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The effect of digitalism on supply chain flexibility of food industry in Jordan

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A B S T R A C T

This study comes to ascertain the impact of digitalism on supply chain flexibility. A sample consisting of 350 employees was selected from manufacturing companies in the food industry to collect research data. One inclusion criterion was assumed in this research, which is employee knowledge of supply chain processes. Research data was gathered using a questionnaire distributed to the members of the sample. The final number of the questionnaires was 297 with a response rate of 85%. Analyzing data via SmartPLS 3.0, the results indicated that Internet of things (IOT) had a significant effect on supply chain flexibility. Such results confirmed that one dimension of digitalism, which is the Internet of things, has a significant effect on supply chain flexibility.

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1. Introduction

Modern technology has invaded people's lives, and it has become with people at all times. Modern smart phones, computers, and modern means of technology have entered all industries such as the automobile industry and the aircraft industry, and despite the negatives that occurred as a result of the misuse of technology, modern technology has great benefits (Altarifi et al., 2015; Al-Hawary & Alhajri, 2020; Al- Quran et al., 2020; Al-Abbadi et al., 2021; Tariqa et al., 2022a). With the continuation of digital transformation, organizations have been able to process information faster and benefit from knowledge more (Al-Alwan et al., 2022; Al-Hawary & Obiadat, 2021). Digital transformation has contributed to improving the performance of supply chains, and organizations are also able to use raw materials in a better way and reduce energy consumption (Al-Alwan et al., 2022; Tariq et al., 2022b; Eldahamsheh et al., 2021; Al-Shormana et al., 2021; Al-Hawary et al., 2020). Many global supply chains are not ready to deal with the new world. For this reason, supply chain managers need to shift from cost-cutting strategies to adopting new processes, which makes organizations more flexible in creating value across their supply chains (Aityassine et al., 2021; Al-khawaldah et al., 2022). Organizations today find themselves in the midst of the new digital age among the digital technologies that appear every day, which in turn will disrupt most areas of traditional business operations (AlTaweel & Al-Hawary, 2021; Al-Hawary & Al-Syasneh, 2020). Supply chains are considered the backbone of global trade and the cornerstone of the growth of the world economy, especially in the post-Coronavirus pandemic, and their current form may not be commensurate with the next stage facing the world, and it is certain

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that it will witness many changes in the coming years, and these changes may make it worse before it starts getting better, the effects of the Corona crisis may contribute to the increase in inflation, which has begun to show clear signs in the economy of countries. The Corona pandemic imposed many obstacles in the way of supply chains, the most important of which is the difference in consumer behavior, as demands for electronic goods increased and workers shifted to working from home, which reduced the production of electronic chips with the increasing demand for them from all factories, whether they were car factories or home appliance factories, and in light of all of this, supply chains remained unable to adapt to these sudden changes due to the precautionary restrictions imposed on ports in terms of the number of workers allowed in them and the closure of airports and ports in many countries. Accordingly, by increasing the shortening of waiting times at the ports and accelerating the examination and transportation of goods to warehouses in a harmonious manner, appropriate systems have been developed for them using digital transformation tools that can significantly improve the performance of logistics systems and thus support the flexibility of supply chains.

Supply Chain Flexibility (SCF) is the logical development of manufacturing flexibility. Flexibility of supply chains enables organizations to maintain their competitive capabilities in volatile business environments, and flexibility is also a feature essential to the supply chain for industries characterized by short product life cycles, significant technological change, and increased customer demand (Al-Hawary et al., 2017; Al-Hawary & Al-Jawazneh, 2011). Supply chain Flexibility has previously been examined, but without presenting any precise approach or established theory, and only from a resource-based perspective (Manders et al. 2017), implying that more research is needed to support and supplement the viewpoints required to fully comprehend it.

Flexibility is one of the most important factors that provide new profit opportunities for the supply chain. Xu, Zhang, X., Feng, & Yang, W. (2020) noted that working to allocate financial resources to the supply chain has an important impact on its flexibility. Reliance on the flexibility of supply chains also has a significant impact on the performance of organizations. Changes in customer needs and technology needs have forced industrial organizations to develop the flexibility of their supply chains to increase their competitiveness. According to Sheel et al. (2020), Martnez-Sánchez, et al. (2020), the nature of the environment affects the level of flexibility required in operations and supply chains. They added that the organization and its supply chain must be more flexible when operating in dynamic environments.

Digitalism affects the economy as a whole by creating significant opportunities and challenges for organizations. Digitalism is no longer an option for organizations but an urgent necessity in all industries. Digitalism targets manufacturing processes, work, business models, products and services. The application of digital technologies in supply chains requires a detailed understanding due to its multiple business impacts and benefits. Implementing digital transformation throughout the supply chain processes provides a solution to supply chain risks. However, the practical application of digital transformation technologies in supply chains is a difficult problem that requires more research and exploration. Supply chain managers are tasked with keeping their companies competitive by devising strategies to improve existing digital capabilities and capitalize on opportunities from digital tools that have yet to be embraced. Hence, this study comes to ascertain the impact of digitalism on supply chain flexibility.

2. Theoretical framework and hypotheses development

2.1 Digitalism

The various digital technologies that have recently been used in and affected various business sectors are Mobile Advices, the Internet of Things (IoT) that connects many devices and things around us to the Internet while giving us the ability to control them through mobile devices, and Cloud Computing, Social Media, and Big Data Analytics are among the most important modern digital technologies (Schwertner, 2017). Mubarak, Shaikh, Mubarik, Samo & Mastoi (2019) found that some digital transformation technologies such as big data, electronic physical systems, and interoperability have a significant positive impact on improving business performance, while the negligible impact of the Internet of Things on improving the performance of organizations was revealed. It involves fairly profound changes in a company's business model, which may occur in processes, resources, operational methods, or culture (Henriette, Feki & Boughzala, 2016).

Organizations respond to changing work environments objectively by using different digital transformation techniques, and this requires a clear strategy that sets priorities with the provision of financial resources, the use of appropriate leadership styles, and the inclusion of all employees in the organization (Schwertner, 2017). Organizations have to adopt digital transformation techniques and formulate plans to advance them. Organizations also suffer from the lack of digital technologies in their work and the lack of expertise and professional cadres specialized in developing and transforming them into digital and technical forms, which negatively affects their services and products (Nayak et al., 2019).

The importance of digitalism is to keep pace with the development of global technology that has changed the ways of thinking and behavior of beneficiaries and consumers. The digital transformation also accelerates the daily way of work so that technology is exploited at work to be faster and better, which reduces work effort and saves time to think about development and innovation. Digital transformation has become the ultimate way in which organizations work. Digitalism refers to "the change in people’s communication and behavior in society as a result of the widespread use of digital technologies" (Gimpel and Roglinger et al. 2015). Digitalism creates opportunities for organizations and supply chain practices. Many organizations have started digital transformation because they have noticed the importance and value of digital technologies to help them

in their business performance and development, and organizations have also increased their administrative support for such technologies (Bughin et al. 2015).

Drechsler et al., (2020) define digital transformation as "a transition process from using traditional mechanisms to digital ones based on controlling technology to perform various activities, and this is by adopting a comprehensive digital technological system for all functions and tasks that enables it to tabulate data and information to become available and easy to use in order to achieve a number of objectives and a competitive advantage." While Warner & Wäger (2019) defines it as "the process of organizations transitioning to a business model based on digital technologies in creating products and services, providing new revenue channels and opportunities that increase the value of their product," Indriastuti & Fuad (2020) also defined digital transformation as an attempt to accelerate business using technology tools and the search for opportunities that can help business operations or have a broader target market. In general, digital transformation can be defined as a comprehensive development process for organizations using digital technologies that works on progress at all levels of the organization in order to keep pace with the rapid development of the era and its increasing requirements, which increases the value of organizations.

Studies have mentioned many metrics that enable us to measure digitalism, and many researchers have addressed them according to the purpose and nature of their study and the field of application. Mabkhot, Al-Ahmari, Salah & Alkhalefah (2018) Chen, Wan, Shu, Li, Mukherjee & Yin (2017), Imran, ul-Haque (2018). This study is based on a number of them, namely: **Cyber-physical systems** are the new generation of systems that connect the physical world and the computerized world and can interact with humans in organizations through many new methods. **The smart factory** is a manufacturing solution that provides flexible and adaptable production processes in organizations that solve problems that arise autonomously in a facility. Production with dynamic and rapidly changing frontier conditions in an increasingly complex world. *The Internet of Things* is a model of preparing things (physical components) in organizations with identification, sensing, networking, and processing capabilities that will allow them to communicate with each other and with other devices and services over the Internet to achieve some goals, and *Big Data* is a term that refers to huge data sets with a large, diverse, and complex structure with difficulties in storage, analysis, and visualization of further processes or results in organizations.

2.2 Supply chain flexibility

Supply Chain Flexibility (SCF) is defined as the ability of organizations to respond to unexpected changes in customer needs and the movements of competitors in a volatile business environment. Flexibility is manufacturing a product or providing a service that suits the needs and requirements of each customer, and this became possible because of flexible manufacturing systems, group technology, and integrated computerized manufacturing, in addition to other methods such as information technology and communication systems, which contributed to increasing the speed of response to changing customer requirements and providing instant information (Gunasekaran et al. 2001). Organizations' awareness of the flexibility of the supply chain enables them to respond quickly to customers' needs by providing products that match the desires of each customer and their ability to reduce cycle time and inventory levels, which include in a typical environment raw material, semi-finished products, and finished products. It is imperative that there be supply chain practices in the organization that compete through flexibility (Narasimhan& Das, 2000). In addition, (Morgan, 2004) stated that one of the characteristics that should be measured in order to benefit from the supply chain is flexibility, and according to Gunasekaran et al. (2001) on flexibility, the delivery system can be considered one of the measures of customer acquisition and retention. Many experts believe that supply chain flexibility is critical to efficiency and sustainability (Duclos et al. 2003). According to Upton (1994), "The ability to alter or react while lowering time, effort, cost, or performance" is described as Internal and external risks can cause corporate activities to be delayed, hence flexibility is a beneficial risk management technique. It is defined as the internal efficiency that helps firms to develop their manufacturing and production capacities in response to client requirements (Delic and Eyers 2020; Song, Chen, and Lei 2018). The success of applying resilience methods in reacting to product modification difficulties has been established (Novais, Maqueira, and Bruque 2019).

The literature has mainly adopted specific dimensions of supply chain flexibility, and researchers have noted a limitation in studies that have identified special dimensions of supply chain flexibility, especially in considering it a shared responsibility for many functions along the supply chain, whether internal or external. The internal dimensions of supply chain flexibility are at the organization level, while external dimensions fall along the supply chain. This confirms that developing the flexibility of supply chains requires capabilities at the operational and organizational levels so that the criteria for assessing flexibility are general, the most important of which are flexibility in products, flexibility of paths, flexibility of transportation, flexibility of resources, and flexibility of supply and demand. Farok and Wahab (2016) expand the concept of supply chain flexibility by defining six dimensions of it: operational, market, logistics, supply, organizational, and information systems flexibility. The literature confirms that adopting flexibility practices is costly, and that a decision must be made about the type of flexibility to be used, taking into account the environment of uncertainty (Sreedevi and Saranga 2017; Merschmann and Thonemann 2011). Moon et al (2015) referred that the dimensions of the flexibility of supply chains are a construct that consists of: the flexibility of resources, that is, the availability of materials and services and the ability to purchase them in proportion to changing needs; Flexibility of the operating system, i.e., the ability to have properties, formulations, and sizes along the product line to meet multiple customer specifications; Flexibility of distribution, i.e., effectively managing distributors, warehouses and loading capacities; The flexibility of information systems, i.e., the adaptation of an organization's information systems to changing market conditions (Sadi-Nezhad, 2021).

2.3 Digitalism and supply chain flexibility

Organizations are affected by uncertainty and risks that occur along the supply chain. Decision makers are affected in the supply chain, which leads to inefficiency and ineffectiveness in the performance of business, which may thus affect the performance of the organization. Organizations understand very well the need for organizational flexibility when trying to adapt to any change in their external environment as a result of the great competitive pressures to make decisions and raise performance levels. At the same time, technology offers new solutions to competition, and at the same time, it almost eliminates the old solutions, and then the problem of change and an immediate and rapid transition from the old form of doing business to the new form appears. Therefore, organizations must take effective measures to achieve success. Speed greatly affects the activities of organizations, as time reduction strategies positively affect the performance of organizations. Therefore, in order for organizations to realize the benefits of a flexible supply chain, they need to define its dimensions and indicators, in addition to recognizing the level of its impact, so that they can measure the flexibility of their supply chain. Every organization has its own organizational culture that dictates when and how to do business; for example, differing procedures, strategies, techniques, and practices of logistics management, which makes it difficult to agree on one opinion regarding quality and speed related to the supply chain, making achieving flexibility difficult. It is therefore important for an organization to be able to understand and interpret its external environment and how its partners think along the supply chain.

Research confirms the impact of organizational learning on supply chain flexibility begins with improving supply chain flexibility processes within an organization, whether through the application of new solutions, management of existing solutions, improvement of process technology performance, or improvement of its integration. The researcher adds here that there is a significant impact of organizational learning on the flexibility of supply chains and their various activities. Several studies have shown that digital transformation affects the performance of organizations. The study of Lee, Azmi, Hanaysha, Alzoubi, & Alshurideh, (2022) indicated that digital transformation has a role in raising the efficiency of organizations' performance and attracting investments, as indicated by Llopis-Albert, Rubio & Valero (2021), that digital transformation has an impact on the automotive industry, Pavlekovskaya, Urintsov, Staroverova & Nefedov (2018) emphasized that digital transformation affected knowledge management processes, Reinartz, Wiegand, and Imschloss (2019) noted that digital transformation affects the retail value chain, Hanelt, Piccinini, Gregory, Hildebrandt & Kolbe (2015) note that digital transformation of core physical industries and digital trends are affecting the business models of auto manufacturers, and Grab, Olaru & Gavril (2019) emphasize the impact of digital transformation on strategic business management.

According to Rutkowski & Rutkowski (2015), supply chain managers who have made the switch to digital methods must rethink how they manage their present supply chain and seek to identify possibilities and obstacles. New digital technologies such as 3D printing, the Internet of Things, and social media, according to Agrawal and Narain (2018), are having a substantial impact on the existing and future supply chain management model. It is expected that the new digital technologies will overcome some of the challenges facing the flexibility of supply chains, which leads to lower levels of cost and complexity and increased flexibility of scale. However, even if digital transformation has a significant impact on the supply chain, many stakeholders still doubt its true added value from a cost/benefit perspective (Makris, Lee Hansen, and Khan 2019). Increased flexibility, and cost reduction are the main goals of digital transformation (Hofmann and Rüsch, 2017). Insufficient flexibility of intra- and inter-organizational business processes are two existing hurdles to the targeted and efficient use of DTTs (Junge, 2019). Kearney looked at 60 European firms' global SCM and discovered six technology enablers that are helping to digitize SCM (Kearney 2015). The study looked at the effects of digitization on SCM and discovered that it had a significant impact on stock levels, delivery schedules, and SCM flexibility. AM technologies can have a variety of effects on supply chains, including enhanced production flexibility, reduced material waste, and the capacity to decentralize manufacturing. Furthermore, I4.0 allows for the introduction of new technologies and systems that can improve the effectiveness and efficiency of value-added business processes while also increasing industrial flexibility (Hahn, 2020). Certain competencies, such as I4.0 proficiency or big data capabilities, are thought to positively promote flexibility (Dubey et al., 2019). To increase the flexibility of supply networks, it is vital to pursue Digital Transformation (Acero et al., 2022). Digital Transformation will lay the groundwork for reinventing companies and creating new customer experiences by finding the right technologies to enable the new supply chain capabilities that have become the norm, such as flexibility, resilience, responsiveness, visibility, and collaboration. The ability of an organization's information system to support structural flexibility helps to supply chain adaptability to meet the ever-changing business environment (Gupta et al., 2019). Electronic Data Interchange (EDI) allows for the interchange of information, resulting in the rational alignment of operational tasks and system adaptability (Praditya et al. 2017; Barreto et al., 2017). Accordingly, the study hypothesis can be formulated as follows:

H_1: *Digitalism has an effect on Supply Chain Flexibility.*

3. Methodology

3.1 Research sample and data collection

A sample consisting of 350 employees was selected from manufacturing companies in the food industry to collect research data. One inclusion criterion was assumed in this research, which is employee knowledge of supply chain processes. Research data was gathered using a questionnaire distributed to the members of the sample. A total of 333 questionnaires were received,

out of them 36 were excluded as extreme values or due to incomplete responses. The final number of the questionnaires was 297 with a response rate of 85%.

3.2 Research model

Research model in Fig. 1 highlights a potential link between one independent variable (digitalism) and one dependent variable (supply chain flexibility). Digitalism consists of 4 dimensions; physical cyber systems, smart factory, Internet of things, and big data. Supply chain flexibility comprises 4 dimensions; resource flexibility, operation system flexibility, distribution flexibility, and information systems flexibility.

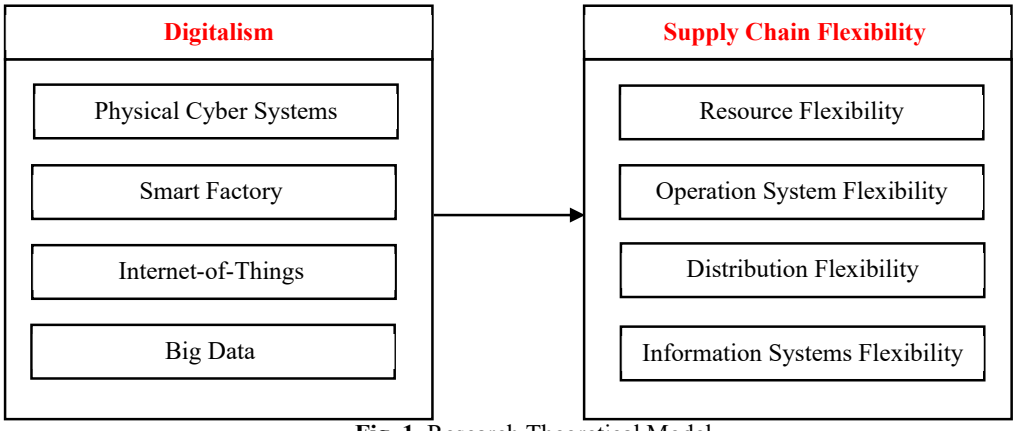

Fig. 1. Research Theoretical Model

3.3 Research instrument

Based on previous studies on both digitalism and supply chain flexibility, a questionnaire was developed using a 5-point Likert scale in which 1 refers to "strongly disagree", 2 means "disagree", 3 assumes a "neutral" response, 4 refers to "agree", and 5 represents "strongly agree". The independent variable (digitalism) was measured based on 20 items distributed equally on 4 dimensions (physical cyber systems, smart factory, Internet of things, big data). On the other hand, the dependent variable was measured using 16 items related equally to 4 dimensions (resource, operation system, distribution, and information systems flexibility).

3.4 Reliability and validity

The results of reliability and validity of digitalism scale in Table 1 show that the overall values of the scale meet the required thresholds. Factor loadings for all items were higher than 0.5.

Table 1
Reliability and validity of digitalism items

Factors	Items	Outer loadings	Cronbach's alpha	Composite reliability	AVE values
Digitalism	PCS1-BDT5	0.756-0.973	0.950	0.955	0.520
	PCS1	0.902			
	PCS2	0.889			
Physical cyber systems	PCS3	0.910	0.915	0.936	0.747
	PCS4	0.756			
	PCS5	0.855			
	SFC1	0.897			
	SFC2	0.837			
Smart factory	SFC3	0.926	0.936	0.952	0.798
	SFC4	0.905			
	SFC5	0.898			
	IOT1	0.972			
	IOT2	0.966			
Internet of things	IOT3	0.960	0.978	0.983	0.919
	IOT4	0.950			
	IOT5	0.945			
	BDT1	0.973			
	BDT2	0.940			
Big data	BDT3	0.919	0.969	0.976	0.892
	BDT4	0.934			
	BDT5	0.955			

Moreover, the results in Table 1 indicate that Cronbach's alpha and composite reliability values were greater than 0.70, and values of the average variance extracted were greater than 0.50. On the other hand, the results of reliability and validity of supply chain flexibility scale imply that the all factor loadings were higher than 0.50, Cronbach's alpha and composite reliability were more than 0.7, and AVE values were higher than 0.5. It should be noted that reliability was measured using Cronbach's alpha and composite reliability and validity was tested using factor loadings and AVE values.

Table 2
Reliability and validity of supply chain flexibility items

Factors	Items	Standardized loadings	Cronbach's alpha	Composite reliability	AVE values
SCF	RFX1-ISF4	0.760-0.964	0.953	0.958	0.590
Resource flexibility	RFX1	0.860	0.900	0.930	0.770
	RFX2	0.879			
	RFX3	0.887			
	RFX4	0.882			
Operation system flexibility	OSF1	0.760	0.874	0.914	0.729
	OSF2	0.869			
	OSF3	0.902			
	OSF4	0.876			
Distribution flexibility	DFX1	0.919	0.943	0.960	0.856
	DFX2	0.867			
	DFX3	0.964			
	DFX4	0.947			
Information systems flexibility	ISF1	0.843	0.923	0.945	0.813
	ISF2	0.927			
	ISF3	0.919			
	ISF4	0.915			

In terms of model quality, Stone-Geiser's (Q^2) was used for such a purpose; its value (0.515) was higher than zero and close to zero (0.002) for supply chain flexibility, and R^2 for supply chain flexibility (0.003) was also close to zero.

3.5 Research structural model 1

The structural model in Figure 2 displays the results of testing the effect of digitalism as measured by 4 dimensions (physical cyber systems, smart factory, Internet of things, big data) on supply chain flexibility as evaluated by 4 dimensions (resource flexibility, operation system flexibility, distribution flexibility, and information systems flexibility). The model shows a very weak effect of digitalism (estimate = 0.057) on supply chain flexibility. Such a finding is clear based on the explanatory power, which was also very weak (R^2 = 0.003). More details on the test are shown in Table 3.

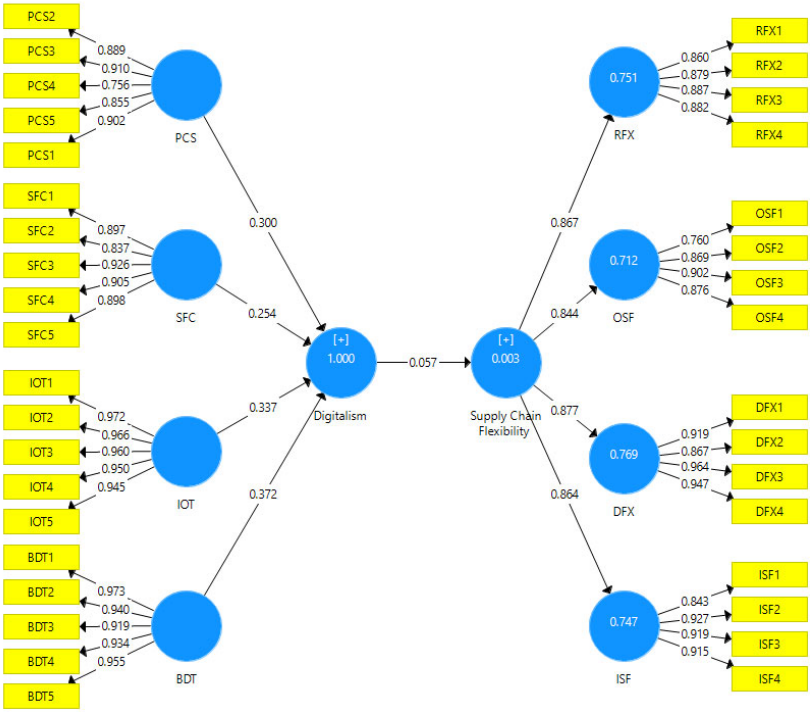

Fig. 2. Research structural model 1

3.6 Research structural model 2

The second structural model in Fig. 3 illustrates the effects of digitalism dimensions on supply chain flexibility as a whole dependent variable. The model indicates that the most influential factor is the Internet of things (IOT). The overall explanatory power of digitalism dimensions is acceptable ($R^2 = 0.105$).

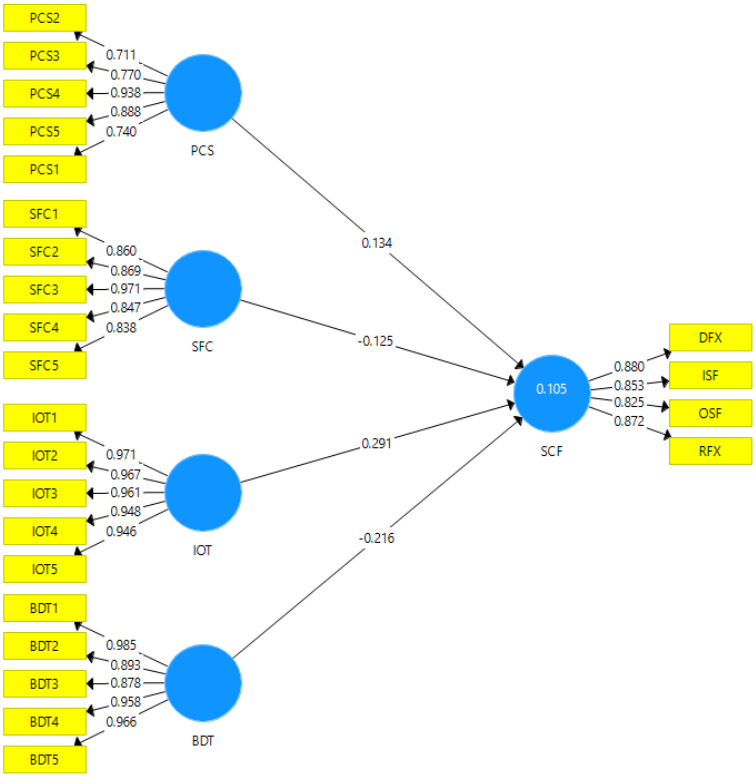

Fig. 3. Research structural model 2

The results of both structural model 1 and structural model 2 are depicted in Table 3. It can be noted that digitalism had no significant effect on supply chain flexibility (β = 0.057, T = 0.759, P = 0.448). Physical cyber systems (PSC) had no significant effect on supply chain flexibility (β = 0.134, T = 0.984, P = 0.326). As well, an insignificant effect of smart factor (SFC) on supply chain flexibility (β = 0.125, T = 1.140, P = 0.255). Furthermore, it was noted that big data (BDT) exerted an insignificant effect on supply chain flexibility (β = 0.216, T = 1.825, P = 0.069). However, the results indicated that the Internet of things (IOT) had a significant effect on supply chain flexibility (β = 0.291, T = 3.897, P = 0.000). Such results confirmed that one dimension of digitalism, which is the Internet of things, has a significant effect on supply chain flexibility.

Table 3
Results of hypotheses testing

Constructs and paths			β	T statistics	P value	R^2
Digitalism	→	**SCF**	0.057	0.759	0.448	0.003
PCS	→	**SCF**	0.134	0.984	0.326	
SFC	→	**SCF**	0.125	1.140	0.255	0.105
IOT	→	**SCF**	0.291	3.897	0.000	
BDT	→	**SCF**	0.216	1.825	0.069	

4. Discussion

The results of the study showed that organizations have the ability to cooperate and coordinate to provide complete and diverse new products at a high speed, in addition to their ability to reduce the development cycle of new products because of the technological developments witnessed in the markets and the great investment in modern technology, which helped industries achieve high flexibility in providing products such as flexible manufacturing systems and computer-integrated manufacturing (CIM). Organizations have resorted to developing and improving their products by investing in digital technologies that contribute to raising their competitive capabilities, helping them keep pace with continuous environmental developments, and supporting them in obtaining a larger market share and improving their competitive capabilities in the long run. The high flexibility in providing the product requires manufacturing the product that matches the requirements of the customer and delivering it directly to the market with the highest value and the best price. This flexibility in product

offering allows the organization to be highly responsive to the market and enables it to quickly design new products. (Carter, 1986; Gerwin, 1993). The results of the study also show that organizations can increase and decrease the volume of total production in order to meet the fluctuation of demand among customers, and they can diversify the sizes of their products to meet the special needs of each customer without entailing additional cost or time. It can also adjust the size of the supplied quantities of products by changing consumer demand for the product, control supply levels in terms of rise and decline, and employ alternate paths to transfer stock in operation through various sources.

Organizations that have high supply flexibility are able to provide superior value to the customer and thus serve them better, as the flexibility of supply means that the organization has a great opportunity to respond to the customer with regard to the delivery of the product. The results of the study indicated that the organizations under study can deliver orders on time without delay, and they can also distribute and deliver the product in the specified quantities and according to the changes that occur to suppliers or customer locations without any increase in time. Advances in transportation methods and their lower costs have increased organizations' desire to gain new customers and provide products in wide geographical areas through agents, wholesalers, and retailers, which has made them more competitive and gained new markets locally and globally (Kalakota and Robinson ,2000). The study's findings revealed that companies may do various and diverse activities simultaneously by communicating, exchanging, and sharing data inside them, and that the methods of information systems used and the needs of the organization are in sync. As a result, organizations are constantly looking to increase their investment in information systems, in addition to information technology and communication systems, because it improves the speed of response and the provision of information electronically, which has a positive impact on customer service quality and identifying and meeting their needs and desires quickly. The ability to respond quickly and provide new products is both tied to the flexibility of information systems.

The study's findings concluded that digitalism has an impact on supply chain flexibility, which is consistent with the findings of Agrawal & Narain (2018), who found that digital transformation is critical for supply chain flexibility, and (Bulovi & ovi, 2020), who found that digital transformation has an impact on organizational business. And it modifies the shape of retailers' business models, necessitating further research into supply chain resilience and associated topics, as Papyshev (2017) pointed out, because Industry 4.0 technologies affect numerous organizational activities. The study (Nara et al., 2021) showed that digital transformation technologies represented in the Internet of Things, cyber-physical systems, sensors, and implementation of big data are drivers of organizational development; and (Krmela, 2019) indicated in his study that digital transformation supports the implementation and spread of business models; while the study by Henriette et al. (2016) emphasized that digital transformation is a strategic, organizational, and cultural stake for the organization and that the commitment and participation of senior management in it is essential. Customer digital engagement and e-word play a beneficial impact in strengthening brand image along the supply chain, according to Mihardjo et al. (2019).

The application of digital tools in the supply chain can achieve several benefits that support its flexibility, as supply chains become more transparent, enabling them to make better decisions. In addition to the low levels of inventory due to the timely purchase of supplies, the integrated storage system gives a comprehensive and integrated picture along the supply chain, and digital technologies help to create decentralized stores of goods that support the speed of delivery, the time required for submission will inevitably decrease. Better understanding customer requirements by sensing demand and constantly updating sales information using digital tools also makes the supply chain more efficient and flexible. The use of digital tools also improves supply chain flexibility because it reduces the risks and costs involved in supply chain flexibility. It supports the decision-making process in it, which leads to better supply chain management decisions and supports competitive advantage. Huge changes that digital transformation is bringing about in supply chain flexibility as the implementation of new digital technologies such as big data, cloud computing and the Internet of Things can help overcome all challenges and obstacles and improve supply chain flexibility. New digital technologies help standardize, simplify and standardize products and processes.

5. Recommendations

Based on the findings of the study, taking into account its determinants and limits, the researcher recommends that the researched organizations focus on increasing knowledge of how information systems are used to enhance the flexibility of information systems and improve supply chain performance and work to achieve flexibility in the organization's supply chains by supporting integration between marketing, financial, development, inventory, and production control activities, in addition to improving the relationship with suppliers and the need for adequate information systems. It is also necessary for tight coordination between the factory and suppliers, especially in cases of increased demand, in order to avoid maintaining high levels of stock. The study recommends that the surveyed organizations put product flexibility at the top of their competitive priorities as it requires effective cooperation between functional units such as the marketing unit, product design and development, and the engineering department. Also, organizations must increase the levels of response to the target market and the fluctuations of its conditions through restructuring the organization, forming work teams with sufficient knowledge and simplifying work procedures for them, and therefore, the responsibility for the flexibility of response is a responsibility that flows through the supply chain and on individuals. Share the responsibility for implementing and managing market response flexibility.

The study also recommends organizations achieve flexibility for supply chain management by applying advanced information technology such as electronic data interchange (EDI) systems, internet-based technology applications, customer relationship management (CRM) systems, and enterprise resource planning systems. Resource planning (ERP). It also recommends that the supply chain partners share the responsibility for implementing and managing the flexibility required for the supply chain. The manufacturing department is responsible for the flexibility of size; the marketing department is responsible for the flexibility of distribution; the development and research department is responsible for the flexibility of introducing new products; and the responsibility to achieve the required flexibility is a joint responsibility. Close cooperation between marketing and customers is necessary to achieve product flexibility with the concerned parties of the organization. Finally, the study advises decision-makers and strategists to examine the provider's characteristics, such as the number of suppliers, average supplier size, determine the size of their investments, how to link information with them, and the nature of contracts, in order to comprehend the provider's needs and strengths. Manufacturers and suppliers must meet the demands and wishes of the final consumer, which necessitates managers analyzing the customer's attributes, which includes the necessary knowledge about the product and its life cycle.

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