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Exploring the Mediating Role of Strategic Synergy between Supply Chain Agility and Smart Logistics at Jordanian Pharmaceutical Manufacturing Companies

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Abstract

Purpose – The dynamically changing logistics environment requires new methods, products, and services to meet the demands of the changing market. The shift from traditional supply chain to open networks and the complexity of networks require agility, adaptability, and proactivity. The current study aims to investigate the impact of supply chain agility (SCA) and strategic synergy (SS) on smart logistics (SL). **Design/methodology/approach –** The quantitative approach (descriptive and analytical) method was employed. Data were collected from managers at the top and middle managerial level working at Jordanian Pharmaceutical Manufacturing Companies. PLS-SEM was utilized to test the measurement and structural model. **Findings –** According to the study's findings, supply chain agility impacts smart logistics at Jordanian Pharmaceutical Manufacturing Companies. Moreover, strategic synergy plays a partial mediation role between supply chain agility and smart logistics. **Originality/value –** This study delivers to the body of literature and knowledge previously in existence about the impact of supply chain agility and strategic synergy on smart logistics at Jordanian Pharmaceutical Manufacturing Companies.

Keywords: Supply Chain Agility (SCA), Strategic Synergy (SS), Smart Logistics (SL), Jordanian Pharmaceutical Manufacturing Companies.

Introduction

Logistics is the fundamental basis of the economy due to effective role in providing for the needs of different sectors, its reactivation for the trade of states, as well as providing of individual, organizations, and society needs. Sun et al (2021), noted that the logistics, as a primary function of an organization or a supply chain, logistics has been profoundly impacted by recent technological enhancements and innovations. According to Feng and Ye (2021), the logistics industry is facing novel issues due to the global cooperation and amalgamation of online and offline platforms. Additionally, Schmidtke et al (2022), observed that digitalized and automated economic sectors require an organized process that presuppose the application and incorporation of proven process, the interaction of logistical objects, processes and systems is accomplished in a target-oriented way relying on the needs and the situation.

Companies are looking for activities that would generate a sustained competitive advantage and value as a result of the globalization process. Local supply networks and digitization have recently attracted attention, in part because of crises and epidemics (Thekkoote, 2022). Supply chain agility enhances logistical efficiency and customer satisfaction, contributing to value added. Flexibility and agility are key indicators in creating a competitive advantage in supply chains (Guliman & Gavrila, 2018). The effectiveness of the strategy formulation in accomplishing organizational goals is the basis for assessing the strategy formulation's success. Strategic synergy allows smart logistics to expand its operations more easily and adapt to changing market requirements and customer expectations (Azhari & Taufik, 2021). Many researchers have demonstrated different aspects of the benefits of synergy: share resources and knowledge, cost savings, creating value added through interaction, cooperation and partnership between different elements and stakeholders within the organization (Josas, 2004, 327; wang, 2013; Vaičiūtė et al., 2022)

Improving the company's image by diversifying its product portfolio and increasing its competitiveness responsive logistics operations ultimately boosts the competitiveness and value proposition of logistics service providers. This is the main way in which strategic synergy impacts smart logistics. In sum, in order to increase supply chain agility and stay up with market and industry structural changes, synergies between smart logistics and supply chain agility are crucial. Moving to Industry 5.0 emphasizes more on the connection between the human element and technology in smart logistics, as indicated by Jafari et al. (2022). This moving calls for more developments in intelligent logistics as well as the incorporation of new technology to enhance decision-making, communication, information transparency, and technical support systems (Woschank & Zsifkovits, 2021). The majority of studies addressed smart logistics processes from a technological background and looked at them from a purely technological point of view, such as the internet of things, big data, digital transformation, and ICT information and communication applications (Yao et al., 2022; Jafari et al., 2022; Elsanhoury et al., 2022; Ding et al., 2021; Issaoui et al., 2022; and Liao and Wang, 2018). Whereas this study attempts to construct its model with managerial dimensions, the present studies have concentrated on analysing how supply chain agility affects performance (Aljawazneh., 2024; Osoro et al., 2024; Panigrahi et al., 2023; Shee et al., 2021; Abdallah et al., 2021; Alkrait & Almaktoom., 2021; Nazempour et al., 2020).

What is clear is that the literature lacks information on how supply chain agility (SCA) can improve smart logistics (SL); this is what prompted the researchers to conduct this study. Within the limits of the scholar's knowledge, the current study is the first to examine the impact of the agility of supply chains on smart logistics, as well as to address smart logistics in administrative approach rather than digital or technological approach.

With the aforementioned in mind, this study is one of the few that aims to investigate the impact of SCA on SL. And also, examining to what extent the strategic synergy (SS) affects as a mediator variable at Jordanian Pharmaceutical Manufacturing Companies.

The study is split up to the following five parts: The introduction comes first. In part two, the study model is explained and the research hypotheses are generated. In part three, the research approach used for the study is described, together with a sample explanation and research instrument. Fourth-part analysis of the data is presented. Part five presents the discussion of the study and its conclusion.

Theoretical Background

Supply Chain Agility

There are various definitions of SCA that appear in the literature. The majority of definitions of SCA are centered around the ability of the entire supply chain to change quickly enough to better respond to the needs of its customers (Van Hoek et al., 2001; Lin et al., 2006; Swafford, 2008; Li et al., 2008; Dubey et al., 2018; Thekkoote, 2022). In addition, Yang (2014) defines SCA as the ability to respond swiftly to unpredictable and volatile markets on an operational and relational level. To Sharma et al. (2017) SCA refers to the supply chain's strategic ability to detect and react to changes in the internal and external environment swiftly, either proactively or reactively, by exploiting intra- and inter-organizational skills in a way that maximizes profitability.

Alageel (2021), explains that SCA is a crucial instrument that helps businesses maintains their competitiveness by optimizing their manufacturing and delivery systems. Ugochukwu et al. (2012) summarized the benefits of SCA as follows: Low inventories, high quality, optimized efficiency, high flexibility, customer satisfaction, reduced costs and improved delivery time. In order to respond to uncertainties and unanticipated disturbances, supply chain resilience is boosted by agility, additionally to maximizing productivity and conserving resources (Kamalahmadi & Parast, 2017).

Smart Logistics

In literature a definition for smart products or services can be found. However, a perfect definition of smart logistics remains missing (Uckelmann, 2008). Smart logistics, sometimes referred to as "logistics 4.0" or "intelligent logistics" (Feng & Ye, 2021). Smart logistics refers to a combination of technology, management, and human activities, in order to eliminate communication barriers between the various supply chain components and effectively coordinate resources for the attainment of agreed goals (Korczak & Kijewska, 2019). In this context, Hercko et al (2016), defines smart logistics as a strategic approach to managing logistics operations in an intelligent and effective manner. It can be said that there is no agreed upon definition of smart logistics (Shee et al., 2021).

The primary challenges faced by logistics organizations are delayed or inaccurate delivery, misplaced items, harmed goods, and inadequate packaging (Huang et al., 2015). Some organizations now try to rework their primary logistics procedures in order to prevent problems like these. Rushton et al. (2017, 118) briefly reviewed the three components for the success of redesigning logistics processes. First, well-designed processes should be client-facing, meaning their primary goal should be in order to fulfil the requirements and expectations of the customer. Additionally, since they traverse both organizational boundaries and functions, they must to be supply-chain focused. In closing, acknowledge that time is a crucial component of the logistical offering. These days, the product delivery services carried out in shipping centers continue to be performed using conventional ways. These logistical traits reduce supply chain efficiency in addition to raising supplier costs. Thus, the application of smart logistics offers logistics firms effective and affordable options (Issaoui et al., 2022). In addition to cutting lead times, increasing quality, and promoting sustainability through positive social and environmental effects, smart logistics provides prompt delivery, agility, flexibility, and predictive analytics (SAĞLAM, 2024, Alsudani et al., 2023).

Therefore, smart logistics provides a workable solution to manage the increasing volume and complexity of logistical operations through global collaboration and the integration of both online and offline pathways.

Strategic Synergy

Synergy is derived from the Greek term synergism, which means cooperation. In current usage, the underlying meaning is that the whole will result in a bigger effect than the sum of its separate components. (Linnér, 2006). In 1960 synergy was introduced as a concept in the field of strategic management (Holtström & Anderson, 2021), by Igor Ansoff in his book "*Corporate Strategy*" (Juga, 1996). Synergy refers to integrated two units or more to achieve something cannot be obtained through the separation (Nouri & Jumaah, 2015; Chen et al., 2008; Li et al., 2006). Canongia (2007) viewed synergy and cooperation are synonyms. In general, synergy means cooperation replacing competition and conflict, which often leads to joint efforts in controlling risks and threats (Chen, et, al., 2008). Strategic synergy is defined as the interconnectedness and purposeful relationship between two or more parts to share goals, strive to achieve mutual benefits, and work at the highest level of cooperation and dependably (Pansiri, 2005). In the same context, Al-Shamaa (2007, 49) considers that strategic synergy means that the whole is greater than its parts.

Figure 2 presents a model of sources of synergy (Diep & Anh, 2020). According to the researchers, obtaining synergies and the success of mergers and acquisitions are significantly influenced by these sources.

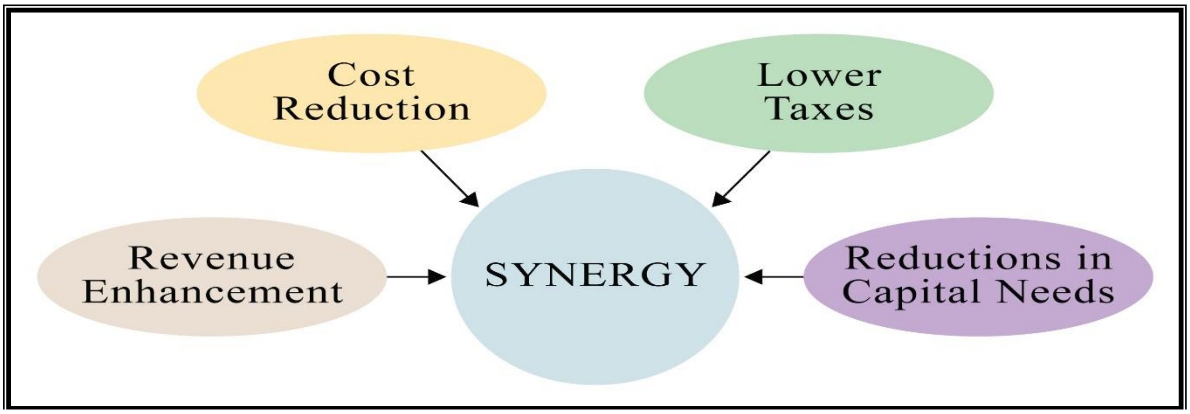


Figure 1 *Sources of synergy*
Source: Diep, B., & Anh, T. (2020). Synergies in merger & acquisition: A case study of SMEs in Vietnam. *Journal of Project Management*, *5*(3), 189-200.

Strategic synergies achieve a range of benefits such as: Improving the overall production efficiency of the company, impact on scale and scope through economies of scale, reducing the average fixed cost, increase sales revenue, reducing sales expenses, and enhancing the competitive advantage (Bakher, 2018).

Research Model and Hypothesis Development

Study Model

Researchers have addressed the dimensions of SCA, according to an analysis of the research publications, table (1) shows that the 28 dimensions of agility put out in these articles.

Table 1
Dimensions of agility mentioned in literature

Dimension proposed by authors	No. of dimensions	Authors
Flexibility, responsiveness, quickness, and competency.	4	Sharifi and Zhang (1999)
Flexibility.	1	Swafford et al. (2006)
Flexibility and information technology integration.	2	Swafford et al. (2008)
Alertness, accessibility, decisiveness, swiftness, and flexibility.	5	Gligor (2016)
Strategic perspective, a capability, and performance.	3	Sharma et al. (2017)
Competency, speed, flexibility, and responsiveness.	4	Bidhandi, and Valmohammadi (2017)
Lean procurement, lean transport and lean storage.	3	Awso et al. (2019)
Strategic relationships with suppliers and customer relationships.	2	AlKharasheh (2019)

Value stream analysis, customer relationship management, information technology, Just in time, and supplier relationship management.	5	Mahmoud et al. (2020)
Speed, flexibility, cost, and customer satisfaction.	4	Alageel (2021)
Accessibility, alertness, flexibility, and swiftness.	4	Jindal et al. (2021)
Flexibility, quickness, competency, and responsiveness.	4	Patel and Sambasivan (2022)
Swiftness, accessibility, decisiveness, alertness, and flexibility.	5	Ishak et al. (2022)
Swiftness and alertness.	2	Zakir et al. (2022)

Many researchers have looked at the dimensions of smart logistics through different lenses, and this is clearly as shown in table 2.

Table 2
Dimensions of smart logistics mentioned in literature.

Dimension of smart logistics proposed by authors	No. of dimensions	Authors
Plan, execute, predict, monitor, recommend, and adapt.	6	Mousheimish et al. (2015)
Order fulfilment, product returns, new product development, information management, new product introduction, aftermarket or service parts logistics.	6	Rushton et al. (2017)
Flexibility, intelligence, integration of logistics, and self-organization.	4	Feng, and Ye (2021)
Location services, condition monitoring, visibility, connectivity, identification, environmental scanning, autonomous, compatible, data analytics, and safety and security.	10	Shee et al. (2021)
Intelligent and lean supply chain, intelligent logistics through ICT, and intelligent logistics systems and transport vehicles.	3	Woschank and Zsifkovits (2021)

Figure 2 depicts the current study model, which is based on prior literature. The framework shows how SCA affects SL. The framework also shows how SS has a mediating influence on the relationship between SCA and SL. We proposed four research hypotheses.

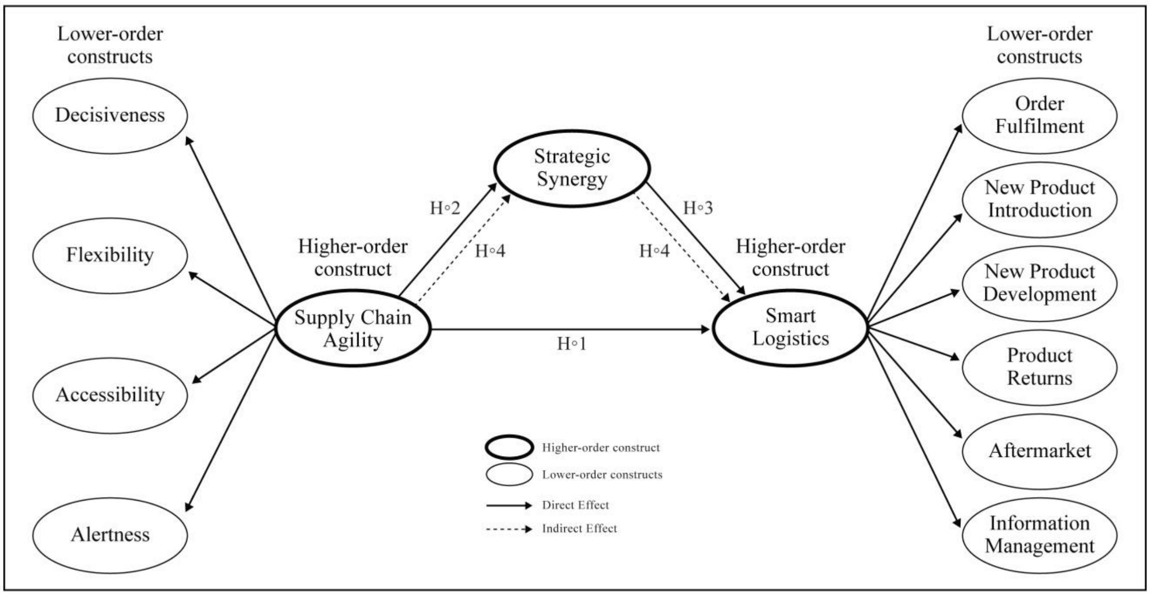


Figure 2 *Study model*

Literature Review and Hypothesis

SCA and SL

Research interest in SCA has grown considerably; therefore, the main definition of SCA is a company's supply chain's ability to adapt quickly to changes in the market and satisfy customer requests. Lummus et al. (2001) emphasized that logistics and supply chains overlapping and that logistics is part of the supply chains. In a supply chain, agility refers to the swift modification of the chain's network and operations in response to changing consumer needs. The primary goal is to manage enterprises in network architectures with enough agility to anticipate changes in advance, react to them, and look for new opportunities (Ambe, 2010).

Since research on SCA has been conducted during the preceding 20 years of its existence. The notion of SCA is considered to be rather novel. However, there is no literature review specifically devoted to the analysis and classification of these studies. (Sharma et al., 2017). Recently, Zakir et al (2022), define agility as a process efficiency of the businesses, while agility in terms of the supply chain is taken as the ingredients of operational efficiency within overall supply chain operations. A more thorough definition was provided by Braunscheidel and Suresh (2009), who defined agility as the organization's capacity to quickly adapt to changes in the market as well as possible or actual disruptions, both internally and in collaboration with its major suppliers and customers.

Agile supply chains' effects on distribution networks were studied by Alageel (2021). According to the survey, auto dealers that are more agile are able to respond to shifting consumer and market demands more quickly and supply products to clients more quickly. Reviewing the many viewpoints on agility reveals that there is a clear correlation between this idea and certain logistics components. In particular, the analysis of the corresponding literature bases reveals that the two have common themes related to information capabilities, integration, and responsiveness. Furthermore, the literature on agility highlights the necessity of having the flexibility to adapt to shifting circumstances that may be influenced by supply or demand (Gligor & Holcomb, 2012). you can say smart logistics is a convenient solution to meet Increasing the complexity and volume of logistical operations because of global cooperation and online integration and offline channels. Meantime, smart logistics is supposed to be part of the smart supply chain and is compatible with different processes and industries (Feng & Ye, 2021). In light of those findings, we thus announce our initial research hypothesis (H.1):

H.1: SCA has a significant positive impact on SL at Jordanian Pharmaceutical Manufacturing Companies.

SCA and SS

The results of many studies showed the reality of synergy between supply chains efficiency (Effective Supply Chain), the competitiveness of organizations, and their effective role in creating integration between operations and business processes integration, not only to reduce costs but for creating added value for organizations and customers (Alrufaie, 2014).

The concept of synergy posits that certain firms work better together than they would separately because of their coordination under a single owner, which enables them to perform either more efficiently or more effectively (Carpenter et al., 2012, 206).

According to Evtodieva et al (2016), the significance of strategic synergy on design of networks in logistics, which appears from two aspects: First: An economic component that enables all participants in a logistical network to consider communication within. Network as a set of interactions that provide an opportunity to earn income and achieve something profitability level for all network participants. Second: The additional benefits that the participants of a logistic network have and that they improve competitiveness, financial stability, reduced risk, potential for joint sales channels. Similarly, Izmailova et al (2018) found a significant role for strategic management of logistics innovations in maximizing synergies and enhancing competitive position. Accordingly, we decided to propose the second research hypothesis (H.2):

H.2: SCA has a significant positive impact on SS at Jordanian Pharmaceutical Manufacturing Companies.

SS and SL

Wheelen et al (2018, 242), argue that the parenting approach implicitly expresses synergy since it relies on two of the synergy's key tenets: cooperation and partnership.

Nowadays, keeping an eye on the synergy across logistical operations is thought to be unique and highly relevant. The primary cause of solution synergy is the increasing significance of these answers when essential for operational responses. Quality, which encompasses the never-ending logistical operations, is an essential component of the synergy. Collaboration with suppliers and other food market players is continuously improving the standard of logistical procedures (Abramović et al., 2017).

The earlier businesses can adapt to consumer needs and offer effective, high-quality logistics services, the better their synergy will be (Chunfang et al., 2019). Based on this, we propose the final research hypothesis (H.3):

H.3: SS has a significant positive impact on SL at Jordanian Pharmaceutical Manufacturing Companies.

H4. SS mediates the relationship between SCA and SL at Jordanian Pharmaceutical Manufacturing Companies.

Research Methodology

Method:

The quantitative approach (descriptive and analytical) method was employed in this study at Jordanian Pharmaceutical Manufacturing Companies. The population of this study consisted of all managers at the top and middle management level, numbering (24) companies according to the report of the Jordanian Federation of Pharmaceutical Manufacturers for the year 2023, A stratified random sample was drawn equal, where the sample size was (240) managers, with (10) questionnaires for each company, of which (220) were retrieved, while the number of valid ones for analysis purposes was (192) at a rate of 87% (Sekaran & Bougie, 2016).

Measurement

The development of the study constructs and items was predicated upon the literature review. According to the questionnaire items and references in table 3, each item was measured using a five-point Likert scale. The data was analyzed through Smart-PLS 4 Structural equation modeling (SEM).

Table 3

Research Constructs measures

Construct	Code	Item	References
SCA: Supply chain Agility Decisiveness item (1,2,3) Flexibility item (4,5,6) Accessibility item (7,8,9) Alertness item (10,11,12)	Agil1	Customer demand is constantly fluctuating, which affects our supply chain.	Qi et al. (2011)
	Agil6	We can access to the information we need to adapt with changes in the company's environment.	researchers
	Agil8	speed in decreasing the lead time for manufacturing.	Swafford et al. (2008)
	Agil2	Our supply chain adapts fast to the changing economic climate.	Qi et al. (2011)
	Agil3	Suppliers are chosen for our supply chain relying on their performance in terms of flexibility and responsiveness.	Qi et al. (2011)
	Agil7	We have the ability to monitor and follow developments in legislation and laws that may affect the company's business.	researchers
	Agil4	Our company's original equipment logistics procedures are actually capable of offering a proper support system for the spare parts.	Qi et al. (2011)
	Agil5	Quick response to requests for product customization.	Al Kharasheh (2019)
	Agil12	We are able to take advantage of opportunities when they arise.	Gligor et al. (2013)

	Agil9	Enhancing responsiveness to changing market demands quickly	Swafford et al. (2008)
	Agil10	my company is more resolute at making decisions regarding supply chain operations, as compared with our competitors.	Gligor et al. (2013)
	Agil11	My company can quickly respond to changes in the business environment.	Gligor et al. (2013)
SS: Strategic Synergy	Syn1	Working together by individuals or departments yields greater results than single work.	Nouri and Jumaah (2015)
	Syn2	Any change in parts of the organization as seen from the company's overall performance.	Nouri and Jumaah (2015)
	Syn3	Mutual interaction between departments achieves clear results.	Nouri and Jumaah (2015)
	Syn4	The company focuses on the synergy of employees in solving problems and performing tasks.	Kerroumi (2018)
	Syn5	The company focuses on synergy (coordination, cooperation, and integration) between the functions of the organization.	Kerroumi (2018)
	Syn6	In the company, many activities share the same sources.	Ensign (1998)
	Syn7	Play history units (evolution). An important part of the skills and resources of current groups.	Ensign (1998)
SL: Smart Logistics	Smlog1	Returns of our products will either be reused or thrown away.	researchers
	Smlog2	Fulfilling the order of products is an easy and streamlined process.	researchers
	Smlog3	logistics structures and processes are appropriate to enable a satisfactory launch of a new product.	researchers
	Smlog4	Our products reach to customer quickly	researchers
	Smlog5	Logistics processes in our organization for the original equipment are really capable of providing a suitable support mechanism for the spare parts.	researchers
	Smlog6	Information about the products is available to the customer (delivery time preference, order size	researchers

		preference, invoicing requirements, etc).	
	Smlog7	Supply chain risks (e.g., delivery failures, out-of-stock situations, and customer complaints) are appropriately managed.	Shee et al. (2021)
	Smlog8	To better serve our consumers, we manage the overall costs.	Shee et al. (2021)
	Smlog9	Waste of all types is treated (e.g., overstock, waiting, and defective items).	Shee et al. (2021)
	Smlog10	The ability to reduce safety stock in our supply chain.	Shee et al. (2021)

Analysis and Results

Descriptive statistics

Table 4 shows that the data for all variables symmetrical data distribution, which means that the response pattern is normal. The skewness ratios are close to zero, and the kurtosis parameters are between -2 and +2 (Hair *et al.*, 2022).

Table 4
Descriptive statistics

Construct	Mean	Standard Deviation	Skewness	Kurtosis
SCA	4.37	.547	-1.501	2.685
SL	4.33	.533	-1.366	2.827
SS	4.42	.492	-1.037	.985

Note: SCA = supply chain agility, SL = smart logistics, SS = strategic synergy.

Evaluation of Reflective Measurement Models

This part outlines the evaluation process for reflective measurement models using PLS-SEM, focusing on reliability and validity. It evaluates measures at both an indicator and construct level and uses the average variance extracted (AVE) and heterotrait-monotrait (HTMT) ratio of correlations to assess convergent and discriminant validity.

The study adopted the reflective measurement model, as the evaluation of the reflective measurement model includes evaluating the reliability of the measurements, or what is known as the reliability of the study tool, whether at the level of indicators through external loadings, or at the level of variables through internal consistency reliability using Cronbach's alpha, the composite reliability coefficient (CR), and validity evaluation, or what is known as the validity of the tool, which includes evaluating two types of validity, the first type is convergent validity for each scale using the average variance extracted (AVE), and the second type is discriminant validity, which compares all construct measures in the same model through several criteria, namely: the Fornell-Larcker criterion, and the HTMT criterion (Hair et al., 2021, 116-117).

Reliability and Validity

Convergent validity is the extent to which a construct converges to explain the variance of its indicators. It is evaluated using the average variance extracted (AVE) for all indicators on each construct. A minimum acceptable AVE of 0.50 indicates the construct explains 50% or more of the indicators' variance. Hair et al (2017, 137) indicate that the reliability of the tool at the level of indicators is measured through the external loadings, which must be equal to or higher than 0.708 for each paragraph of the study tool. Figure (5) shows that the values of the external load coefficients for all paragraphs exceeded the minimum limit, with the exception of paragraphs (20), (21), and (22) of the dependent variable as these paragraphs were deleted to obtain the best degree of stability, while paragraph No. (23 and 29) of the mediating variable were deleted even though they are greater than (0.70) because it affects the results later.

The reliability of a tool is verified by testing internal consistency reliability using Cronbach's Alpha and the composite reliability coefficient (CR). Cronbach's Alpha estimates the reliability of internal consistency based on the interrelationships of observed indicator variables, with values greater than 0.70 considered acceptable. Hair et al. (2021) suggest using a different scale, composite reliability or composite reliability coefficient, which ranges between (0) and (1), with higher values indicating higher levels of reliability. Composite reliability is a conservative measure of reliability, as it may underestimate true internal reliability.

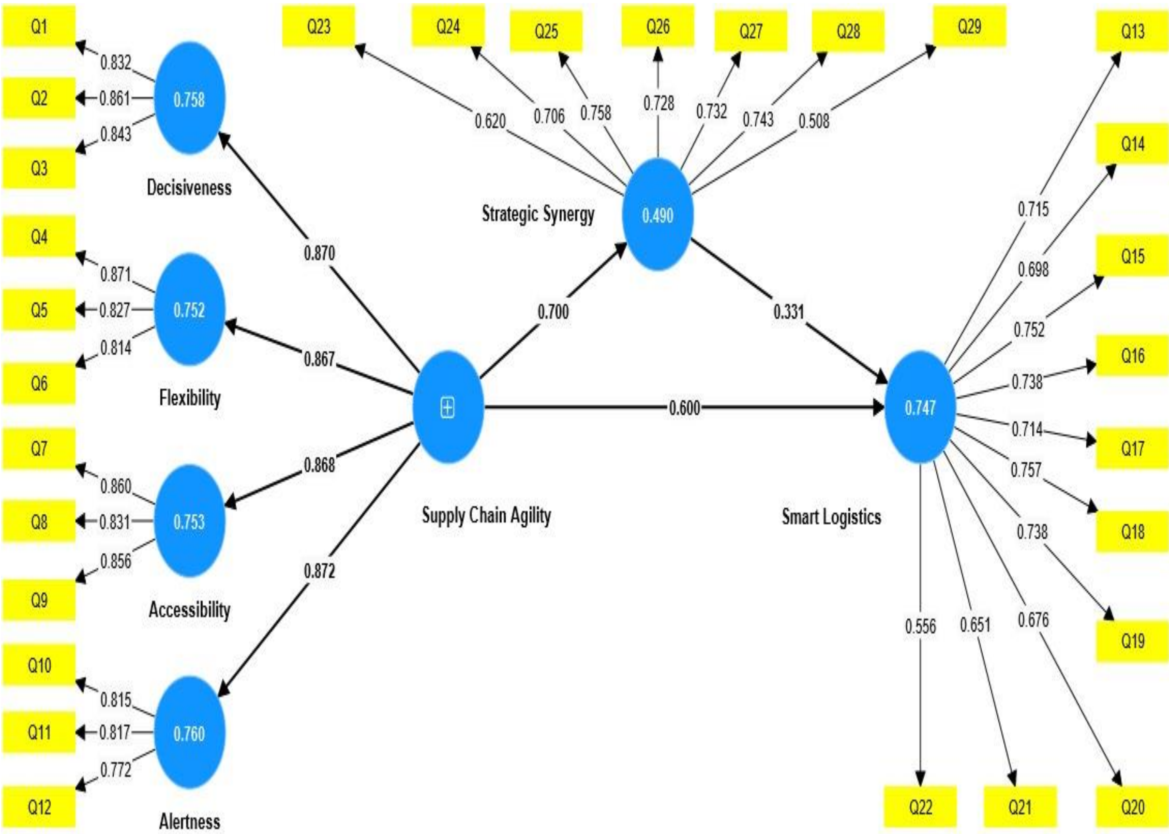


Table 5
Reliability and validity

Construct	Indicators	Outer Loadings >0.708	Cronbach's Alpha >0.70 and <0.95	Reliability (rho_a) >0.70 and <0.95	Composite Reliability (rho_c) >0.70 and <0.95	Average Variance Extracted ≥0.50
Decisiveness	Dec1	0.832	0.800	0.801	0.882	0.714
	Dec2	0.861				
	Dec3	0.843				
Flexibility	Flex1	0.871	0.787	0.789	0.876	0.701
	Flex2	0.827				
	Flex3	0.814				
Accessibility	Access1	0.860	0.807	0.810	0.886	0.721
	Access2	0.831				
	Access3	0.856				
Alertness	Alert1	0.815	0.721	0.723	0.843	0.642
	Alert2	0.817				
	Alert3	0.772				
Smart Logistics	SL1	0.715	0.856	0.857	0.893	0.582
	SL2	0.752				
	SL3	0.738				
	SL4	0.714				
	SL5	0.757				
	SL6	0.738				
Strategic Synergy	SS1	0.706	0.808	0.810	0.867	0.566
	SS2	0.758				
	SS3	0.728				
	SS4	0.732				
	SS5	0.743				

Discriminant Validity

Fornell-Larcker Criterion

Fornell-Larcker criterion is a way to find out if a construct is valid in a structural model is to compare its squared variance within (AVE) to the squared inter-construct correlation of all the other constructs that were measured reflectively (Hair et al., 2021).

Table 6
Discriminant Validity: Fornell-Larcker Criterion

	Dec	Flex	Access	Alert	SS	SL
Dec	0.845					
Flex	0.699	0.837				
Access	0.646	0.655	0.849			
Alert	0.681	0.659	0.707	0.801		
SS	0.528	0.605	0.639	0.641	0.752	
SL	0.654	0.678	0.691	0.772	0.674	0.763

Heterotrait–Monotrait Ratio (HTMT)

The heterotrait-monotrait ratio is a critical method for determining discriminant validity in structural models. It compares indicator correlations across constructs to the standard deviation of averaged coefficients; it must not exceed 0.85 (Hair et al., 2021).

Table 7
Heterotrait-monotrait ratio (HTMT) – Matrix

	Dec	Flex	Access	Alert	SS	SL
Dec						
Flex	0.837					
Access	0.801	0.813				
Alert	0.816	0.811	0.720			
SS	0.651	0.746	0.779	0.819		
SL	0.790	0.818	0.824	0.828	0.799	

Evaluation of the Structural Model
Collinearity Assessment (Variation inflation factor/ VIF):

Structural model coefficients are derived from estimating regression equations, and to avoid bias in point estimates and standard errors, they must be examined for potential Collinearity issues. This process is similar to assessing formative measurement models, but using construct scores to calculate variance inflation factor (VIF) values. VIF values above 5 indicate probable Collinearity issues, but Collinearity can also occur at lower VIF values. If Collinearity is a problem, higher-order constructs can be created to address the issue. Collinearity issues are most likely to occur when VIF is greater than 5, uncritical when VIF is 3-5, and not problematic when VIF is less than 3 (Hair et al., 2021).

Table 8
Collinearity Statistics (VIF)

Construct	Strategic Synergy	Smart Logistics
Strategic Synergy		1.935
Supply Chain Agility	1.000	1.935

Explanatory Power of the Model

The coefficient of determination (R^2) is a measure of a model's explanatory power, indicating the variance explained in each endogenous construct. The adjusted R^2 metric adjusts the R^2 value based on the number of explanatory variables in relation to the data size. R^2 values of 0.75, 0.50, and 0.25 indicate substantial, moderate, and weak data fit, while excessive values suggest over fitting due to model complexity (Hair et al., 2021).

Table 9
Coefficient of Determination (R^2)

Construct	R^2	R^2 adjusted
Smart Logistics	0.672	0.669
Strategic Synergy	0.483	0.481

Effect size f^2

The f2 effect size allows researchers to assess how deleting a predictor construct affects the R2 value. Table 10 reveals that SCA on SS has the largest effect (0.935), followed by SCS on SL (0.664) and SS on SL (0.078). The f^2 value measures the degree of the influence, with values above 0.02, 0.15, or 0.35 indicating small, medium, or high effects.

Table 10
f^2 effect size

Path	f^2
Supply Chain Agility → Smart Logistics	0.664
Supply Chain Agility → Strategic Synergy	0.935
Strategic Synergy → Smart Logistics	0.078

Evaluation of the Predictive Power of the Model

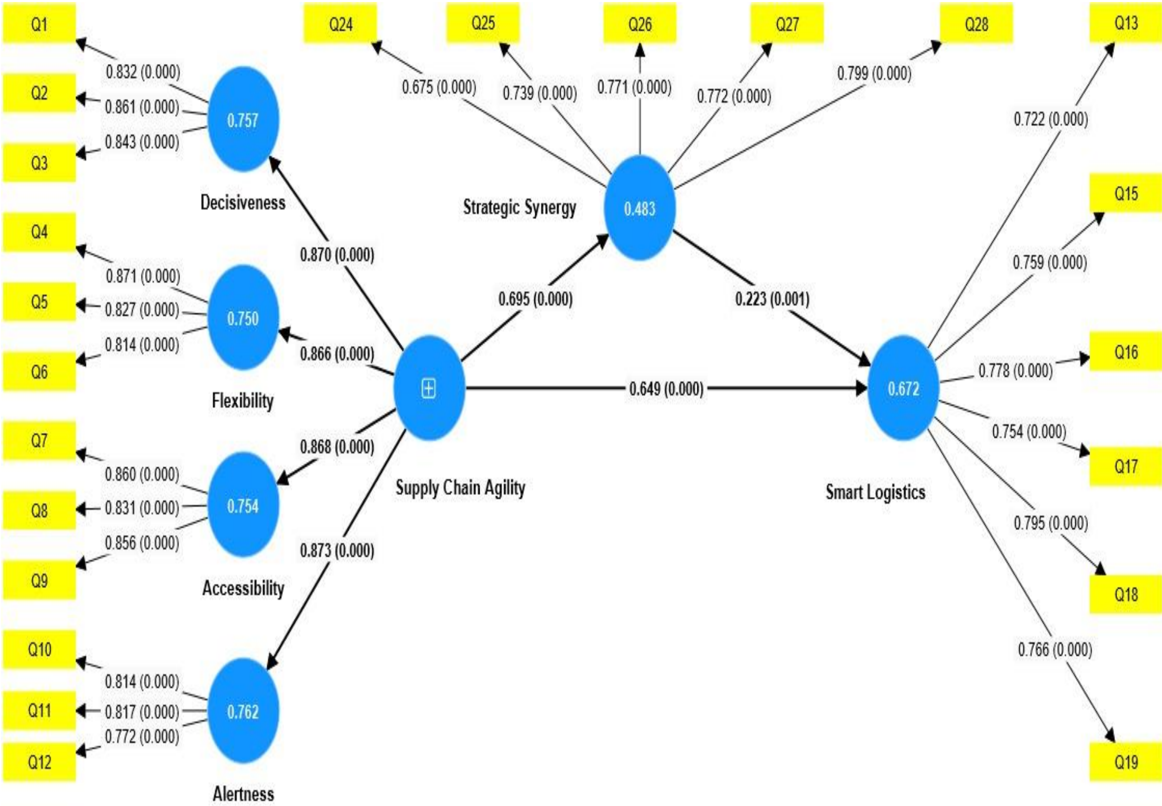
The PLS predict procedure evaluates the model's predictive power using the Q^2predict criterion. A Q^2predict value greater than zero indicates that the PLS path model surpasses the naive criterion in predictive power, as shown in Table 11.

Table 11
Values of the predictive relevance $Q^2_{predict}$

Construct	$Q^2_{predict}$
Strategic Synergy	0.644
Smart Logistics	0.475

Hypothesis Testing

The study employs Partial Least Squares Structural Equation Modeling (PLS-SEM) utilizing Smart PLS 4 program to test the four hypotheses.



First, examine the direct effect of SCA on SL as well as test the direct impact of the SCA on SS. Furthermore, testing the direct impact of SS on SL:

Table 12
Significance test for the path coefficients (direct effects)

Path	Original sample	Sample mean	R^2	SD.	*t*-value	*p*-value	Confidence intervals (95%)	Status
SCA → SL	0.649	0.645	0.672	0.059	11.024	0.000	[0.533 – 0.762]	Supported
SCA → SS	0.695	0.696	0.483	0.052	13.348	0.000	[0.575 – 0.781]	Supported
SS → SL	0.223	0.225	----	0.068	3.284	0.001	[0.087 – 0.352]	Supported

Note: "*t* values are more than 1.96; *Note*: SCA = Supply Chain Agility, SL = Smart Logistics, SS= strategic Synergy".

In order to test the direct impact of SCA on SL, Table (12) shows that there is a direct positive impact between SCA and SL at Jordanian pharmaceutical companies.

The study found a positive, direct, and statistically significant relationship between SCA and SL accordance to Beta value (0.649). The calculated t value (11.024) was higher than the original value of 1.96, and the p value was less than (α ≤ 0.05), confirming the acceptance of the first main alternative hypothesis.

Based on table (12), the study also found a positive, direct, and statistically significant relationship between SCA and SS accordance to Beta value (0.695). The calculated t value (13.348) was higher than the original value of 1.96, and the p value was less than (α ≤ 0.05), confirming the acceptance of the second main alternative hypothesis.

The results of hypothesis testing for the path coefficients for the third hypothesis, as shown in Table (12), the study also found a positive, direct, and statistically significant relationship between SS and SL accordance to of Beta value (0.223). The calculated t value (3.248) was higher than the original value of 1.96, and the p value was less than (α ≤ 0.05), confirming the acceptance of the third main alternative hypothesis.
Second, testing the indirect impact of SS on the relationship between SCA and SL:

Table 13
Significance test for the path coefficients (specific indirect effects)

Path	Path coefficient (*β*)	*t*-value	*p*-value	Confidence intervals (95%)	Status
SCA → SL → SS	0.155	3.130	0.002	[0.058 – 0.250]	Supported

Note: "*t* values are more than 1.96; *Note*: SCA = Supply Chain Agility, SL = Smart Logistics, SS= strategic Synergy".

Table 14
Significance test for the total effects

Path	Path coefficient (*β*)	*t*-value	*p*-value	Confidence intervals (95%)
SCA → SL → SS	0.804	17.778	0.000	[0.699 – 0.876]

Note: "*t* values are more than 1.96; *Note*: SCA = Supply Chain Agility, SL = Smart Logistics".

Based on Table (13 & 14), the fourth hypothesis tested in this study revealed an indirect relationship between Supply Chain agility (SCA) and smart logistics (SL) with Strategic synergy (SS) as a mediating variable at Jordanian pharmaceutical companies. The study measured the direct impact (0.649) and indirect impact (0.155) of these paths, and found a significant impact of strategic synergy as partial mediation between supply chain agility and smart logistics. The total effect of SCA on SL in the presence of SS was found to be 0.804. Thus, the fourth alternative hypothesis (H4) is confirmed.

Conclusion and Discussion

This paper has investigated the relationship between Supply chain agility (SCA) and smart logistics (SL) through the mediating role of strategic synergy (SS) at pharmaceutical manufacturing companies in Jordan. Supply chain agility and smart logistics are both hot issues at present. Nevertheless, the existing research on the relationship between SCA and SL and the mechanism of action between them is insufficient. The objective of the study is to determine how SCA and SS impact SL. The first hypothesis of the study confirmed that there is a significant impact for supply chain agility on smart logistics at Jordanian pharmaceutical companies. Supply chain agility is crucial for Jordanian pharmaceutical companies to remain competitive in a dynamic market. It involves responding quickly and effectively to changes in demand and market trends, improving operations, reducing delivery times, and reducing costs.

These results are consistent with study Kübra et al (2023), which indicated that SCA practices enhance smart logistics services by improving response, reducing transportation times, and improving resource allocation, which ultimately leads to improved customer service and operational efficiency. Also, the study's results supported by many studies such as (Pernici et al, 2020; Selvakumar & Jayashree, 2019).

The current study revealed that there is a significant impact for supply chain agility on strategic synergy at Jordanian pharmaceutical companies. Supply chain enables companies to respond quickly to market changes, reduces production and distribution costs, and improves operational efficiency. High-quality products also enhance a company's reputation, contributing to strategic synergies. Resilient supply chains foster innovation by allowing companies to explore new solutions and modern technology, leading to increased market share. Close collaboration between companies, suppliers, and customers is essential for achieving common goals. Data visibility and analytics contribute to improved decision-making, and agility helps companies be better prepared for crises like the COVID-19 pandemic by directing resources and operations quickly. Improving supply chain agility requires investments in technology, skills development, and strengthening partnerships to enhance responsiveness to market changes and competition. Thus, this finding is at par with earlier studies of SCA on SL (Holloway, 2024; Mate, 2022; Banihashemi, 2011).

Furthermore, the current study confirmed the third hypothesis which declared that there is a significant impact for strategic synergy on smart logistics at Jordanian Pharmaceutical Companies. Strategic synergy and smart logistics are crucial concepts at Jordanian pharmaceutical companies. Strategic synergy links and coordinates various strategic functions and operations, promoting harmony and integration between activities, resources, and capabilities. It enhances interaction and cooperation between different units and departments. Smart logistics, on the other hand, utilizes modern techniques and advanced technology to manage logistics operations, increasing efficiency and effectiveness in managing materials, information, and money. It improves response to demand, reduces costs, and enhances customer service. The relationship between strategic synergy and smart logistics is crucial for improving the efficiency and effectiveness of Jordanian pharmaceutical companies.

Jordanian pharmaceutical companies are leveraging smart strategies to enhance their logistics operations. These strategies include strategic alignment, which involves developing sustainable and flexible strategies that adapt to market and customer needs, and accuracy, which involves using modern technologies like artificial intelligence and data analysis to improve supply chain management, reduce costs, and increase efficiency.

The relationship between strategic synergy and smart logistics is a powerful tool for Jordanian pharmaceutical companies to enhance their efficiency and competitiveness in the market. These findings are following earlier studies (Volosnikova, 2023; Liu et al, 2021). Supply chain agility, strategic synergy, and smart logistics are interconnected elements in improving supply chain management in Jordanian pharmaceutical companies. Supply chain agility is crucial for quick responses in dynamic market conditions. Strategic synergy enhances coordination, adaptability, innovation, efficiency, and competitiveness. By enhancing coordination between departments, Jordanian companies can adapt to market changes and implement smart logistics solutions like modern technology. Collaboration reduces waste, improves operational efficiency, and enhances profitability.

Limitations

The current investigation encounters a few constraints. First, the sample's size was drawn. To obtain more general results, the findings must be confirmed using a larger sample size. Second, this study solely includes pharmaceutical companies. It is not viable to generalize the results across different industries. Finally, this study utilized closed-ended questionnaires; it is possible to utilize focus groups, and interviews to gather qualitative data that yielded a thorough comprehension of the phenomenon under inquiry.

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