilized. It allows for a better grasp of the interviews and perceptions of industry professionals on the digitalization of supply chains. The descriptive form is used, which sufficiently describes the current status of the digitalization approach in FMCG firm supply chains, with an idea of the current state of resilience and efficiency. As a descriptive research study, a particular emphasis will be placed on understanding and interpreting how industries are utilizing digitalization integration in their supply chains, including participants' viewpoints and experiences.

3.2 Research Design

1.2 Since the study is quantitative and descriptive, the survey design is adopted with closed-ended questionnaires. It is particularly helpful for acquiring purposefully selected and comparable data from a large number of participants regarding the integration of digitalization in supply chains so that patterns can be identified.

3.3 Target Population

The audience is comprised of supply chain managers, IT, and executives from the FMCG industry with an interest or interactions in the integration of digitalization in supply chain systems.

3.4 Sample Size & Sampling Technique

As for quantitative research employing closed-ended questionnaires, researchers should

be able to get a variety of responses from 250-300 respondents, as the number is vast enough to capture a wide array of perceptions but not too large in terms of data analysis. This range offers enough statistical precision or significance (as defined by power as high as 80% or more) for identifying significant differences or significant correlation between variables in a conventional alpha level of 0. 05. It addresses the issue of accurate estimations; increasing the sample size decreases the margin of error and improves the confidence level with regards to the productivity of data collection within the time, financial, and accessibility confines. This sample size enables the separation of subgroups in the data collected, which makes it stronger and relatable to the FMCG industry. It is a practical method of ensuring that a large, diverse sample is collected in one way or another, yet is still not excessively large. In purposive sampling, the study will identify and choose the most appropriate candidates for the research study. Therefore, this approach provides an opportunity to involve participants with focused knowledge or practical experience regarding digitalization in supply chains.

3.5 Research Instrument

The questionnaire will be designed with structured, closed-ended questions. These questions will focus on:

1. The extent and nature of digitalization integration in the participant's supply chain.
2. Perceived benefits and challenges of digitalization in enhancing supply chain resilience and efficiency.
3. The overall impact of digitalization on supply chain operations within the FMCG industry.

3.6 Data Collection

Closed-ended questionnaires are used to gather data. These questionnaires consist of a series of fixed-response questions that participants can quickly and efficiently respond to. The questions are designed to collect specific information about digitization and integration and their impacts on supply chain resilience and efficiency. The data are taken from the employees working in the supply chain of the FMCG industry.

3.7 Data Analysis Method

In this study, we looked at the impact of Digitalization of the Supply Chain on Supply Chain Resilience and efficiency. We would use the smart PLS approach to analyze the data since it can be applied in situations like these and yields reliable results; other methods were not appropriate due to the small sample size. Smart PLS offers solutions

with modest sample sizes when models have many constructs and elements.

4. Results & Data Analysis

1.3   4.1 Demographic Result

This section defines the proportion of male and female respondents who participated. The survey data was gathered from people working across different FMCG industries. The sections also present the professional experience of respondents who helped during data collection. A total of 303 volunteers participated across different FMCG manufacturing industries located in Karachi, Pakistan. A questionnaire was designed to identify the role of the Implementation of Digital Technologies to enhance resilience and efficiency of the Supply Chain, and the Pandemic Situation was taken as a moderator.

SPSS was used for the analysis of demographics and respondent profiles. All the demographic data have been reported using SPSS software 29.0.2.0 Version. It was identified that a total number of 65 females out of 303 participants were female's survey and their percentage stood at 21.5%. The male population was greater, and a total of 238 male respondents participated. The percentage of males stood at 78.5%.

Table: 1

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	65	21.5	21.5	21.5
	Male	238	78.5	78.5	100.0
	Total	303	100.0	100.0	

1.4   4.2 Estimation Model

The analysis was performed on Smart PLS 4, and a very in-depth analysis and results were found. The PLS-SEM is the most advanced software available for data analysis and for the identification of results. Two techniques were used on Smart PLS 4 while evaluating results. The PLS Algorithm was used for the identification and estimation of path coefficients. This technique was used to estimate the reliability and validity of the results. The second technique used was bootstrapping. This was used to estimate the

significance of the variables.

The picture below is the Path Model and was extracted from the Smart PLS while evaluating the results.
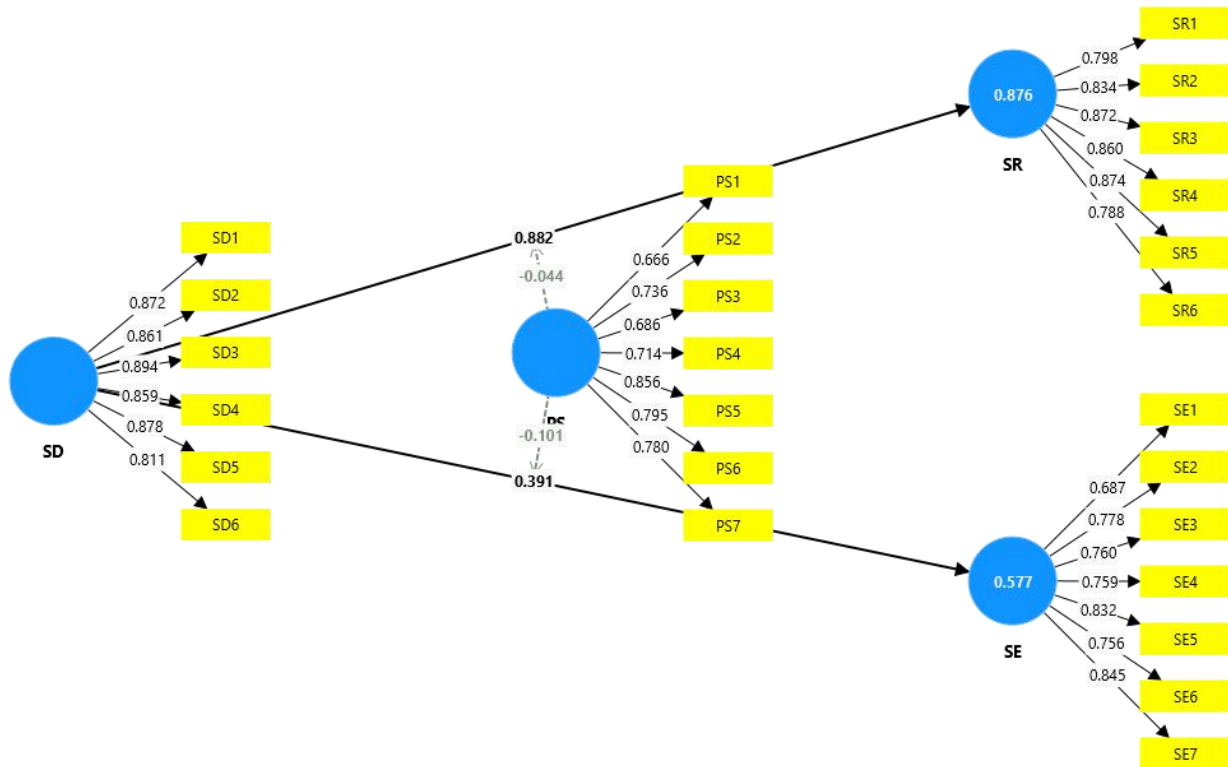
The numerical figures on the arrows arising from the latent variables to the indicators represent the outer loadings. The figures in the yellow boxes are the indicators of the variables. The value inside the blue circles represents the value of R-squared. The variables are defined along with the analysis in the latter part of the analysis.

1.5   4.2.1 Construct Reliability & Validity

It is the measure of positive correlation with the alternative measure of the same construct.

Outer loadings of indicator values should be greater than 0.708 ideally and not less than 0.4, in any case. In case the value is less than 0.708, but it is greater than 0.4, and the average variance is greater than or equal to 0.5, then no changes in indicators are needed. Average Variance should be greater than or equal to 0.5.

   Table: II

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	PS	SD	SE	SR	PS x SD
PS1	0.666				
PS2	0.736				
PS3	0.686				
PS4	0.714				
PS5	0.856				
PS6	0.795				
PS7	0.78				
SD1		0.872			
SD2		0.861			
SD3		0.894			
SD4		0.859			
SD5		0.878			
SD6		0.811			
SE1			0.687		
SE2			0.778		
SE3			0.76		
SE4			0.759		
SE5			0.832		
SE6			0.756		
SE7			0.845		
SR1				0.798	
SR2				0.834	
SR3				0.872	
SR4				0.86	
SR5				0.874	
SR6				0.788	
PS x SD					1

Table: III

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
PS	0.873	0.902	0.899	0.563
SD	0.931	0.931	0.946	0.745
SE	0.889	0.89	0.913	0.601
SR	0.915	0.916	0.934	0.703

The results are analyzed for the convergent validity, and both the above-stated rules are met. The table screenshots are taken from the original Smart PLS screen. Both conditions for the convergent validity are met.

1.5.1   **4.2.2   Internal Consistency Reliability**

There are two conditions for the internal consistency of reliability,

1. Cronbach Alpha Cut Off Value (0.65 – 0.9)
2. Composite Reliability Cut Off Value (0.65 – 0.9)
   The Cronbach Alpha and Composite Reliability show excellent cut-off. The figure is taken from the actual data processing on the Smart PLS 4.

It is defined as the uniqueness of the construct and the distinction between the constructs. The intent is that the construct should be distinctive and should not capture the phenomena of other constructs. The researchers are focused on two aspects,

1.5.2   **4.3 Fornell-Larcker Criterion**

1.5.3 **The square root of the average variance should be greater than all other correlations.**

Table: IV

	PS	SD	SE	SR
PS	0.75			
SD	0.487	0.863		
SE	0.639	0.64	0.775	
SR	0.504	0.932	0.663	0.838

The data shows that the square root of the average variance is greater than all other correlations.

1.5.4   4.4 Cross Loading

Outer loading of an indicator with its construct should be greater than loadings on the other construct.

Table: V

	PS	SD	SE	SR	PS x SD
PS1	0.666	0.242	0.383	0.251	-0.114
PS2	0.736	0.323	0.482	0.308	-0.239
PS3	0.686	0.136	0.429	0.178	-0.205
PS4	0.714	0.222	0.333	0.229	-0.317
PS5	0.856	0.475	0.573	0.529	-0.384
PS6	0.795	0.401	0.398	0.392	-0.265
PS7	0.78	0.553	0.628	0.551	-0.338
SD1	0.462	0.872	0.534	0.835	-0.322
SD2	0.421	0.861	0.531	0.788	-0.287
SD3	0.393	0.894	0.481	0.844	-0.259
SD4	0.474	0.859	0.607	0.782	-0.334
SD5	0.35	0.878	0.545	0.834	-0.281
SD6	0.422	0.811	0.618	0.737	-0.326
SE1	0.446	0.545	0.687	0.555	-0.296
SE2	0.497	0.52	0.778	0.523	-0.285
SE3	0.514	0.543	0.76	0.594	-0.489
SE4	0.559	0.463	0.759	0.46	-0.29
SE5	0.538	0.452	0.832	0.479	-0.395
SE6	0.404	0.409	0.756	0.42	-0.343
SE7	0.486	0.52	0.845	0.539	-0.382

SR1	0.385	0.781	0.484	0.798	-0.335
SR2	0.46	0.746	0.53	0.834	-0.348
SR3	0.374	0.804	0.456	0.872	-0.271
SR4	0.503	0.801	0.632	0.86	-0.381
SR5	0.381	0.819	0.593	0.874	-0.344
SR6	0.438	0.728	0.643	0.788	-0.357
PS x SD	-0.369	-0.35	-0.459	-0.404	1

This can be verified from the above table that the outer loadings of an indicator with its construct are greater than the loadings with the other constructs.

1.5.5 **4.5 Testing Multicollinearity**

High correlation between the indicators is called collinearity. There are two aspects to it,

1. Outer VIF (For Indicators): VIF<5
2. Inner VIF (For Indicators): VIF<5

Table: VI

	VIF
PS1	2.265
PS2	2.303
PS3	1.995
PS4	1.899
PS5	3.118
PS6	3.393
PS7	2.188
SD1	3.51
SD2	2.914
SD3	3.801
SD4	2.873
SD5	3.153
SD6	2.452
SE1	1.808

SE2	2.474
SE3	1.928
SE4	2.299
SE5	3.41
SE6	3.12
SE7	3.08
SR1	2.309
SR2	2.447
SR3	2.992
SR4	2.694
SR5	3.148
SR6	2.315
PS x SD	1

The all the values process show that no value is greater than 5 and hence no collinearity issue exists.

Table: VII

	VIF
PS -> SE	1.394
PS -> SR	1.394
SD -> SE	1.371
SD -> SR	1.371
PS x SD -> SE	1.211
PS x SD -> SR	1.211

Table: VIII

	PS	SD	SE	SR	PS x SD
PS			1.394	1.394	

SD			1.371	1.371	
SE					
SR					
PS x SD			1.211	1.211	

The inner VIF values are less than 5 and hence no collinearity issue exists.

1.5.6   **4.6 Hypothetical Testing**

4.6.1.   **Co-Efficient Of Determination**

In PLS Algorithm there is no define criteria for R Square. It is basically a correlation between an independent and dependent variable. A general rule of thumb is, 0.75, 0.5, and 0.25 are considered Substantial, Moderate and weak correlation.

Table: IX

	R-square	R-square adjusted
SE	0.577	0.573
SR	0.876	0.875

The results indicate a strong co relationship between the independent and dependent variables.

4.6.2.   **Bootstrapping**

The bootstrapping helps to calculate the P value and T Value and helps to calculate if the hypothesis is supported or not.

Table: X

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Results
PS -> SE	0.382	0.386	0.054	7.091	0	Support
PS -> SR	0.045	0.048	0.031	1.44	0.15	Not Support
SD -> SE	0.391	0.39	0.065	6.051	0	Support
SD -> SR	0.882	0.88	0.04	22.196	0	Support
PS x SD ->	-0.101	-0.098	0.023	4.301	0	Support

SE					
PS x SD -> SR	-0.044	-0.049	0.021	2.077	0.038	Support

The results indicate that the hypothesis is supported except PS→SR as, the P value is greater than the criteria limit.

Table: XI

	Original sample (O)	Sample mean (M)	2.50%	97.50%
PS -> SE	0.382	0.386	0.281	0.491
PS -> SR	0.045	0.048	-0.009	0.113
SD -> SE	0.391	0.39	0.26	0.518
SD -> SR	0.882	0.88	0.799	0.952
PS x SD -> SE	-0.101	-0.098	-0.143	-0.051
PS x SD -> SR	-0.044	-0.049	-0.106	-0.019

Table: XII

	Original sample (O)	Sample mean (M)	Bias	2.50%	97.50%
PS -> SE	0.382	0.386	0.004	0.273	0.481
PS -> SR	0.045	0.048	0.003	-0.014	0.108
SD -> SE	0.391	0.39	-0.001	0.263	0.521
SD -> SR	0.882	0.88	-0.002	0.801	0.953
PS x SD -> SE	-0.101	-0.098	0.002	-0.148	-0.057
PS x SD -> SR	-0.044	-0.049	-0.005	-0.097	-0.016

5. **Discussion of Results**

This study aimed to rigorously assess the influence of digitalization on enhancing the

reliability of supply chains and efficiency in the FMCG sector. On this basis, it is possible to determine key overall conclusions. Our results supported our research hypotheses that the use of digital technologies contributes to enhancing the supply chain's responsiveness to disruptions. The technologies enhanced all organizations' agility, resilience, and rebound from disruptions such as COVID-19. This illustrates that digitalization is beneficial in the synergies created in supply chain resilience. We concluded that digitalization in general had a positive impact on services by reducing costs, increasing output, and enabling the on-time flow of operations. Technologies assisted in optimising the inventory management, logistics, and enhance customer satisfaction; therefore, digitalisation of supply chains enhance and facilitate supply chain processes. Digital tools as foreseen are essential in maintaining business operations during COVID-19 through risk management and business continuity processes. Covid crisis also promoted the idea of new technological solutions as global governments and companies progressed their transformation processes. It's fair to say that digital tools are the primary condition for effective supply chain management and address its challenges from both the ever-present globalisation and now evident health threats. The research met its objectives of evaluating the role that digitalisation contributes in improving flexibility and reliability of supply chain in the fast moving consumer goods domain, while also avoiding major disruption from the pandemic. They are merely important approaches to managing a strong, flexible, and sustainable supply chain.

6. **Conclusion**

From the research recommendations there are the following recommendations that can be made to FMCG companies and policy makers that include setting aside a budget for real-time supply chain visibility, planning and analytic systems to prepare the organization for a radical digital strategy, where plans of how the change will be facilitated can be developed alongside the acquisition of Change Management solutions that can be utilized in the area of training for organizations staff. The further recommendations to encourage digitization are: the use of blockchain technology for data/resource sharing with sectors and incentivizing the technology through funding/tax incentives for SME's. It is also important to realize in the implementation of the proper

frameworks to shield the organization's technology from any threats.

1.6 There are a series of limitations to the research that should be acknowledged. This study had a small sample size to work with across the experiment, and therefore, we cannot generalize our findings. Future research could work to gather more participants, which would allow for further potential data points. In just discussing limitations of variables, this study also kept other constructs like organisational culture and leadership constrained. Additionally, this paper was developed using a cross-sectional study design; ideally, a longitudinal study would create more insight into the effect on the of digitalization on supply chains during a crisis. Potential more research areas include conducting a number of comparative studies that can assess digital technology and the application of them in various sectors/regions or countries. It is also able to conduct similar assessments with relevant use and performance data collected from empirically real world usage. There are opportunities for research frameworks that can investigate strategies for pandemic responses and disruptions to be managed, improvement of organisational readiness made easier by new technologies. Recently it has been observed that academia and industry relationships can develop practices that are insightful for both.

The findings of the research indicated the value of digitalization for improving level of supply chain readiness during a pandemic and level of supply chain performance. That been said though, the research did identify barriers to adoption, yet technology is a definitive solution to create strong supply chain framework and support companies in times of crisis. The capabilities that will be required moving forward will need to be digital supply Chains which will help sustain micro such business ventures in areas that are at risk of becoming disrupted.

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