LogForum
> Scientific Journal of Logistics <
2023, 19 (1), 15-32
http://doi.org/10.17270/J.LOG.2023.779
http://www.logforum.net p-ISSN 1895-2038 e-ISSN 1734-459X

ORIGINAL PAPER

EXPLORING THE INFLUENCE OF IS ON COLLABORATION, AGILITY, AND PERFORMANCE. THE CASE OF THE AUTOMOTIVE SUPPLY CHAIN

Khaled Naoui, Omar Boubker, Mohamed El Abdellaoui

Research Laboratory on Development and Valorization of Resources in Desert Zones, Ibn Zohr University, Agadir, **Morocco**

ABSTRACT. Background: Supply chain information systems (SCIS) have turned into a key success factor for the proper management of the automotive supply chain. Therefore, the scope of this paper is to explore the impact of SC information system infrastructure (SCISI) and SC information sharing (ISSC) on interorganizational trust (IOT), SC collaboration (SCC), SC agility (SCA), and SC performance (SCP) in the Moroccan automotive industry context.
Methods: The dataset was drawn from a selected sample of Moroccan automotive industry firms through an online survey. Furthermore, the partial least squares (PLS-SEM) procedure was applied to test the conceptual model.
Results: The findings support the positive influence of SCIS infrastructure on IOT and SC agility. Similarly, information sharing in SC positively affects the collaboration between IOT and automotive SC. The results also provide evidence that IOT plays a significant role in improving SC agility. Lastly, agility and SC collaboration were identified as key drivers of SC of performance.
Conclusions: The findings extend the existing literature on SC management and management information systems by providing empirical verification of how information sharing and IS infrastructure can influence collaboration, agility, and SC performance. These findings are useful in guiding SC managers through the process of improving SC performance.

Keywords: Information systems, information sharing, interorganizational trust, performance.

INTRODUCTION

With a strategic geographical position, a skilled workforce and attractive industrial ecosystems, Morocco has become an African pillar of the automotive industry. This sector has recorded a very notable export performance in recent years. The Moroccan automotive industry has become the leading exporting sector in Morocco [Hahn & Auktor, 2017]. With a contribution of the 16% of gross domestic product (GDP) in 2019, this sector constitutes a driving force of Morocco's industrial development and employment of Morocco's industry.

The automotive industry is driven by a complex demand, in which logistics has a key role to play [Boysen et al., 2015]. Usually, the automotive supply chain is approached in an exhaustive manner by considering, beyond the sole automotive manufacturing, the activity of the production of automotive components and equipment [Frigant & Layan, 2009]. Many players interact within automotive SC, including designers, assemblers, parts suppliers, original equipment manufacturers (OEMs), carriers, and distributors.

In the automotive supply chain, suppliers have increasingly switched to personalization, assuming more responsibility for product design and technology to meet OEM specifications, instead of making ready-made products. In this sense, suppliers began to deliver complete systems; therefore, the responsibility of the first-tier suppliers became assembling entire units. In fact, the role of first-tier suppliers is becoming

Citation: *Naoui K., Boubker O., El Abdellaoui M., 2023. Exploring the influence of IS on collaboration, agility, and performance. The case of the automotive supply chain. LogForum 19 (1), 15-32,* http://doi.org/10.17270/J.LOG.2023.779
Received: 05.10.2022, Accepted: 08.02.2023, on-line: 31.03.2023

more critical in coordinating with second-party providers.

In the past, there was a deeper integration in the value chain. More particularly, automakers predesigned the respective units and then subcontracted the production of the individual parts to their suppliers, and then assembled them again in-house. This changing division of labour among producers, and in particular their first-tier providers, generated the need for manufacturers to leverage their suppliers' quality systems and production processes to achieve efficiency. As a result, cooperation and long-term partnership between SC members have grown [Thoméet al., 2014].

Faced with challenging upstream logistics and extremely unpredictable demand, collaboration among automotive supply chain members has become a key success factor. This means that the actors in the supply chain, from design to delivery, must collaborate to deliver high-performance logistics services.

In a global market marked by fierce competition, SCIS are becoming essential tools for companies to improve SCM practices in the Moroccan automotive industry. In this regard, the integration of interorganizational information technology is increasingly taking a central place in the automotive Supply Chain. This research seeks to address the potential impact of SCIS on the trust, SC collaboration, SC agility, and performance of the automotive SC in Morocco. In other terms, the question of this research can be formulated as follows: How do information systems contribute to the performance of the automotive supply chain?

This article is structured in the following sections. The first section contains a literature review. The methodology is considered in Section 2. Then, Section 3 is devoted to reporting research findings. Lastly, Section 4 provides discussions and conclusions, highlighting implications, limitations, and perspectives for future studies.

LITERATURE

The automotive supply chain is characterized by the presence of two types of operations: upstream logistics, which serves to supply manufacturing plants, and downstream logistics, which deals with the management of flows between manufacturing plants and the points of sale. Clearly, production sites represent the central point where two logistics issues converge. Upstream, managing production forecasts with precision, in order to guarantee the supply of the factories at all times and at the lowest cost. Downstream, to ensure the delivery of the car to the end customer under the best conditions (cost, quality, lead time, etc.).

Supply chain information system (SCISI)

The functioning of the Supply Chain is based on the complementarity between two kinds of integration: interfunctional and inter-organizational integration. The first revolves around the integration of all logistics processes from upstream to downstream [Tyndallet al., 1998]. Whereas, the second is built around a series of relationships between partner organizations that reciprocally share information, risks, and rewards that lead to the achievement of competitive advantage [Cooper & Ellram, 1993].

For the proper management of logistics operations, enterprises opt for a multitude of information technology systems [Gunasekaranet et al., 2017], such as enterprise resource planning systems (ERP), warehouse management systems (WMS), transport management systems (TMS), and electronic data interchange (EDI). In the present study, we argued that SCIS represent an interorganizational information system, allowing to support cross-border processes within an enterprise (Fig. 1).

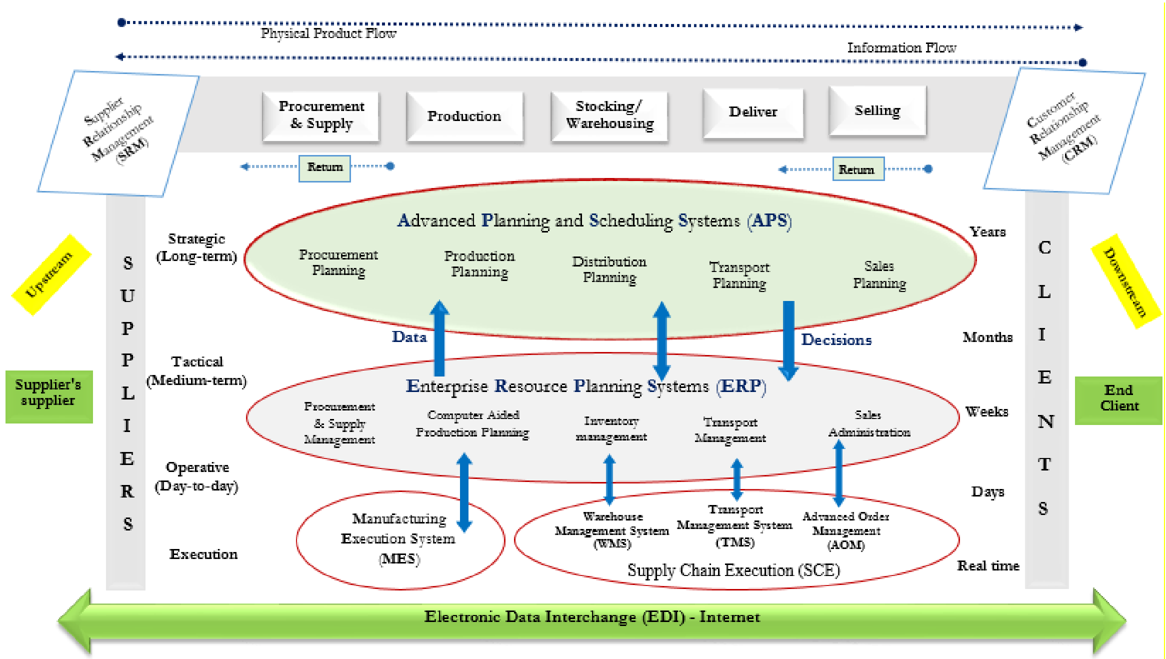

Fig. 1. A framework of IS used in supply chain [Boubker, 2022, p. 61].

The literature has debated the benefits of information technology in the supply chain [Khalid & Omar, 2016]. Information technologies are an essential element to help the supply chain meet changing business demands by reducing overall costs and providing better quality [DeGroote & Marx, 2013]. For example, APS serves as a strategic tool that offers enterprises a solution to achieve several goals at a reasonable cost, in terms of both quality and response time [Jamruset al., 2020]. The ERP system enables the automation of business processes, in turn increasing efficiency and reducing costs for the firm [Oghaziet al., 2018]. RFID technology represents a strategic tool to improve supply chain performance [Ali & Haseeb, 2019]. The EDI system enables coordination among SC partners, which in turn may improve performance and increases the company's competitiveness [Hill & Scudder, 2009]. As explained above, SCIS tools have been identified as an important factor in improving supply chain management practices.

Supply chain information system infrastructure (SCISI)

A large and growing literature has investigated the role of SCIS infrastructure in SC management. Previous studies revealed that the integration of the information system plays an important factor in ensuring a smooth operation of the supply chain by enabling its integration [Liet al., 2009]. IT can also improve the level of interorganizational trust [Chen, 2019], and SC agility [García-Alcaraz et al., 2020; Swaffordet al., 2008]. In sum, technologies facilitate the collection, storage, sharing, and analysis of data [Swafford et al., 2008].

Furthermore, IT integration helps to increase trust among SC members and foster SC agility. For instance [Chen, 2019] put that IT integration into SC contributes to improving the level of interorganizational trust and SC agility. Therefore, we formulate the following hypotheses.

H_1. SCISI has a positive and direct relationship with IOT.

H_2. SCISI has a positive and direct relationship with SCA.

Information sharing (ISSC)

Scientists argued that the use of information technology in SC fosters information sharing [Kim & Chai, 2017]. EDI systems facilitate the exchange of data within the supply chain, allowing the alignment of relationships between partners [Choon Tanet al., 2010]. Information sharing represents a readiness to make strategic and tactical data (e.g., orders, stock levels, forecasts, sales promotion, etc.) available to all supply chain members [Cao & Zhang, 2013b].

In addition, information sharing in SC ensures enterprise survival and facilitate SC integration [Lotfiet al., 2013]. Information sharing provides critical benefits to supply chain members [Kumar & Kushwaha, 2018]. Kim and Chai [2017] argue that information sharing contributes to improved supply chain agility. The IT capacity provides infrastructure for communication and information sharing that promotes collaborative practices within the SC [Fawcettet al., 2011].

The exchange of information among providers and producers can be helpful in responding to uncertainties in the external business environment [Zhou & Li, 2020]. It is inconceivable to ensure coordination between SC members without information sharing [Chen, 2003]. As Fawcett et al. [2011] indicate, a culture focused on information sharing is likely to improve collaboration within the supply chain, contributing to improving operational performance [Fawcett et al., 2011]. Information sharing also promotes SC collaboration and SC integration, and therefore leads to improved supply chain agility [Braunscheidel & Suresh, 2009]. Based on a study among manufacturing companies in India [Afshan, Chatterjee, & Chhetri, 2018] revealed that information sharing and the quality of information significantly affect SC collaboration. Likewise, secure sharing of information improve the level of trust and effective collaboration between SC partners [Panahifaret al., 2018]. From these previous empirical studies, the following hypotheses can be supposed:

H_3. ISSC has a positive and direct relationship with IOT.

H_4. ISSC has a positive and direct relationship with SCC.

Interorganizational trust (IOT)

In recent years, there has been considerable academic and practical interest in the topic of inter-organizational trust [Seppänen et al., 2007]. This concept is defined as "*the extent to which a firm subjectively believes that supply chain partners will perform work and transactions based on its confident expectations, regardless of its ability to check on behaviour or monitor them*" [Cao & Zhang, 2013a, p. 45].

Previous studies have confirmed that trust and technology have a positive and meaningful influence on supply chain collaboration and operational performance [Salam, 2017]. Trust leads to improving the level of collaboration in the supply chain [Panahifar et al., 2018; Uca et al., 2018]. Furthermore, interorganizational trust is an antecedent for commitment, which in turn leads to collaboration among supply chain partners [Afshan et al., 2018]. Likewise, improving the level of trust contributes to improving SC agility [Chen, 2019]. Hence, we assume the following hypothesis:

H_5. IOT has a positive and direct relationship with automotive SCA.

H_6. IOT has a positive and direct relationship with automotive SCC.

Supply chain agility (SCA), SC collaboration (SCC), and SC performance (SCP)

Many studies have identified a number of SC performance predictors [Asamoah et al., 2021; Chandak et al., 2021], including SC agility [García-Alcaraz et al., 2017; Swafford et al., 2008] and SC collaboration [Mofokeng & Chinomona, 2019].

SC agility refers to the response ability of the SC to changing business environments in due course [Al Humdan al., 2020; Kim & Chai, 2017; Shukor al., 2020]. Agility refers to "*ability of an organization's internal supply chain functions to provide a strategic advantage by responding to marketplace uncertainty*" [Khan & Pillania, 2008, p. 1511]. SC agility can generate business performance [Yusuf et al., 2014], sales growth, profitability, market share, timeliness, and client service [DeGroote & Marx, 2013]. In addition, SC agility improves client value and satisfaction [Gligor et al., 2020] and improve firm performance [Chan et al., 2017]. From the above studies, it is possible to hypothesize that:

H_7. SCA has a positive and direct relationship with automotive SCP.

SC collaboration refers to "*a long-term partnership process where supply chain partners with common goals work closely together to achieve mutual advantages that are greater than the firms would achieve individually*" [Cao al., 2010, p. 6617]. It is recognized that SC partnership, SC collaboration, and integration positively and directly influence SC performance [Mofokeng & Chinomona, 2019]. Likewise, effective collaboration enables SC partners to reduce delivery time, develop distinctive capabilities, improve flexibility, increase client satisfaction, and expand market share and profits [Kumar al., 2017]. Hence, we suggest these hypotheses:

H_8. SCC has a positive and direct relationship with automotive SCP.

The proposed conceptual model includes two independent variables, SCIS infrastructure and information sharing in SC, and four dependent variables, interorganizational trust, SC agility, SC collaboration and SC performance (**Fig. 2**).

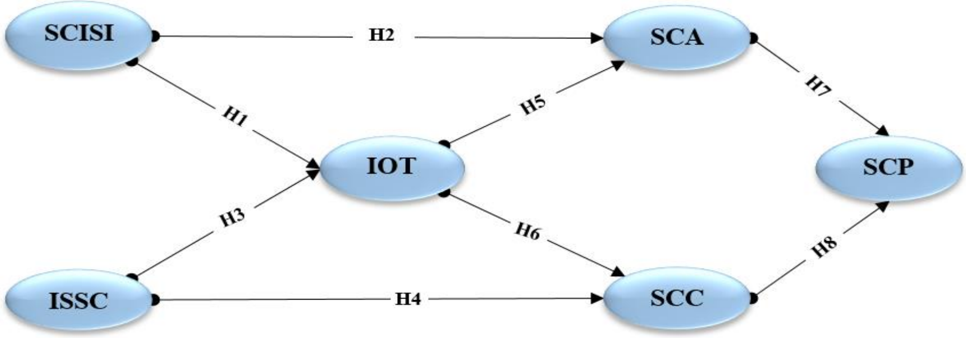

Fig. 2. Proposed research model.

METHODS

The Kingdom of Morocco constitutes a significant manufacturing and export platform for the automobile industry. This sector is a pillar of the Moroccan economy, with many international companies investing in industrial zones, such as the Kenitra Atlantic Free Zone, Tanger Automotive City and Tangier-Free Zone.

Constructs operationalization

The measures used in the current study were selected from the existing literature (Table 1). According to Sundram et al. [2018], SCIS infrastructure has been evaluated using five items. Referring to the study of Kim and Chai [2017], we chose 12 items to measure information sharing in the SC (SCIS). Interorganizational trust (IOT) was measured through six items [Salam, 2017]. SC collaboration (SCC) was measured using five items [Wu & Chiu, 2018]. To measure the agility of SC (SCA), we mobilize the Kim and Chai [2017] scale. Finally, SC performance (SCP) was assessed using six items chosen from Qrunfleh and Tarafdar [2014]. All latent variables were scored according to a seven-point Likert scale, ranging from 1 (total disagreement) to 7 (total agreement).

Table 1. Constructs and measurement items.

Variables	N. of items	Author
SC information system infrastructure (SCISI)	5 items	Sundram et al. [2018]
Information sharing in SC (ISSC)	12 items	Kim and Chai, [2017]
Inter-organizational trust (IOT)	6 items	Salam, [2017]
SC collaboration (SCC)	5 items	Wu and Chiu, [2018]
SC Agility (SCA)	8 items	Kim and Chai, [2017]
SC performance (SCP)	6 items	Qrunfleh and Tarafdar [2014]

Method of data collection and sample size

The sampling frame was composed of a sample of automotive supply chain partners. Because a database of all firms operating in the Moroccan automotive industry is unavailable, we employed a nonprobabilistic method to select the study sample.

This research was implemented in two rounds. As a first step and in order to ensure the relevance of the questionnaire's content, a pilot test of the questionnaire elements was carried out through telephone interviews with two academics and three logistics managers. As a second step, the survey was conducted through a web-based survey between December 2020 and January 2021.

The survey instrument includes two main sections. The first section is devoted to gathering data on the sociodemographic characteristics of the respondents. In the second section, we collect data regarding the latent variables of the conceptual model.

Data analysis method

Regarding the data processing methodology (**Fig. 3),** we used the PLS-SEM method. This decision is motivated by the suitability of this approach to testing complex models, which provides a strong degree of statistical significance using a smaller sample size [Bayonne et al., 2020]. Furthermore, the data set was processed using SmartPLS 3 software [Ringle et al., 2015].

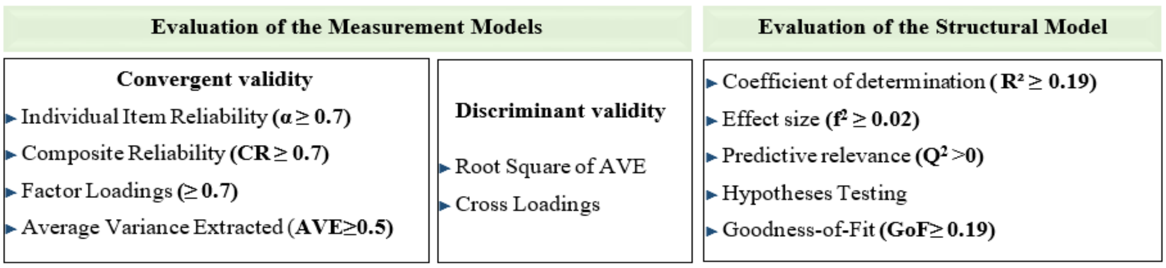

Fig. 3. Stages of data processing [Boubker et al., 2021, p. 7].

FINDINGS

Descriptive analysis

The dataset was compiled by 31 participants from the Moroccan automotive industry, including logistics manager (19.4%), supply planning manager (16.1 percent), logistics customer service manager (12.9%), logistics coordinator (9.7 percent), supply chain manager (9.7%), logistics supervisor (6.5 percent), purchasing managers (6.5%), supply manager (6.5%), demand and supply planner (3.2 percent), logistics director (3.2%), logistics project manager (3.2 percent), and supply chain project managers (3.2 percent). The average age of the respondents is 33 years. Regarding the educational level of the survey participants, 71% held a master's degree (BAC+5), 19.4% had a bachelor's degree (BAC+3), and 6.5% held a Ph.D. Furthermore, more than 70 percent of the theme have gained more than three years of work experience (Table 2).

Based on descriptive statistics, it can be observed that study participants use several IT tools dedicated to SC management in the Moroccan automotive industry, including APS systems, ERP systems (SAP, AS400 and Oracle), EDI, TMS, WMS, SRM, and CRM (Fig. 4).

Results of outer models assessment

The outer models' assessment results provide evidence that the values of all criteria meet scientific standards. The external loading values are all higher than 0.7 (**Fig. 5**), supporting a significant contribution to the model constructs.

Table 2. Study participants' characteristics.

Measure	Category	Percentage
Gender	Female	12.9%
	Male	87.1%
Job Title	Logistics Manager	19.4%
	Supply Planning Manager	16.1%
	Logistics Customer Service Manager	12.9%
	Logistics Coordinator	9.7%
	Supply Chain Manager	9.7%
	Logistics Supervisor	6.5%
	Purchasing Manager	6.5%
	Supply Manager	6.5%
	Demand & Supply Planner	3.2%
	Logistics Director	3.2%
	Logistics Project Manager	3.2%
	Supply Chain Project Manager	3.2%
Education Level	BAC+3 (Bachelor)	19.4%
	BAC+5 (Master degree)	71.0%
	MBA (Master of Business Administration)	3.2%
	BAC+8 (PhD)	6.5%
Work experience	1-3 years	25.8%
	3-5 years	22.6%
	5-7 years	12.9%
	Above 7 years	38.7%

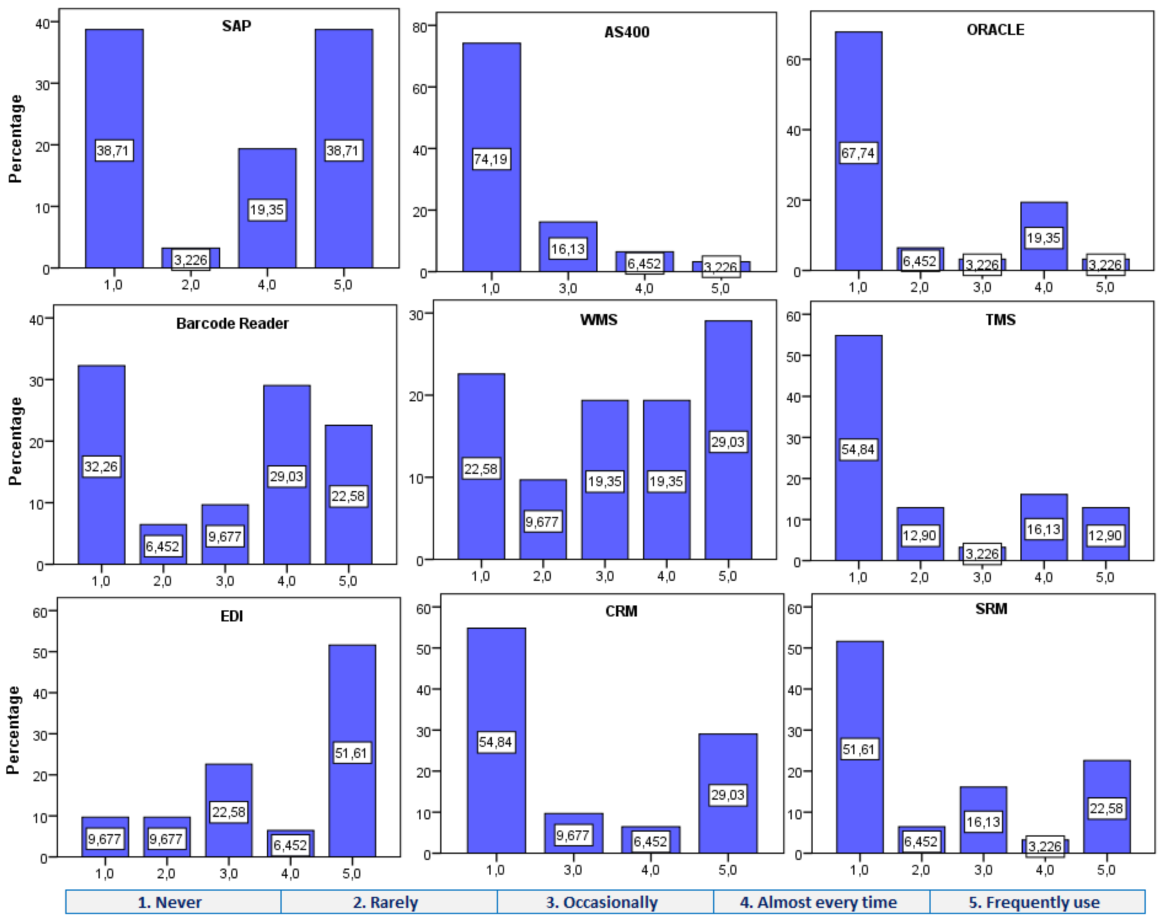

Fig. 4. IT used by the companies surveyed.

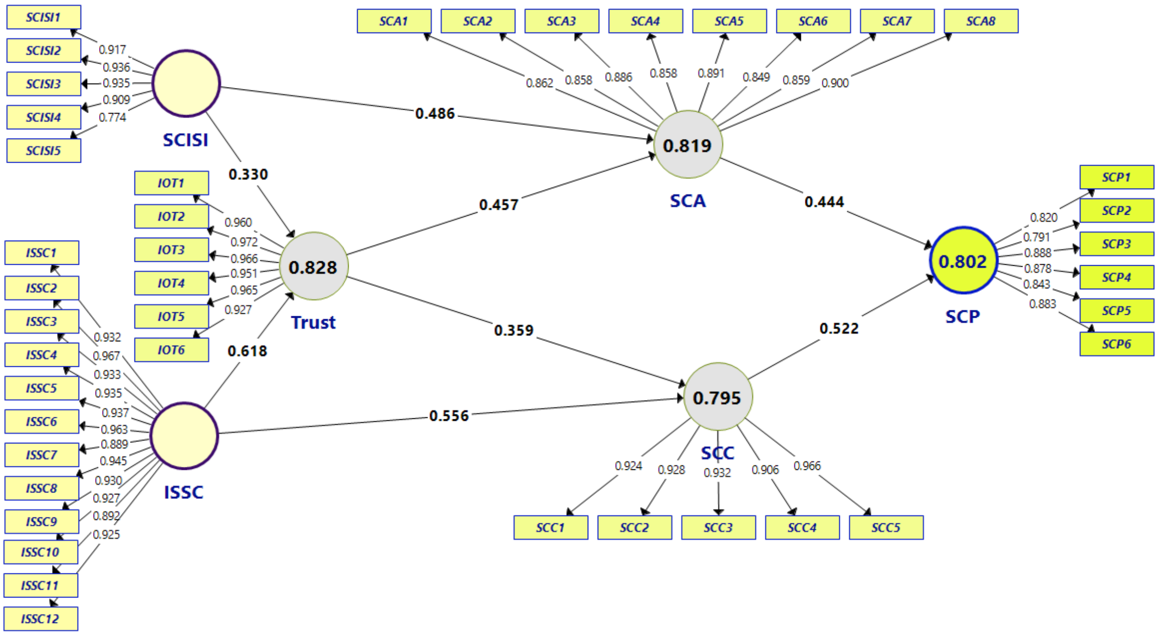

Fig. 5. Measurement model validation.

The AVEs values are all larger than 0.5, meaning that all latent constructs at least provide an explanation of fifty percent of their items' variance [Hair et al., 2019]. Furthermore, both the scale reliability (α) and composite reliability scores are higher than 0.7. Consequently, these results reveal a high degree of convergent validity of the outer model [Boubker et al., 2022]. In addition, the discriminant validity is checked using the Fornell and Larcker criterion (Table 3). Similarly, discriminant validity of the outer models is achieved using the cross-loading criteria (Table 4).

Table 3. Reflective evaluation of the outer model assessment.

Construct	α	CR	rho_A	AVE	ISSC	SCA	SCC	SCISI	SCP	IOT
ISSC	0.986	0.987	0.987	0.867	**0.931**					
SCA	0.954	0.955	0.962	0.758	0.799	**0.871**				
SCC	0.962	0.962	0.970	0.868	0.877	0.718	**0.931**			
SCISI	0.937	0.943	0.953	0.803	0.827	0.870	0.614	**0.896**		
SCP	0.925	0.933	0.940	0.725	0.708	0.818	0.841	0.657	**0.851**	
Trust	0.982	0.982	0.985	0.916	0.891	0.866	0.855	0.841	0.826	**0.957**

Results of assessing inner model

The findings listed in **Fig. 6** support that the R2 values for the four endogenous constructs, trust, SCA, SCC, and SCP are greater than 0.75, which are 0.828, 0.819, 0.795, and 0.802, respectively, demonstrating a robust degree of determination of these variables. It is widely recognised that f^2 values exceeding 0.35, 0.15 and 0.02 are deemed strong, moderate, and weak effect size, respectively [Cohen, 1988]. Accordingly, f^2 of SCIS infrastructure on interorganizational trust, and SC agility are 0.200, and 0.381, meaning that their effect sizes were moderate and strong. Moreover, f^2 of information sharing in SC on interorganisational trust and SC collaboration are strong (0.702) and moderate (0.312). Furthermore, the effect size values of inter-organizational trust on SC agility, and SC collaboration are strong (0.337) and weak (0.130). The f^2 value of the SC agility in SC performance is 0.481, reflecting a large effect size. Lastly, f square of SC collaboration on SC performance is strong (0.666). Furthermore, all Q^2 scores were above zero, showing strong predictive relevance [Hair et al., 2011]. Finally, the calculated GoF value is higher than 0.36, reflecting a great goodness-of-fit of the model [Henseler et al., 2009].

Table 4. Discriminant validity according to cross-loading criteria.

	ISSC	SCA	SCC	SCISI	SCP	IOT
ISSC1	**0.932**	0.742	0.870	0.698	0.695	0.810
ISSC2	**0.967**	0.772	0.916	0.744	0.760	0.871
ISSC3	**0.933**	0.729	0.800	0.802	0.610	0.835
ISSC4	**0.935**	0.747	0.896	0.750	0.730	0.862
ISSC5	**0.937**	0.739	0.835	0.729	0.634	0.765
ISSC6	**0.963**	0.831	0.822	0.862	0.692	0.879
ISSC7	**0.889**	0.716	0.675	0.842	0.493	0.796
ISSC8	**0.945**	0.801	0.769	0.832	0.649	0.887
ISSC9	**0.930**	0.692	0.817	0.752	0.663	0.836
ISSC10	**0.927**	0.764	0.747	0.829	0.650	0.809
ISSC11	**0.892**	0.633	0.791	0.682	0.644	0.781
ISSC12	**0.925**	0.760	0.833	0.735	0.669	0.818
SCA1	0.661	**0.862**	0.621	0.739	0.700	0.774
SCA2	0.684	**0.858**	0.654	0.736	0.725	0.791
SCA3	0.669	**0.886**	0.543	0.777	0.608	0.754
SCA4	0.691	**0.858**	0.627	0.765	0.634	0.741
SCA5	0.791	**0.891**	0.710	0.782	0.794	0.782
SCA6	0.670	**0.849**	0.667	0.688	0.805	0.717
SCA7	0.699	**0.859**	0.582	0.782	0.695	0.715
SCA8	0.694	**0.900**	0.586	0.794	0.720	0.752
SCC1	0.883	0.706	**0.924**	0.676	0.733	0.874
SCC2	0.755	0.635	**0.928**	0.503	0.808	0.762
SCC3	0.733	0.604	**0.932**	0.496	0.840	0.774
SCC4	0.813	0.708	**0.906**	0.578	0.763	0.771
SCC5	0.894	0.690	**0.966**	0.601	0.772	0.798
SCISI1	0.741	0.730	0.440	**0.917**	0.415	0.713
SCISI2	0.809	0.797	0.662	**0.936**	0.698	0.837
SCISI3	0.772	0.823	0.569	**0.935**	0.679	0.764
SCISI4	0.817	0.811	0.664	**0.909**	0.636	0.828
SCISI5	0.537	0.733	0.375	**0.774**	0.485	0.600
SCP1	0.806	0.911	0.738	0.800	**0.820**	0.834
SCP2	0.289	0.407	0.601	0.156	**0.791**	0.422
SCP3	0.631	0.824	0.670	0.679	**0.888**	0.731
SCP4	0.731	0.772	0.786	0.742	**0.878**	0.839
SCP5	0.553	0.520	0.798	0.387	**0.843**	0.640
SCP6	0.467	0.609	0.666	0.401	**0.883**	0.640
IOT1	0.863	0.851	0.823	0.827	0.783	**0.960**
IOT2	0.839	0.832	0.783	0.849	0.767	**0.972**
IOT3	0.860	0.861	0.754	0.851	0.745	**0.966**
IOT4	0.853	0.800	0.857	0.759	0.804	**0.951**
IOT5	0.809	0.794	0.840	0.757	0.811	**0.965**
IOT6	0.888	0.831	0.851	0.784	0.834	**0.927**

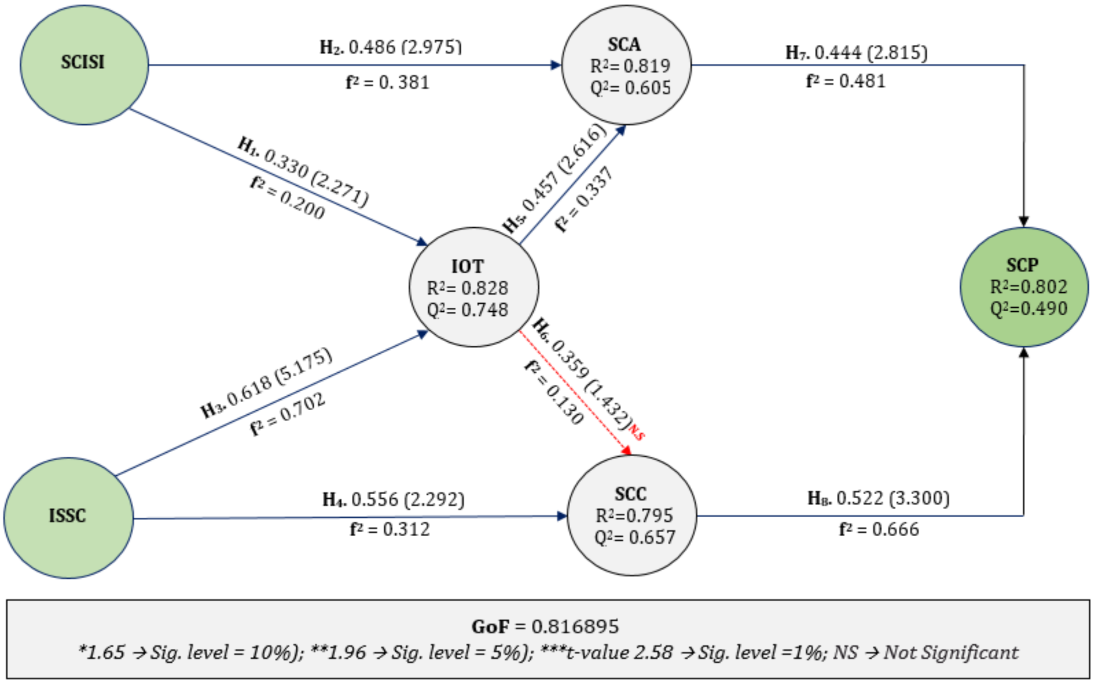

Fig. 6. Results of the model testing.

Based on the PLS-SEM outputs, seven hypothesised relationships were supported, and only one hypothesis was rejected. Thus, H1 was supported (β= 0.330, t = 2.271; p = 0.007), demonstrating a positive influence of the SCIS infrastructure on inter-organizational trust (Fig. 7). The second hypothesis, which stated the positive influence of the SCIS infrastructure on the agility of automotive SC, was found to be statistically significant (β= 0.486; t = 2.975; p = 0.003).

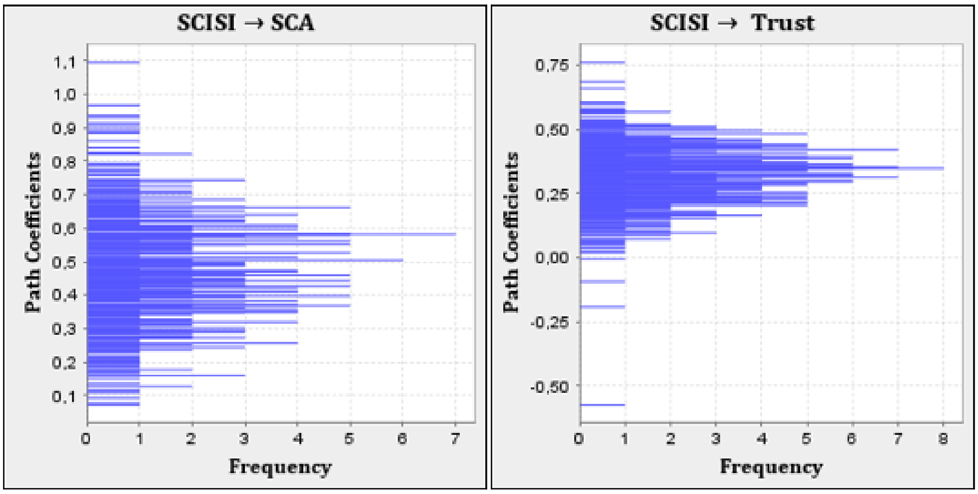

Fig. 7. Path coefficients of SCISI on SCA and IOT - Output SmartPLS.

The findings also supported the third and the fourth hypothesis (Fig. 8), indicating a significant, positive and direct association between information sharing in SC, and inter-organizational trust (β = 0.618; t = 5.175; p = 0.000), and automotive SC collaboration (β = 0.556; t = 2.292; p = 0.022).

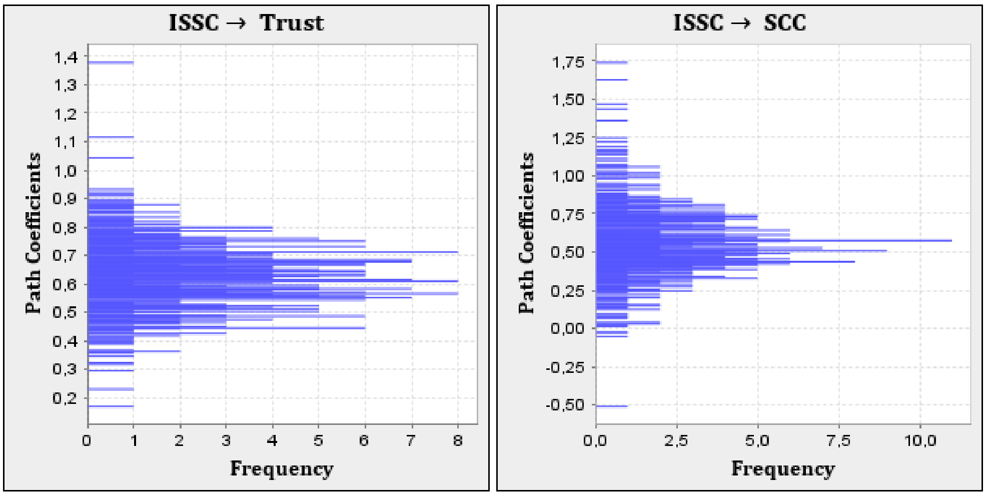

Fig. 8. Path coefficients of ISSC in IOT and SCC - Output SmartPLS.

The fifth hypothesis has also been accepted, indicating a significant association between organizational trust on automotive SC agility ($\beta = 0.457$; $t = 2.616$; $p = 0.009$). The sixth hypothesis, which claims a positive correlation interorganizational trust and automotive SC collaboration, is statistically not significant ($t = 1.432$; $p = 0.153$), which allows us to reject this hypothesis (**Fig. 9**).

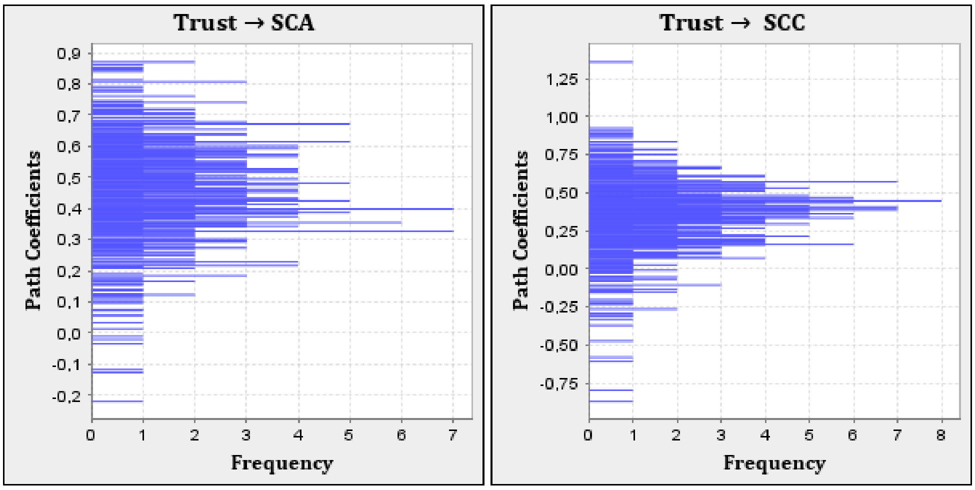

Fig. 9. Path coefficients of IOT on SCA and SCC - Output SmartPLS.

From the PLS analysis (**Fig. 10**), it turns out that automotive SC agility positively and significantly affects automotive SC performance (H_7. $\beta = 0.444$; $t = 2.815$; $p = 0.005$). Finally, the relationship between SC collaboration and automotive SC performance also receives support from our results (H_8. $\beta = 0.522$; $t = 3.300$; $p = 0.001$).

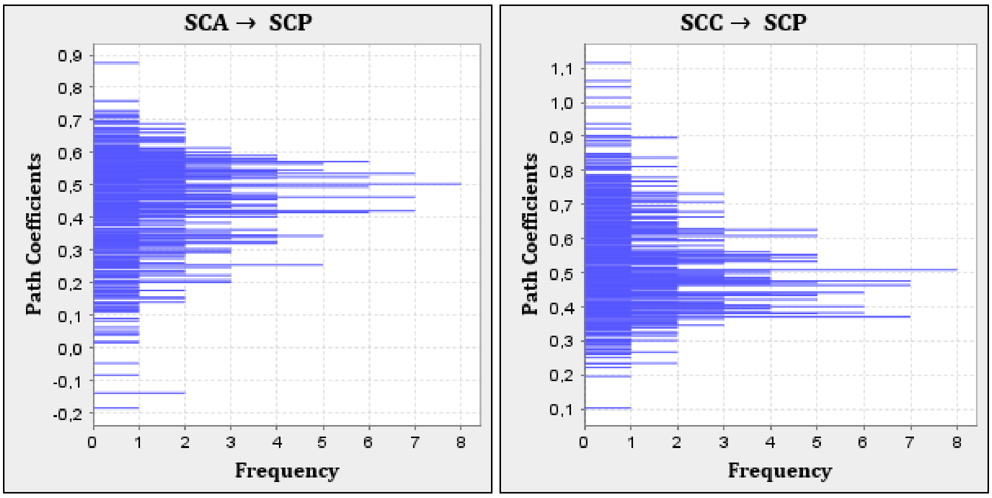

Fig. 10. Path coefficients of SCA and SCC on SCP - Output SmartPLS.

DISCUSSIONS AND CONCLUSIONS

The focus of the current research was to empirically explore the antecedents of SC performance in the Moroccan automotive industry. By employing PLS-SEM, the study findings confirm the positive effect of the SCIS infrastructure in ensuring trust between automotive SC members, and contribute to raising SC's agility level. In other words, automotive SC partners who invested in the SCIS infrastructure (barcode and RFID tags, electronic data interchange) can achieve a significant return on their investment, which strengthens trust among SC members, and further promotes SC agility. These findings were found to be in line with earlier empirical investigations, implying that IT integration helps to build interorganizational trust between SC members [Chen, 2019], and to improve the level of SC agility [García-Alcaraz et al., 2020; Swafford et al., 2008]. With an empirical study of 204 Taiwanese manufacturing firms, Chen [Chen, 2019] showed that IT integration and trust between SC partners strongly improve SC agility and innovation, helping to enhanced company's competitive advantage of the company.

Moreover, information sharing has been shown to reinforce interorganizational trust and to foster collaborative efforts among automotive SC partners. This means that a strategy focused on information sharing and continuous communication between SC actors represents a powerful way to establish interorganizational trust, leading to stronger interorganizational collaboration. As suggested by previous research, secure information sharing among SC partners is a determinant of interorganizational trust and collaboration [Panahifar et al., 2018]. For Indian manufacturing firms, information sharing and its quality were identified as appropriate solutions to increase SC's collaboration level [Afshan et al., 2018]. Furthermore, the results support the positive impact of trust between SC members on the agility of automotive SC. The proof of this hypothesis is consistent with prior studies. For example, Chen [2019] concluded that improving the level of trust between SC partners contributes to improving the level of SC agility.

In contrast to past studies, which highlighted the existence of a positive and indirect link between trust and collaboration [Uca et al., 2018], our findings testify to the lack of a link between trust and collaboration among automotive SC partners.

The findings confirmed the positive effect of SC agility and collaboration between automotive SC partners on automotive SC performance. In this regard, automotive SC parties using practices related to process or product design, and implementation of communication plans, as well as frequent interactions in problem situations, can reap an improved level of performance of the entire supply chain. These results are consistent with previous studies. For example, the study of Blome et al. [2013] carried out with 121 SC professionals shows the presence of a positive link between agility and operational performance. A more recent study showed that collaboration between SC partners improves performance [Mofokeng & Chinomona, 2019].

Implication for theory

In sum, the findings demonstrate that SCIS infrastructure and information sharing provide a basis for enhancing the level of interorganizational trust, collaboration and agility in the automotive SC. Similarly, collaboration and agility also contribute to the explanation of the performance of the automotive SC. Consequently, the current study added value to the literature on SC management. Consequently, the key implication for theory consists in proposing a model specifically appropriate for the context of automotive SC in a developing country, allowing a better understanding of key drivers of SC performance in a particular context.

Implication for practitioners

This research offers certain implications for the practice. The findings highlighted that SCIS infrastructure plays a central role in fostering SC agility and interorganizational trust. In the same way, information sharing between automotive SC members helps to foster interorganizational trust and SC collaboration. Accordingly, we suggest that trust among SC participants should be fostered to achieve agility of the SC, by being able to react to demand fluctuations without overstocking or lost sales, and achieving SC performance.

Another way to improve automotive SC performance consists in ensuring a highest degree of interorganizational collaboration in the automotive industry, by building effective collaborative practices such as designing processes or products, implementing operational activities, and keeping frequent interactions when logistics problems occur.

Furthermore, this study provides automotive SC managers with more understanding of the ways in which SCIS infrastructure, information sharing, trust, SC collaboration, and SC agility can influence SC performance. Hence, automotive SC managers looking to increase SC performance can use these research findings to justify investments in SCIS infrastructure and technologies, i.e., SAPS, ERP, MES, SCE, EDI, barcode, RFID tags.

Study limitations and perspectives

While the current study has provided some valuable practical and theoretical implications, some limitations are present that might be considered in future studies. First, the sample size was smaller than expected, which prevents generalization of the findings. Consequently, increasing the sample size constitutes a recommendation for future work to remedy this limitation. Second, the measurement scales adopted in this research are derived from previous empirical work, without being adapted to the automotive industry. Therefore, a promising direction for future research concerns using an exploratory qualitative approach among automobile company managers, to build measures specifically to the Moroccan automobile industry. Lastly, the implications of the current study are applicable only to the automotive industry. As a future direction, the empirical study can be extended to other sectors, such as the pharmaceutical and aerospace industries in Morocco, in order to generalize the results to these sectors.

ACKNOWLEDGMENTS

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

Afshan, N., Chatterjee, S., & Chhetri, P., 2018. Impact of information technology and relational aspect on supply chain collaboration leading to financial performance : A study in Indian context. *Benchmarking: An International Journal*, *25*(7), 2496-2511. https://doi.org/10.1108/BIJ-09-2016-0142

Al Humdan, E., Shi, Y., & Behnia, M., 2020. Supply chain agility : A systematic review of definitions, enablers and performance implications. *International Journal of Physical Distribution & Logistics Management*, *50*(2), 287-312. https://doi.org/10.1108/IJPDLM-06-2019-0192

Ali, A., & Haseeb, M., 2019. Radio frequency identification (RFID) technology as a strategic tool towards higher performance of supply chain operations in textile and apparel industry of Malaysia. *Uncertain Supply Chain Management*, *7*(2), 215-226. http://dx.doi.org/10.5267/j.uscm.2018.10.004

Asamoah, D., Agyei-Owusu, B., Andoh-Baidoo, F. K., & Ayaburi, E., 2021. Inter-organizational systems use and supply chain performance : Mediating role of supply chain management capabilities. *International Journal of Information Management*, *58*, 102195. https://doi.org/10.1016/j.ijinfomgt.2020.102195

Bayonne, E., Marin-Garcia, J. A., & Alfalla-Luque, R., 2020. Partial least squares (PLS) in Operations Management research : Insights from a systematic literature review. *Journal of Industrial Engineering and Management*, *13*(3), 565. https://doi.org/10.3926/jiem.3416

Blome, C., Schoenherr, T., & Rexhausen, D., 2013. Antecedents and enablers of supply chain agility and its effect on performance : A dynamic capabilities perspective. *International Journal of Production Research*, *51*(4), 1295-1318. https://doi.org/10.1080/00207543.2012.728011

Boubker, O., 2022. The effects of information technologies on automotive supply chain and firm performance. *Logforum*, *18*(1), 59-73. https://doi.org/10.17270/J.LOG.2022.641

Boubker, O., Douayri, K., & Ouajdouni, A., 2021. Factors affecting intention to adopt Islamic financing : Evidence from Morocco. *MethodsX*, *8*, 101523. https://doi.org/10.1016/j.mex.2021.101523

Boubker, O., Naoui, K., Ouajdouni, A., & Arroud, M. (2022). The effect of action-based entrepreneurship education on intention to become an entrepreneur. *MethodsX*, 9, 101657. https://doi.org/10.1016/j.mex.2022.101657

Boysen, N., Emde, S., Hoeck, M., & Kauderer, M., 2015. Part logistics in the automotive industry : Decision problems, literature review and research agenda. *European Journal of Operational Research*, *242*(1), 107-120. https://doi.org/10.1016/j.ejor.2014.09.065

Braunscheidel, M. J., & Suresh, N. C., 2009. The organizational antecedents of a firm's supply chain agility for risk mitigation and response. *Journal of Operations Management*, *27*(2), 119-140. https://doi.org/10.1016/j.jom.2008.09.006

Cao, M., Vonderembse, M. A., Zhang, Q., & Ragu-Nathan, T. S., 2010. Supply chain collaboration : Conceptualisation and instrument development. *International Journal of Production Research*, *48*(22), 6613-6635. https://doi.org/10.1080/00207540903349039

Cao, M., & Zhang, Q., 2013a. Antecedents of Supply Chain Collaboration. *Supply Chain Collaboration*, 31-54. https://doi.org/10.1007/978-1-4471-4591-2_3

Cao, M., & Zhang, Q., 2013b. *Supply Chain Collaboration : Roles of Interorganizational Systems, Trust, and Collaborative Culture*. London: Springer-Verlag. https://doi.org/10.1007/978-1-4471-4591-2

Chan, A. T. L., Ngai, E. W. T., & Moon, K. K. L., 2017. The effects of strategic and manufacturing flexibilities and supply chain agility on firm performance in the fashion industry. *European Journal of Operational Research*, *259*(2), 486-499. https://doi.org/10.1016/j.ejor.2016.11.006

Chandak, A., Chandak, S., & Dalpati, A., 2021. Evaluation of Impact of Success Factors of Supply Chain Strategy and Flexibility on Supply Chain Performance. *Pakistan Journal of Statistics and Operation Research*, *17*(1), 185-194. https://doi.org/10.18187/pjsor.v17i1.2874

Chen, C.-J., 2019. Developing a model for supply chain agility and innovativeness to enhance firms' competitive advantage. *Management Decision*, *57*(7), 1511-1534. https://doi.org/10.1108/MD-12-2017-1236

Chen, F., 2003. Information Sharing and Supply Chain Coordination. In *Supply Chain Management: Design, Coordination and Operation*: *Vol. 11. Handbooks in Operations Research and Management Science* (p. 341-421). Elsevier. https://doi.org/10.1016/S0927-0507(03)11007-9

Choon Tan, K., Kannan, V. R., Hsu, C., & Keong Leong, G., 2010. Supply chain information and relational alignments : Mediators of EDI on firm performance. *International Journal of Physical Distribution & Logistics Management*, *40*(5), 377-394. https://doi.org/10.1108/09600031011052831

Cohen, J., 1988. *Statistical power analysis for the behavioral sciences* (2nd ed). Hillsdale, N.J: L. Erlbaum Associates. https://doi.org/10.4324/9780203771587

Cooper, M. C., & Ellram, L. M., 1993. Characteristics of Supply Chain Management and the Implications for Purchasing and Logistics Strategy. *The International Journal of Logistics Management*, *4*(2), 13-24. https://doi.org/10.1108/09574099310804957

DeGroote, S. E., & Marx, T. G., 2013. The impact of IT on supply chain agility and firm performance : An empirical investigation. *International Journal of Information Management*, *33*(6), 909-916. https://doi.org/10.1016/j.ijinfomgt.2013.09.001

Fawcett, S. E., Wallin, C., Allred, C., Fawcett, A. M., & Magnan, G. M., 2011. Information Technology as an Enabler of Supply Chain Collaboration : A Dynamic-Capabilities Perspective. *Journal of Supply Chain Management*, *47*(1), 38-59. https://doi.org/10.1111/j.1745-493X.2010.03213.x

Frigant, V., & Layan, J.-B., 2009. Géographie d'une industrie automobile modulaire : Le cas des équipementiers français en Europe de l'Est. *Revue d'Économie Régionale & Urbaine*, (4), 711-737. https://doi.org/10.3917/reru.094.0711

García-Alcaraz, J. L., Maldonado-Macías, A. A., Hernandez, G. A., Jiménez-Macías, E., Muro, J. C. S. D., & Blanco-Fernández, J., 2017. Impact of human factor on flexibility and supply chain agility of La Rioja wineries. *European Journal of Industrial Engineering*, *11*(5), 663-682. https://doi.org/10.1504/EJIE.2017.087703

García-Alcaraz, J. L., Martínez-Loya, V., Díaz-Reza, J. R., Blanco-Fernández, J., Jiménez-Macías, E., & López, A. J. G., 2020. Effect of ICT integration on SC flexibility, agility and company' performance : The Mexican maquiladora experience. *Wireless Networks*, *26*(7), 4805-4818. https://doi.org/10.1007/s11276-019-02068-6

Gligor, D., Bozkurt, S., Gölgeci, I., & Maloni, M. J., 2020. Does supply chain agility create customer value and satisfaction for loyal B2B business and B2C end-customers? *International Journal of Physical Distribution & Logistics Management*, *50*(7/8), 721-743. https://doi.org/10.1108/IJPDLM-01-2020-0004

Gunasekaran, A., Subramanian, N., & Papadopoulos, T., 2017. Information technology for competitive advantage within logistics and supply chains : A review. *Transportation Research Part E: Logistics and Transportation Review*, *99*, 14-33. https://doi.org/10.1016/j.tre.2016.12.008

Hahn, T., & Auktor, G. V., 2017. *The effectiveness of Morocco's industrial policy in promoting a national automotive industry*. Discussion Paper.

Hair, Joe F., Ringle, C. M., & Sarstedt, M., 2011. PLS-SEM : Indeed a Silver Bullet. *Journal of Marketing Theory and Practice*, *19*(2), 139-152. https://doi.org/10.2753/MTP1069-6679190202

Hair, Joseph F., Risher, J. J., Sarstedt, M., & Ringle, C. M., 2019. When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2-24. https://doi.org/10.1108/EBR-11-2018-0203

Henseler, J., Ringle, C. M., & Sinkovics, R. R., 2009. The use of partial least squares path modeling in international marketing. In R. R. Sinkovics & P. N. Ghauri (Éds.), *New Challenges to International Marketing* (p. 277-319). Emerald Group Publishing Limited. https://doi.org/10.1108/S1474-7979(2009)0000020014

Hill, C. A., & Scudder, G. D., 2009. Supply chain coordination using EDI with performance implications. *International Journal of Manufacturing Technology and Management*, *19*(1-2), 6-26. https://doi.org/10.1504/IJMTM.2010.029448

Jamrus, T., Wang, H.-K., & Chien, C.-F., 2020. Dynamic coordinated scheduling for supply chain under uncertain production time to empower smart production for Industry 3.5. *Computers & Industrial Engineering*, *142*, 106375. https://doi.org/10.1016/j.cie.2020.106375

Khalid, C., & Omar, B., 2016. *Evaluation of the contribution of logistics information systems to company's performance and processes maturity. A qualitative study experiment*. 129-149. Scopus.

Khan K, A., & Pillania, R. K., 2008. Strategic sourcing for supply chain agility and firms' performance : A study of Indian manufacturing sector. *Management Decision*, *46*(10), 1508-1530. https://doi.org/10.1108/00251740810920010

Kim, M., & Chai, S., 2017. The impact of supplier innovativeness, information sharing and strategic sourcing on improving supply chain agility : Global supply chain perspective. *International Journal of Production Economics*, *187*, 42-52. https://doi.org/10.1016/j.ijpe.2017.02.007

Kumar, A., & Kushwaha, G. S., 2018. Supply chain management practices and operational performance of fair price shops in India: an empirical study. *Logforum*, *14*(1), 85-99. https://doi.org/10.17270/J.LOG.2018.237

Kumar, G., Banerjee, R. N., Meena, P. L., & Ganguly, K. K., 2017. Joint planning and problem solving roles in supply chain collaboration. *IIMB Management Review*, *29*(1), 45-57. https://doi.org/10.1016/j.iimb.2017.03.001

Li, G., Yang, H., Sun, L., & Sohal, A. S., 2009. The impact of IT implementation on supply chain integration and performance. *International Journal of Production Economics*, *120*(1), 125-138. https://doi.org/10.1016/j.ijpe.2008.07.017

Lotfi, Z., Mukhtar, M., Sahran, S., & Zadeh, A. T., 2013. Information Sharing in Supply Chain Management. *Procedia Technology*, *11*, 298-304. https://doi.org/10.1016/j.protcy.2013.12.194

Mofokeng, T. M., & Chinomona, R., 2019. Supply chain partnership, supply chain collaboration and supply chain integration as the antecedents of supply chain performance. *South African Journal of Business Management*, *50*(1), 1-10. https://doi.org/10.4102/sajbm.v50i1.193

Oghazi, P., Fakhrai Rad, F., Karlsson, S., & Haftor, D., 2018. RFID and ERP systems in supply chain management. *European Journal of Management and Business Economics*, *27*(2), 171-182. https://doi.org/10.1108/EJMBE-02-2018-0031

Panahifar, F., Byrne, P. J., Salam, M. A., & Heavey, C., 2018. Supply chain collaboration and firm's performance : The critical role of information sharing and trust. *Journal of Enterprise Information Management*, *31*(3), 358-379. https://doi.org/10.1108/JEIM-08-2017-0114

Qrunfleh, S., & Tarafdar, M., 2014. Supply chain information systems strategy : Impacts on supply chain performance and firm performance. *International Journal of Production Economics*, *147*, 340-350. https://doi.org/10.1016/j.ijpe.2012.09.018

Ringle, C. M., Wende, S., & Becker, J.-M., 2015. SmartPLS 3. SmartPLS GmbH, Boenningstedt. *J. of Serv. Sci. and Managm*, *10*(3).

Salam, M. A., 2017. The mediating role of supply chain collaboration on the relationship between technology, trust and operational performance : An empirical investigation. *Benchmarking: An International Journal*, *24*(2), 298-317. https://doi.org/10.1108/BIJ-07-2015-0075

Seppänen, R., Blomqvist, K., & Sundqvist, S., 2007. Measuring inter-organizational trust—A critical review of the empirical research in 1990–2003. *Industrial Marketing Management*, *36*(2), 249-265. https://doi.org/10.1016/j.indmarman.2005.09.003

Shukor, A. A. A., Newaz, Md. S., Rahman, M. K., & Taha, A. Z., 2020. Supply chain integration and its impact on supply chain agility and organizational flexibility in manufacturing firms. *International Journal of Emerging Markets*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/IJOEM-04-2020-0418

Sundram, V. P. K., Bahrin, A. S., Abdul Munir, Z. B., & Zolait, A. H., 2018. The effect of supply chain information management and information system infrastructure : The mediating role of supply chain integration towards manufacturing performance in Malaysia. *Journal of Enterprise Information Management*, *31*(5), 751-770. https://doi.org/10.1108/JEIM-06-2017-0084

Swafford, P. M., Ghosh, S., & Murthy, N., 2008. Achieving supply chain agility through IT integration and flexibility. *International Journal of Production Economics*, *116*(2), 288-297. https://doi.org/10.1016/j.ijpe.2008.09.002

Thomé, A. M. T., Scavarda, L. F., Pires, S. R. I., Ceryno, P., & Klingebiel, K., 2014. A multi-tier study on supply chain flexibility in the automotive industry. *International Journal of Production Economics*, *158*, 91-105. https://doi.org/10.1016/j.ijpe.2014.07.024

Tyndall, G., Gopal, C., Partsch, W., & Kamauff, J., 1998. *Supercharging supply chains. New ways to increase value through global operational excellence*.

Uca, N., Çemberci, M., Civelek, M. E., & Yilmaz, H., 2018. The Effect of Trust in Supply Chain on the Firm Performance through Supply Chain Collaboration and Collaborative Advantage. *Yönetim Bilimleri Dergisi*, *15*(30), 215-230.

Wu, I.-L., & Chiu, M.-L., 2018. Examining supply chain collaboration with determinants and performance impact : Social capital, justice, and technology use perspectives. *International Journal of Information Management*, *39*, 5-19. https://doi.org/10.1016/j.ijinfomgt.2017.11.004

Yusuf, Y. Y., Gunasekaran, A., Musa, A., Dauda, M., El-Berishy, N. M., & Cang, S., 2014. A relational study of supply chain agility, competitiveness and business performance in the oil and gas industry. *International Journal of Production Economics*, *147*, 531-543. https://doi.org/10.1016/j.ijpe.2012.10.009

Zhou, H., & Li, L., 2020. The impact of supply chain practices and quality management on firm performance : Evidence from China's small and medium manufacturing enterprises. *International Journal of Production Economics*, *230*, 107816. https://doi.org/10.1016/j.ijpe.2020.107816

Naoui Khaled ORCID ID: https://orcid.org/0000-0001-6276-141X
Department of Economics and Management, National School of Business and Management,
Research Laboratory on Development and Valorization of Resources in Desert Zones,
Ibn Zohr University, Agadir, **Morocco**
e-mail: naoui.khal@gmail.com

Omar Boubker ORCID ID: https://orcid.org/0000-0001-6365-2653
Assistant Lab Director- Research Laboratory on Development and Valorization of Resources in Desert Zones (LARDEVAR-ZS), Laayoune Higher School of Technology,
Ibn Zohr University, Agadir, **Morocco**
e-mail: o.boubker@uiz.ac.ma

Mohamed El Abdellaoui ORCID ID: https://orcid.org/0000-0001-7416-8218
Department of Economics and Management, National School of Business and Management,
Research Laboratory on Development and Valorization of Resources in Desert Zones,
Ibn Zohr University, Agadir, **Morocco**
e-mail: h.med.elabdellaoui@gmail.com