LogForum

> Scientific Journal of Logistics <

2022, 18 (1), 61-75

http://doi.org/10.17270/J.LOG.2022.641

http://www.logforum.net p-ISSN 1895-2038 e-ISSN 1734-459X

ORIGINAL PAPER

THE EFFECTS OF INFORMATION TECHNOLOGIES ON AUTOMOTIVE SUPPLY CHAIN AND FIRM PERFORMANCE. A PLS-SEM APPROACH

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ABSTRACT. Background: In today's context, information technology is increasingly taking a great interest for academics and practitioners. IT plays a critical role in supply chain readiness to meet market changes by lowering costs and enhancing quality. Hence, the objective of this article is to explore the effect of information technology integration (ITI) and supply chain information management (SCIM) on supply chain integration (SCI) and its association with supply chain performance (SCP) and firm performance in the automotive supply chain.
Methods: The research data were collected from 177 middle and top-level managers of automotive firms installed in Morocco. The structural equation modelling under the partial least squares approach was used in testing the hypotheses and proposed model.
Results: The study findings show that ITI and SCIM positively and significantly affect the level of SCI. In addition, SCI positively and significantly affects SCP and firm performance. Furthermore, SCP plays a direct and positive role in improving firm performance.
Conclusions: The study results provide direction on how automotive SC managers might enhance automotive SCP and firm performance.

Keywords: Supply chain, information technology, IT integration, information management, performance.

INTRODUCTION

The Moroccan automotive industry has succeeded in gradually becoming a leading sector of the national economic environment. The dedicated strategy to this sector has been time to establish the foundations of an efficient and competitive automotive industry, sufficiently integrated into global value chains.

First constriction hub in Africa, the Moroccan automotive industry is the leading sector of export, with over 250 national and international players, this sector contributes to the generation of more than 147,000 direct jobs creation between 2014 and 2019. With nearly 400,000 cars manufactured in 2019, the country is Africa's second-biggest automotive producer after South Africa and the first producer of passengers' cars.

Morocco currently operates with four large industrial hubs in Tangier, Kenitra, Rabat, and Casablanca, as also many training institutes specialized in the automotive industry. With these strengths, the automobile sector provides meaningful opportunities for multinational companies.

The automotive manufacturing business is demand-driven in a complex way, in which the supply chain has a pivotal function [Boysen et al. 2015].

In today's globalized economic environment, competition is not occurring through individual firms but rather across supply chains [Farahani et al. 2014]. Given its

Citation: *Boubker O., 2022. The effects of information technologies on automotive supply chain and firm performance. LogForum 18 (1), 59-73,* http://doi.org/10.17270/J.LOG.2022.641
Received: 12.08.2021, Accepted: 30.11.2021, on-line: 01.03.2022

role in improving supply chain performance and business performance, the integrative supply chain has been a major concern for large automotive companies. In this regard, IT integration and supply chain information management seem to be essential to streamlining automotive supply chain practices.

From this perspective, the current study aims to explore the key factors influencing automotive supply chain performance and firm performance. Therefore, the research questions (RQ) are.

- RQ1: How does IT integration, and SC information management impact the SC integration?
- RQ2: What is the effect of SC integration on SC performance and firm performance?
- RQ3: How does SC performance affect firm performance?

To address these questions of the study, the article is organized through three sections. The first one provides a literature overview. The second presents the research methodology. Following a description of the findings in the third section, the results are discussed in the fourth section.

THEORETICAL FOUNDATIONS AND HYPOTHESES DEVELOPMENT

In general, supply chains are structured around both inter-functional integration and inter-organizational integration. Inter-functional integration involves integrating all upstream and downstream logistics processes [Tyndall et al. 1998]. While inter-organizational integration refers to sharing information, risks, and rewards between SC partners [Cooper and Ellram, 1993].

At this level, information systems generally, and supply chain information systems (SCIS) specifically, play a significant part in implementing supply chain best practices, by offering numerous benefits for organizations [Erceg and Damoska-Sekulowska, 2019; Bal and Pawlicka, 2021].

We consider the supply chain information system (SCIS) as an inter-organizational information system, which allows us to rationalize the internal and external functioning of the company, by allowing efficient flow management between supply chain partners (Fig. 1). SCIS encloses a number of technological solutions that take part at different levels, including the strategic level (advanced planning and scheduling systems - APS), the tactical level (enterprise resources planning systems -ERP), the operational and real-time level (supply chain execution systems -SCE).

In changing marketplace, supply chain information systems allow SC partners to meet clients' needs by providing the right product, at the right price, at the right place and time. In practice, APS solutions are designed for the long-term (strategic level), by helping companies to achieve various objectives at the right cost, time, and quality [Jamrus, Wang, & Chen, 2020]. Likewise, the ERP solutions provide business processes automation, which turns in enhancing efficiency and reducing logistics costs [Oghazi et al. 2018]. As well, electronic data interchange (EDI) solutions support coordination between partners along the supply chain, which in turn help to enhance performance across quality, cost and competitiveness [Hill and Scudder, 2009].

IT integration (ITI), SC information management (SCIM) and SC integration (SCI)

In today's context, information technology [IT] is increasingly taking a great interest for academics and practitioners. This interest in IT can be explained by their critical role in helping organizations collect, store, access, share and analyse data effectively and efficiently [Swafford, Ghosh and Murthy, 2008]. IT enhances the enterprises' ability to process information and sustains business transactions by building connections between organizations and their clients [de Barros et al. 2015].

IT integration can be defined as the degree of communication, coordination, and integration of relevant information between different internal functional departments and external supply chain members [Swafford et al.

2008]. It reflects the level to which information is communicated, coordinated and integrated in a meaningful way between different internal functional departments and external supply chain partners.

IT integration among supply chain partners covers communications, processes, sharing, coordination, and joint decision-making [Singh and Teng, 2016]. ITI covers three kinds of flow integration, namely physical flow integration, financial, and information flows [Rai, Patnayakuni and Seth, 2006].

Previous studies on SC management has been given to the impact of information IT/IS on supply chain integration. The IT is identified as a tool to ensure SC integration and collaboration, by synchronization of material flow, information and financial [Acar and Uzunlar, 2014], and facilitating the coordination and communication between the supply chain members [de Barros et al. 2015].

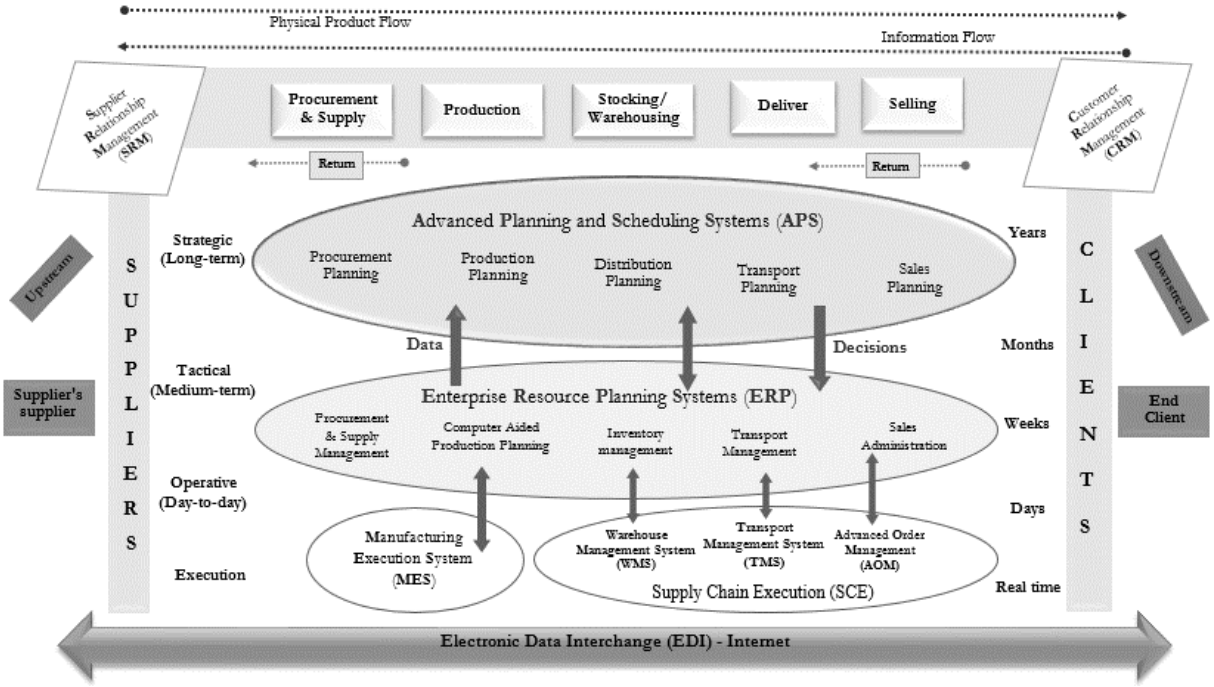

Fig. 1. Supply chain information systems tools used in the supply chain (own elaboration)

Scholars have also shown that IT integration represents a crucial element for the proper functioning of the supply chain, by facilitating the SC integration [Li et al. 2009]. Also, IT integration enhances effective interaction and cooperation for true integration of business processes across supply chain partners [Cooper and Tracey, 2005]. Kim [2017] empirically confirmed the positive influence of integrative IT on SC integration.

In addition, previous studies investigated the effect of SC information management on the SC integration. The purpose of SCIS is to diffuse information through the members of the supply chain [Sundram et al. 2018]. Based on an empirical study among 248 manufacturing businesses, Sundram et al. [2018] argued that SC information management affects positively the level of supply chain integration. Therefore, we can suppose that:

H1: ITI directly and positively affects SCI.

H2: SCIM directly and positively affects SCI.

SC integration (SCI), SC performance (SCP) and firm performance

Supply chain integration refers to the extent and strength of linkages of supply chain processes across firms [Leuschner, Rogers and Charvet, 2013]. It is enabled by informational, operational, and relational integration [Flynn, Koufteros and Lu 2016]. Existing studies suggest different perspectives to define SCI

[Özdemir, Simonetti and Jannelli, 2015]. This concept is analysed with two measures, namely downstream integration with customers and upstream integration with suppliers [Sun and Ni, 2012]. Another vision consists of both internal [Basnet, 2013], and external integration [Boon-itt 2009; Barratt and Barratt 2011; Wong, Wong and Boon-itt, 2013].

For other researchers the SCI can be approached according to three dimensions, namely internal, suppliers, and customer integration [Boon-itt 2009; Flynn, Huo and Zhao, 2010; Chang et al. 2016]. Even more, Ataseven et al. [2020] distinguish between three levels of integration such as supply integration, demand integration, and internal integration.

In sum, SCI refers to "*the degree to which an organization's internal functions and external supply chain partners strategically and operationally collaborate with each other to jointly manage intra- and inter-organizational quality-related relationships, communications, processes, etc., with the objective to achieve high levels of quality-related performance at low costs*." [Huo, Zhao and Lai, 2014:39].

In this study, we focus on both sides of integration, including internal and external integration among the supply chain members. This dual integration is essential to enable a seamless and synchronous flow of information in and through the entire manufacturing supply chain [Sundram et al. 2018].

Many studies have explored SCI well to identify its benefits [Leuschner et al. 2013]. At this level, a large number of existing studies generally agreed on the fact that SCI provides enhanced operational performance [Gimenez, van der Vaart and Pieter van Donk, 2012]. Flynn et al. [2010] argued that internal and customer and supplier integration contribute to the firm performance, by enhancing its level of operational and business performance. Even more, both Internal and customer integration contribute more closely to performance improvement than supplier integration [Flynn et al. 2010]. On their side, Özdemir et al. [2015] studied the effect of SCI and competition capabilities on business performance. They found a positive effect of SCI on competition capabilities and business performance.

In addition, it is recognized that external integration affects positively and directly product innovation [Wong et al. 2013]. Zhao et al. [2015] argued that that integration plays a central part in improving financial performance. As indicated by Chen et al. [2018] a higher degree of integration leads to enhanced firm performance. Based on a meta-analysis, Leuschner et al. [2013] found a positive and significant correlation between SCI [information, operational integration, and relational integration] and firm performance [business, relational and operational performance]. More recently, Chang et al. [2016] supported the positive effect of the internal, supplier, and customer integration on financial performance.

A number of studies support a positive relationship between SCI and SCP [Sezen 2008; Koçoğlu et al. 2011]. Li et al. [2009] claimed that integration in supply chain members [supplier integration, customer integration, and intra-organizational integration] enhance supply chain performance. More recently, Mofokeng and Chinomona [2019] verified empirically that supply chain integration plays a key determinant to supply chain performance improvement. Thus, we hypothesize that:

H3: SCI directly and positively affect SCP.

H4: SCI directly and positively affect firm performance.

Supply Chain Performance (SCP) and Firm Performance

Supply chain performance is defined as "the ability of a supply chain to cost-effectively carry out its activities while minimizing costs, for the main purpose of meeting the ultimate customer's needs" [Mofokeng and Chinomona, 2019:3]. There is a growing body of literature that recognizes the importance of supply chain performance in enhancing firm performance [Li et al. 2006; Qrunfleh and Tarafdar, 2014]. The supply chain's performance represents an essential condition for value-generating [Mofokeng and Chinomona, 2019]. Thus, we propose the following hypotheses.

H5: SCP directly and positively affects firm performance.

Our proposed research model includes two independent variables, namely IT integration and supply chain information management, and three dependent variables, supply chain integration, supply chain performance, and organization performance (Fig. 2).

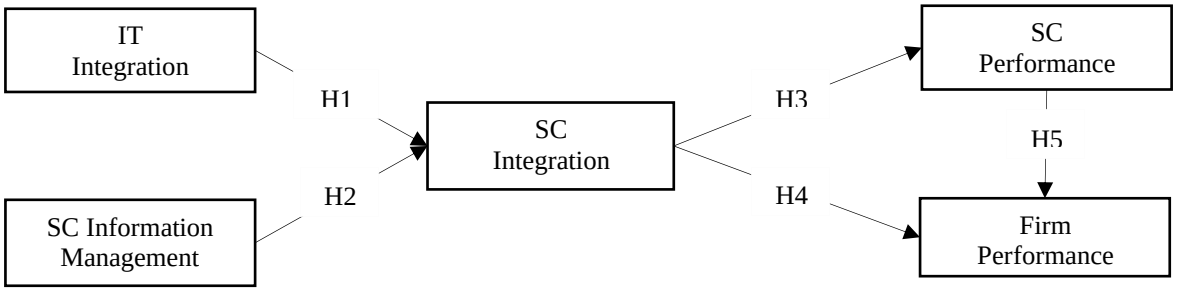

Fig. 2. Proposed research model.

MATERIAL AND METHODS

Research context

The Moroccan automotive industry has achieved sustained growth over the recent decade. This performance is especially noteworthy with regard to exportation and job generation, where the sector has registered a double-digit growth rate every year. Many stakeholders are interacting inside the automobile SC [Raj Kumar Reddy et al. 2021], including designers, third-tier suppliers (initial raw material suppliers: steel, rubber, plastic, silica); second-tier suppliers (component suppliers: piston, gears, alloy wheels, rubber tyre, leather, seat frames, electronics, processors, adhesives, glass sheets), first-tier suppliers (component suppliers: tyre, seats, electronics, glass suppliers); original equipment manufacturer (OEM), transporters, and distributors (Fig. 3).

In this context, the integration of the various players in the supply chain constitutes a major challenge for major automotive firms. Thus, this study focuses on identifying factors that foster supply chain integration and consequently enhance the supply chain and automotive firm performance.

Sample and data collection method

The convenience sampling method is used for data collection among respondents through on-line questionnaire. At that stage, the Google Forms tool was used to administer the research questionnaire, by disseminating the survey link to the target population via social and professional networks, such as Telegram, Viadeo, and LinkedIn. The research questionnaire was conducted in two steps. In the first step, a pre-testing phase of the questionnaire items was conducted to ensure the validity of the questionnaire content. In a second step, the questionnaire was administered via an online survey that applied to the middle and top-level managers of automotive supply chain partners installed in Morocco for five months from November 2020 and March 2021.

Our research questionnaire is arranged in two parts. The first part concerns the socio-demographic and company characteristics, including respondent gender, age range, job title, education level, work experience, company's role in the automotive supply chain, and company geographical location. While the second part of the questionnaire measures the various latent variables, i.e., IT integration (ITI), SC information management (SCIM), SC integration (SCI), SC Performance (SCP), and firm performance (FP).

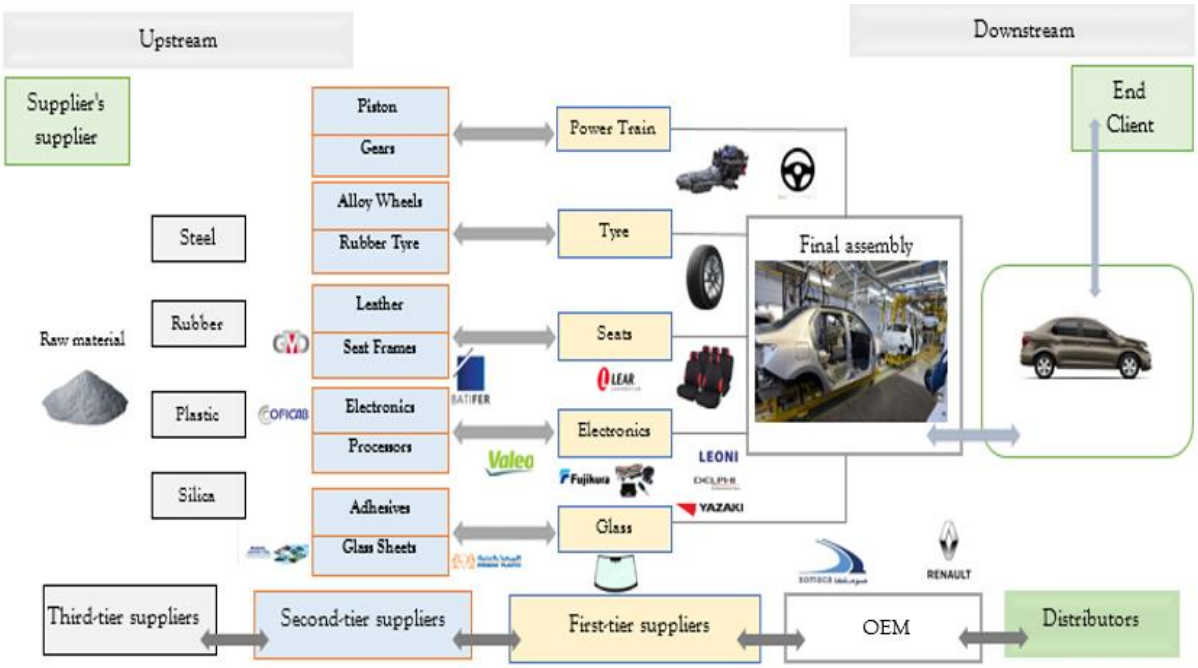

Fig. 3. Automotive supply chain in Morocco.

During the data collection period, we received 177 correct responses (Table 1), including 147 responses from males (83.1%) and 30 from females (16.9%). Regarding the age of respondents, 69 of them are aged between 20 and 26 years old (39%), followed by 67 between 36 and 44 years old, and 22 are aged between 27 and 35 years old. A small number of respondents (19) are over 50 years old (10.7%). The highest percentage of survey participants (84.7%) has a master degree (BAC+5). Regarding the occupation of the respondents, we note that more than 24% of the respondents are production planners, followed by 12.4% of customer service specialists, and more than 30% of respondents are logistics coordinators (10.7%), supply planning managers (10.7%), and procurement managers (10.2%). 38.4% of respondents are between 3 and 5 years old as work experience. Statistics descriptive revealed that 49.2% of respondents were from first-tier suppliers, 37.3% from second-tier suppliers, and finally, 13.6% from original equipment manufacturers. A large part of these companies is located in Tangier (42.4%) and Casablanca (26%).

Measurement instruments

The questionnaire design has been based on measurement scales selected from earlier studies. Hence, information technology integration (ITI) was measured using the Chen [2019] scale with five items. For both variables supply chain information management (SCIM) and supply chain integration (SCI), we mobilized the Sundaram et al. [2018] scale with five items. Referring to Chowdhury et al. [2019], supply chain performance (SCP) was measured with five items. Finally, the measurement of firm performance (FP) was based on the non-financial performance measured by five items selected from the study of Wu and Chiu [2018]. We adopted the seven Likert-type scale to measure each variable. The agreement options are from one as a total disagreement to seven as total agreement (Appendix 1).

Table 1. Descriptive statistics (n = 177)

Categorical		Frequency (%)
Gender	Male	147 (83.1%)
	Female	30 (16.9%)
Age range	20-26 years old	69 (39.0%)
	27-35 years old	22 (12.4%)
	36-44 years old	67 (37.9%)
	Above 50 years old	19 (10.7%)
Education	Bachelor (BAC+3)	15 (8.5%)
	Master degree (BAC+5)	150 (84.7%)
	Master of business administration (MBA)	10 (5.6%)
	PhD (BAC+8)	2 (1.1%)
Job title	Production planner	43 (24.3%)
	Customer service specialist - logistics	22 (12.4%)
	Logistics supervisor	21 (11.9%)
	Logistics coordinator	19 (10.7%)
	Supply planning manager	19 (10.7%)
	Procurement manager	18 (10.2%)
	Transport planner	10 (5.6%)
	Transport manager	9 (5.1%)
	Logistic manager	7 (4.0%)
	Logistics project manager	6 (3.4%)
	Supply chain manager	3 (1.7%)
Work experience (years)	1-3	10 (5.6%)
	3-5 years	68 (38.4%)
	5-7 years	26 (14.7%)
	Above 7 years	73 (41.2%)
Company place in automotive SC	First-tier suppliers	87 (49.2%)
	Second-tier suppliers	66 (37.3%)
	OEM	24 (13.6%)
City	Tangier	75 (42.4%)
	Casablanca	46 (26.0%)
	Kenitra	42 (23.7%)
	Meknes	11 (6.2%)
	Taza	3 (1.7%)

Data analysis method

In order to test the hypotheses and research model, the partial least squares structural equation modelling method was used [Hair et al. 2019; Boubker and Douayri 2020]. For generating descriptive statistics, IBM SPSS Statistics 21 were used. In addition, Smart PLS 3.3.3 software was used to assess the outer model and inner model. The first step of the PLS approach consists in checking the measurement models' validity, through convergent and discriminant validity. Convergent validity requires the assessment of various criteria, namely, reliability of individual items (≥ 0.7), composite reliability (CR $\geq$ 0.7), factor loadings, and average variance extracted (AVE $\geq$ 0.5). Discriminant validity involves the examination of the following three criteria: variable correlation, cross landings and heterotrait-monotrait (HTMT) ratio [Henseler, Ringle and Sarstedt 2015]. The second phase of the PLS method involves structural model assessment under several criteria including coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), goodness-of-fit (GoF), and hypotheses testing under β-value, t-value, and p-value [Boubker, Douayri and Ouajdouni, 2021].

RESULTS

Results of outer models assessment

Table 2 outlines the results of measurement model's assessment. The outer loading of all indicators is above 0.7 (Fig. 4). In addition, the values of AVE are all above 0.5, indicating that all concepts explain at a minimum of 50%of the variance in its items [Hair et al. 2019]. In addition, the values of Cronbach's α, and CR are more than 70%. Therefore, these findings proved to have robust convergent validity. In addition, the discriminant validity assessment is verified by the criterion of Fornell-Larcker. As recommended by Henseler et al. [2015], the highest value of HTMT ratio is 0.74 (Table 3).

Table 2. Results of reliability, convergent and discriminant validity

Construct	Alpha	CR	rho_A	AVE	FP	ITI	SCIM	SCI	SCP
FP	0.97	0.97	0.97	0.88	0.94				
ITI	0.97	0.97	0.98	0.90	0.66	0.95			
SCIM	0.94	0.96	0.95	0.80	0.23	0.20	0.89		
SCI	0.91	0.93	0.93	0.74	0.60	0.62	0.27	0.86	
SCP	0.96	0.97	0.97	0.87	0.71	0.64	0.14	0.57	0.93

Table 3. Discriminant validity using the HTMT ratio

Construct	FP	ITI	SCIM	SCI	SCP
FP					
ITI	0.68				
SCIM	0.23	0.20			
SCI	0.63	0.65	0.31		
SCP	0.74	0.66	0.13	0.59	

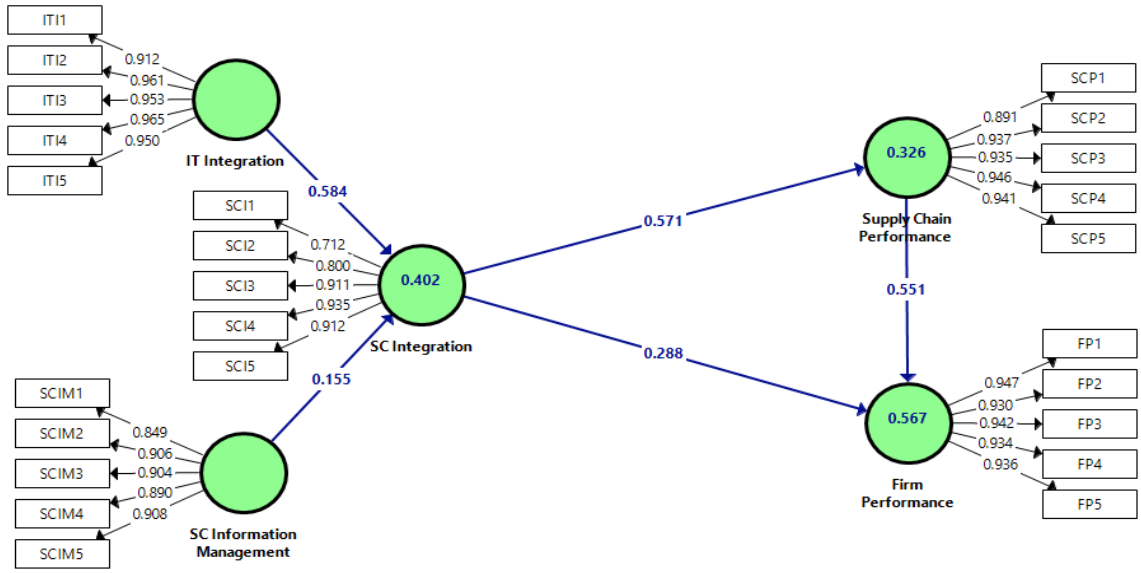

Fig. 4. Measurement model assessment results.

As shown in Table 4, the discriminant validity is also ensured with the cross-loading criteria, showing that the loadings of the indicators are higher than all its cross-loadings.

Results of assessing structural model

For the inner model assessment the R-square values for the three endogenous latent variables, SCI, SCP and FP are 0.40; 0.33; 0.57 and 0.802, respectively. This indicates an acceptable level of determination [Hair et al. 2011]. Cohen [1988] suggested that f^2 values higher than 0.35, 0.15, and 0.02 can be categorized as strong, moderate, and weak, respectively. In this study, the f^2 of ITI and SCIM on SCI are 0.55, and 0.04, which means that their effect sizes are strong and weak, respectively. In addition, the f^2 of SCI on SCP and FP are strong (0.48) and weak (0.13), respectively. The f^2 value of SCP on TP is 0.47, which reflect à strong effect size.

The results listed in Fig. 5 confirm that all values of the Q^2 index are greater than zero, indicating that the constructs have a predictive relevance for the considered endogenous construct [Hair et al. 2011]. Finally, the value of the goodness-of-fit is 0.596647, which reflect a large GoF [Henseler, Ringle and Sinkovics, 2009].

The findings provide evidence to support all research hypotheses. The first hypothesis was accepted (H1. β= 0.584, t = 12. 284; p = 0.000), showing a significant and positive relationship between IT integration and SC integration. The second hypothesis, which states that SC information management has a positive effect on SC integration, is statistically significant (H2. β= 0.155; t = 2.332; p = 0.020). The SEM-PLS results also confirm the third and fourth hypotheses, by showing a positive relationship between SC integration and SC

performance (H3. ***β* = 0.571; *t* = 12.**531; p = 0.000), and firm performance (H4. β = 0.288; t = 4.291; p = 0.000). The fifth hypothesis was also supported by showing a positive, significant and direct effect of SC performance on firm performance (H5. β = 0.551; t = 7.621; p = 0.000).

Table 4. Discriminant validity based on the cross-loading criteria.

	FP	ITI	SCIM	SCI	SCP
FP1	0.95	0.62	0.19	0.56	0.70
FP2	0.93	0.60	0.24	0.57	0.62
FP3	0.94	0.62	0.23	0.52	0.63
FP4	0.93	0.63	0.18	0.54	0.70
FP5	0.94	0.63	0.24	0.63	0.69
ITI1	0.65	0.91	0.15	0.54	0.61
ITI2	0.65	0.96	0.18	0.60	0.65
ITI3	0.61	0.95	0.22	0.60	0.62
ITI4	0.60	0.96	0.17	0.60	0.60
ITI5	0.63	0.95	0.23	0.57	0.58
SCIM1	0.15	0.13	0.85	0.18	0.07
SCIM2	0.15	0.17	0.91	0.21	0.06
SCIM3	0.19	0.20	0.90	0.23	0.13
SCIM4	0.23	0.17	0.89	0.24	0.10
SCIM5	0.27	0.20	0.91	0.31	0.21
SCI1	0.38	0.42	0.49	0.71	0.34
SCI2	0.42	0.44	0.29	0.80	0.33
SCI3	0.53	0.52	0.14	0.91	0.51
SCI4	0.63	0.64	0.17	0.94	0.63
SCI5	0.57	0.57	0.16	0.91	0.56
SCP1	0.59	0.49	0.12	0.46	0.89
SCP2	0.75	0.66	0.19	0.52	0.94
SCP3	0.72	0.69	0.14	0.59	0.94
SCP4	0.63	0.58	0.08	0.57	0.95
SCP5	0.62	0.55	0.11	0.50	0.94

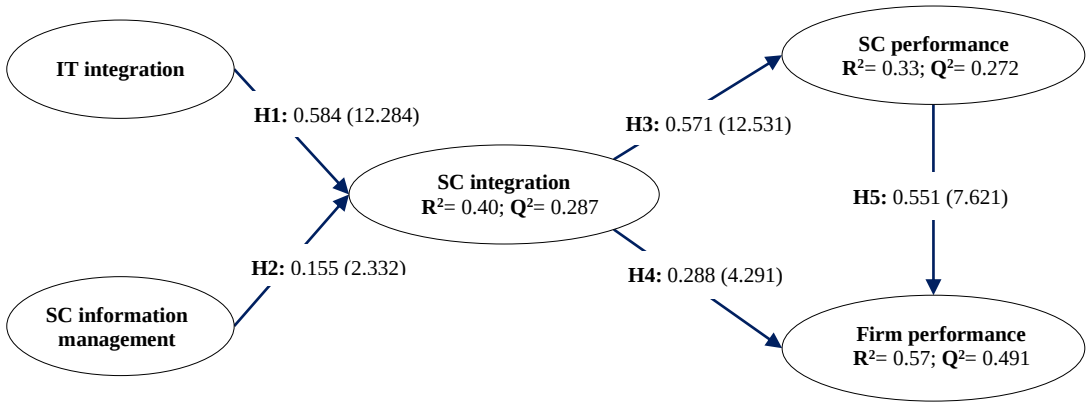

Fig. 5. Hypotheses testing results.

DISCUSSION AND CONCLUSION

The objective of this study was to investigate the link between ITI, SCIM, SCP and firm performance in the case of the Moroccan automotive supply chain. The results reveal that the ITI and SCIM plays a central role in enhancing the level of automotive SCI. These results are consistent with the previous studies, which suggest that ITI contributes to building SCI [Li et al. 2009; Acar and Uzunlar, 2014]. The empirical study of Sundram et al. [2018] confirmed the positive link between SCIM and SCI. In addition, it turns out that automotive SCI enhances SCP and firm performance. As suggested by earlier research, the integrative supply chain plays a central role in firm performance improvement [Flynn et al. 2010; Chen et al. 2018]. As indicated by Chen

et al. [2018] a higher level of SC integration leads to enhanced firm performance. Also, SCI is presented as a solution to enhance the level of SCP [Mofokeng and Chinomona, 2019].

Further, the findings of this research confirmed the positive, direct and significant link between SC performance and firm performance. The validation of this hypothesis is in line with past literature [Li et al. 2006]. Qrunfleh and Tarafdar [2014] concluded that improving the level of SCP positively affect the level of firm performance.

Previous studies suggest that national culture characteristics dictate the type of inter-organizational trust, which in turn affects the nature of SC integration [Balambo, 2013]. Accordingly, our conclusions may be extended for other countries, which are characterized by a similar national culture to Morocco, such as Tunisia.

In both Morocco and Tunisia, the implementation of automotive value chains is the outcome of industrial policy that seeks to enhance comparative advantages by stimulating innovation and technological learning. These two countries have achieved a level of manufacturing capabilities in the automotive industry allowing to increase the North African region's involvement in global value chains. At this level, IT integration and SC information management may turn into unavailable conditions for improving the level of integration of the automotive supply chain in the North African context, which may contribute to achieving a high-level SC performance and firm performance.

Our findings highlight the importance of ITI and SCIM on the enhancement of automotive. SCI also contribute to the explanation of the level of SCP and firm performance. Likewise, SC performance is identified as a determinant of firm performance. This research has enriched the supply chain management literature. Consequently, the major theoretical contribution concerns proposing a model adapted to the context of the automotive supply chain, allowing a better understanding of the contribution of integrative SC and SC information management to the automotive SC performance.

This study also provides some implications for automotive supply chain managers and practitioners. The study has demonstrated that ITI integration and SC information management play a central role in fostering SC integration. In the same, the SC integration contributes to fostering the level of SCP and to enhancing automotive firm performance. At this level, we suggest that the use of inter-organizational IS and the integration of IT in the automotive SC partners should be reinforced in order to ensure SC integration, by responding to demand changes with optimal stock.

In order to enhance automotive SC performance and firm performance, SC partners are invited to reinforce the integrative SC, by establishing more frequent contact with other SC members, creating a compatible communication and information system, participating in the sourcing decisions of their suppliers, and assisting in their customers' marketing efforts.

Despite these implications, the present study has a number of limitations. The conceptual model includes just three variables to predict SC performance and firm performance. It may be interesting to also include other variables such as SC collaboration, information quality, supply chain information system infrastructure, inter-organizational trust, and risk management culture. Moreover, this study is based on previous research to elaborate the research questionnaire. In order to develop a measurement scale adapted in the context of the automotive industry, a qualitative study will be appropriate.

Appendix 1. Questionnaire

Gender	:	□ Female		□ Male	
Age range (years)	:				
Education	:	□ Bachelor	□ Master degree	□ MBA	□ PhD
Job title	:				
Work experience (years)	:	□ 1-3	□ 3-5	□ 5-7	□ ≥ 7
Company place in automotive SC	:				
City	:				

IT integration (SCI)	
ITI 1.	Use of IT to coordinate/integrate activities in design and development
ITI 2.	Use of IT to coordinate/integrate activities in procurement
ITI 3.	Use of IT to coordinate/integrate activities in manufacturing
ITI 4.	Use of IT to coordinate/integrate activities in logistics and distribution
ITI 5.	Use of enterprise resource planning or SC planning software for managing/ coordinating global SC
Supply chain information management (SCIM)	
SCIM 1.	Timely disseminate the information along with the SC
SCIM 2.	Joint production planning and scheduling among suppliers, manufacturing, marketing and distributors
SCIM 3.	Link information systems so that each member of a SC knows others' requirement and status
SCIM 4.	Practice quick information flows along the supply chain
SCIM 5.	Accurate information is usually available for decision-making in our organization.
Supply chain integration (SCI)	
SCI 1.	Firms in SC establish more frequent contact with each other
SCI 2.	Firms in SC create a compatible communication and information system
SCI 3.	Firm extends its SC beyond its customers/suppliers
SCI 4.	Firm participates in the marketing efforts of its customers
SCI 5.	Firm participates in the sourcing decisions of its suppliers
Supply chain performance (SCP)	
SCP 1.	Lead time
SCP 2.	Quality
SCP 3.	Sales growth
SCP 4.	Profit
SCP 5.	Cost
Firm Performance	
FP 1.	The SC can help the firm improve its return on investment.
FP 2.	The SC can help the firm improve its return on assets.
FP 3.	The SC can help the firm improve sales growth.
FP 4.	The SC can help the firm improve production and inventory cost

ACKNOWLEDGMENTS AND FUNDING SOURCE DECLARATION

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

REFERENCES

Acar, A.Z., Uzunlar, M.B., 2014. The Effects of Process Development and Information Technology on Time-based Supply Chain Performance. Procedia - Social and Behavioral Sciences, 150: 744–753. https://doi.org/10.1016/j.sbspro.2014.09.044

Ataseven, C., Nair, A., Ferguson, M., 2020. The role of supply chain integration in strengthening the performance of not-for-profit organizations: evidence from the food banking industry. Journal of Humanitarian Logistics and Supply Chain Management, 10(2): 101–123. https://doi.org/10.1108/JHLSCM-04-2019-0024

Bal, M., Pawlicka, K., 2021. Supply chain finance and challenges of modern supply chains. LogForum, 17(1): 71-82. http://doi.org/10.17270/J.LOG.2021.525

Balambo, M. A., 2013. Culture nationale et nature de l'intégration des supply chains amont: le cas des équipementiers automobiles marocains. Logistique & Management, 21(4): 71-85. http://dx.doi.org/10.1080/12507970.2013.11517036

Barratt, M., Barratt, R., 2011. Exploring internal and external supply chain linkages: Evidence from the field. Journal of Operations Management, 29(5), 514–528. https://doi.org/10.1016/j.jom.2010.11.006

Barros, A.P. de, Ishikiriyama, C.S., Peres, R.C., Gomes, C.F.S., 2015. Processes and Benefits of the Application of Information Technology in Supply Chain Management: An Analysis of the Literature. Procedia Computer Science, 55: 698-705. https://doi.org/10.1016/j.procs.2015.07.077

Basnet, C., 2013. The measurement of internal supply chain integration. Management Research Review, 36(2): 153–172. https://doi.org/10.1108/01409171311292252

Boon-itt, S., 2009. The effect of internal and external supply chain integration on product quality and innovation: evidence from Thai automotive industry. International Journal of Integrated Supply Management, 5(2): 97–112.https://doi.org/10.1504/IJISM.2009.029356

Boubker, O., Douayri, K., 2020. Dataset on the relationship between consumer satisfaction, brand attitude, brand preference and purchase intentions of dairy product: The case of the Laayoune-Sakia El Hamra region in Morocco. Data in Brief, 32: 106172. https://doi.org/10.1016/j.dib.2020.106172

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

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

Chang, W., Ellinger, A.E., Kim, K., Franke, G.R., 2016. Supply chain integration and firm financial performance: A meta-analysis of positional advantage mediation and moderating factors.European Management Journal, 34(3): 282–295. https://doi.org/10.1016/j.emj.2015.11.008

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, M., Liu, H., Wei, S., Gu, J., 2018. Top managers' managerial ties, supply chain integration, and firm performance in China: A social capital perspective. Industrial Marketing Management, 74: 205–214. https://doi.org/10.1016/j.indmarman.2018.04.013

Chowdhury, M.M.H., Quaddus, M., Agarwal, R., 2019. Supply chain resilience for performance: role of relational practices and network complexities. Supply Chain Management: An International Journal, 24(5): 659-676. https://doi.org/10.1108/SCM-09-2018-0332

Cohen, J., 1988. Statistical power analysis for the behavioral sciences, 2nd ed, L. Erlbaum Associates, Hillsdale, N.J.

Cooper, D.P., Tracey, M., 2005. Supply chain integration via information technology: strategic implications and future trends. International Journal of Integrated Supply Management, 1(3): 237-257. https://doi.org/10.1504/IJISM.2005.005949

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

Erceg, A., Damoska-Sekulowska, J., (2019). E-logistics and e-SCM: how to increase competitiveness. LogForum, 15(1): 155-169. http://doi.org/10.17270/J.LOG.2019.323

Farahani, R.Z., Rezapour, S., Drezner, T., Fallah, S., 2014. Competitive supply chain network design: An overview of classifications, models, solution techniques and applications. Omega, 45 :92-118. https://doi.org/10.1016/j.omega.2013.08.006

Flynn, B.B., Huo, B., Zhao, X., 2010. The impact of supply chain integration on performance: A contingency and configuration approach. Journal of operations management, 28(1): 58-71. https://doi.org/10.1016/j.jom.2009.06.001

Flynn, B.B., Koufteros, X., Lu, G., 2016. On Theory in Supply Chain Uncertainty and its Implications for Supply Chain Integration. Journal of Supply Chain Management, 52(3): 3-27. https://doi.org/10.1111/jscm.12106

Gimenez, C., Van Der Vaart, T., Van Donk, D.P., 2012. Supply chain integration and performance: the moderating effect of supply complexity. International Journal of Operations & Production Management, 32(5): 583-610. https://doi.org/10.1108/01443571211226506

Hair, J.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., Sarstedt, M., 2015. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43(1): 115-135. https://doi.org/10.1007/s11747-014-0403-8

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 (eds.), *New Challenges to International Marketing*, Advances in International Marketing, 20: 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

Huo, B., Zhao, X., Lai, F., 2014. Supply Chain Quality Integration: Antecedents and Consequences. IEEE Transactions on Engineering Management, 61(1): 38–51. https://doi.org/10.1109/TEM.2013.2278543

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

Kim, H.J., 2017. Information technology and firm performance: the role of supply chain integration. *Operations Management Research*, 10(1):1-9. https://doi.org/10.1007/s12063-016-0122-z

Koçoğlu, İ., İmamoğlu, S.Z., İnce, H., Keskin, H., 2011. The effect of supply chain integration on information sharing:Enhancing the supply chain performance. Procedia - Social and Behavioral Sciences, 24: 1630–1649. https://doi.org/10.1016/j.sbspro.2011.09.016

Leuschner, R., Rogers, D.S., Charvet, F.F., 2013. A Meta-Analysis of Supply Chain Integration and Firm Performance. Journal of Supply Chain Management, 49(2): 34–57. https://doi.org/10.1111/jscm.12013

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

Li, S., Ragu-Nathan, B., Ragu-Nathan, T.S., Subba Rao, S., 2006. The impact of supply chain management practices on competitive advantage and organizational performance', Omega, 34(2): 107–124. https://doi.org/10.1016/j.omega.2004.08.002

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

Özdemir, A.İ., Simonetti, B., Jannelli, R., 2015. Determining critical success factors related to the effect of supply chain integration and competition capabilities on business performance. *Quality & Quantity*, 49(4): 1621–1632. https://doi.org/10.1007/s11135-014-0074-z

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

Rai, A., Patnayakuni, R., Seth, N., 2006. Firm Performance Impacts of Digitally Enabled Supply Chain Integration Capabilities. MIS Quarterly, 30(2): 225–246. https://doi.org/10.2307/25148729

Raj Kumar Reddy, K., Gunasekaran, A., Kalpana, P., Raja Sreedharan, V., Arvind Kumar, S., 2021. Developing a blockchain framework for the automotive supply chain: A systematic review. Computers & Industrial Engineering, 157: 107334. https://doi.org/10.1016/j.cie.2021.107334

Sezen, B., 2008. Relative effects of design, integration and information sharing on supply chain performance. Supply Chain Management: An International Journal, 13(3): 233–240. https://doi.org/10.1108/13598540810871271

Singh, A., Teng, J.T.C., 2016. Enhancing supply chain outcomes through Information Technology and Trust. Computers in Human Behavior, 54: 290–300. https://doi.org/10.1016/j.chb.2015.07.051

Sun, H., Ni, W., 2012. The impact of upstream supply and downstream demand integration on quality management and quality performance. International Journal of Quality & Reliability Management, 29(8), 872–890. https://doi.org/10.1108/02656711211270342

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

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

Wong, C.W.Y., Wong, C.Y., Boon-itt, S., 2013. The combined effects of internal and external supply chain integration on product innovation', International Journal of Production Economics, 146(2): 566–574. https://doi.org/10.1016/j.ijpe.2013.08.004

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

Zhao, G., Feng, T., Wang, D., 2015. Is more supply chain integration always beneficial to financial performance?'. Industrial Marketing Management, 45: 162–172. https://doi.org/10.1016/j.indmarman.2015.02.015

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