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Research article

# The moderating effect of Technological readiness and the exchange of information on supply chain performance: An empirical study in the Tunisian context

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**Abstract**
The paper proposes a conceptual model of the Supply Chain Communication Systems (SCCS) and the Supply Chain (SC) performance within a systemic approach. Considering the intensity of the use of SCCS has a positive impact on the performance of SC. This relationship is moderated by technological readiness (TR) and the level of information exchange (IE) with suppliers and transporters. The empirical evidence adopts the Partial Least Squares method by exploring the Tunisian context and performing a survey with 117 respondents in the field of logistic. Our results state that the SCCS has a positive impact on the performance of SC, also the positive moderating effects of technological readiness and information exchange with suppliers. The theoretical and managerial implications put forward by highlighting the humanitarian, technological and relational issues on the side of the SCCS.

***Key words:*** SCCS, SC, Technological readiness TR, Information exchange IE, systemic approach



## 1- Introduction

In order not to live in a vacuum, companies have become increasingly linked to each other by the succession of events, from the supply of raw materials to the consumption of the finished product for the purpose of constituting a closed loop system in which logistic, among other things, the goods flow management and the associated information which have a paramount importance (Kang et al., 2018). In the current system, distributors, in order to keep their customers, they must reduce costs and strive to pass the traditional costs to manufacturers, which also look downstream for improvements to share with their customers and upstream for the concessions of their suppliers. All the players are thus trapped on the one hand, by a set of recurring concessions since the fruits of their efforts are reflected only on the final customer. On the other hand, by the accumulation of faults in their respective logistic systems: in particular, the slowness of execution times, the obligation to make discounts to stimulate consumption, the excessive dependence linked to storage for supplies, the burden of paperwork, the

redundancy of steps without added value and the multiplicity of unnecessary costs. It is therefore necessary to create another logic of interaction between the different actors of the same supply chain and to discover the possibilities of achieving savings between them, including with the final consumer, by bringing them together at the same time. Within a network which then becomes a model of efficiency eliminating unnecessary or non-value-added tasks and reducing inventory as well as administrative work to the strict minimum in a coherent and proactive system (Grekova et al., 2016; Fossas-Olalla et al., 2015; Strebinger and Treiblmaier, 2004). Everyone wins thanks to New Information and Communication Technologies (NICT).

One of the disciplines of strategic management of the company, allowing the development of the value creation chain, consists in implementing a global supply chain strategy or Supply chain management (SCM). The SCM, which comes under knowledge engineering, advocates organizations by transversal processes and customer orientation. Improving performance, competitiveness and valuing production based on communication, coordination and cooperation between actors in the supply chain.

The use of communication systems, through its impact on the organization, is a major constraint. But it can be transformed into settlement (which supposes significant investments) while significantly improving their return.as a recent study That's be the most the World Bank can do on supply chain performance in Tunisia which shows substantial sources of savings in sectors such as dates and olive oil. Whereas the same causes generate the same effects, it is easy to extrapolate this reasoning to other sectors. Among the effects of using communication systems within the supply chain is the exchange of information which appears to be a cornerstone for achieving market performance (Tarafdar and Qrunfleh, 2017; Inderfurth et al. 2013; Kurtulus et al., 2012) .. This exchange has an influence on the coordination and responsiveness of the chain (or Responsiveness). This is where its impact on market performance is considerable. Therefore, it is important for managers to understand the different roles of the key activities in improving the partner responsiveness and market performance. (G. Silveira and R. Cagliano, 2006)

Among other things, the active exchange of information between the partners accelerates any reaction against. On the one hand, any environmental changes within the market and on the other hand any competitive development of any product (Clemons and Row 1992). At this level, D. Kim et al. (2006) assert that the said exchange as well as the coordination is improved by the innovation of the communication systems of the Supply chain or SCCS, which facilitate the reactivity of the partners.

Our research problem was built throughout the literature review where we found that most researchers admit that the supply chain communication systems (SCCS) have a generally favorable impact on organizations. Factor's research that determine the impact of communication systems (SCCS) on the performance of the Supply Chain has focused in particular either on interpersonal factors such as trust, the responsiveness of partners, coordination and Technological readiness ( Richard Klein, 2007; Daekwan Kim et al, 2006; Grekova et al., 2016; Fossas-Olalla et al., 2015) or on the technological factors in which we find the exchange and share the information (P. Fiala, 2004). (Grekova et al., 2016; Fossas-Olalla et al., 2015; Strebinger and Treiblmaier, 2004). The issue we are dealing with in our context is the observation of the low performance's level of supply chains within Tunisian companies. In this work we will try to answer the following question: To what extent the Technological readiness and the exchange of information with the supplier and the carrier, moderate the impact of the intensity of use of the communication systems and the overall performance of the supply chain?

The objective of this research is to identify the main factors that determine the adoption of SCCS communication systems in the supply chain. This will allow us to better understand the phenomenon of adoption of technological innovations in Tunisia and more particularly the SCCS, which constitute an emerging category of information systems. It is within the framework of this reflection, that our work will be articulated around two main objectives which are as follows: firstly, to extend the existing theories relating to the adoption of information systems to the applications of the SCCS by developing a conceptual model that adapts to the specificities of SCCS and Supply Chain applications, while focusing on the Tunisian context. Secondly, to determine the factors that influence the application of supply chain performance communication systems.

### 1.1- Contribution and impact of research

Our empirical results show that in Tunisia, the implementation of SCCS supply chain communication systems is a major determinant of its performance and its positioning in the market in general. A particularly interesting conclusion that the SCCS positively effect the performance of the SC in a particular way and the performance of the company in general (a).

This relationship is partly moderated by Technological readiness (b) and the level of

information exchange (c). Therefore to deduce that synergies are created for an organization of the simultaneous implementation of an adequate infrastructure and the constitution of a network of individuals who accept this technology and collaborate with each other. The strongest effect in our study was the moderating influence of Technological readiness on said relationship, which confirms a pre-existing literature that highlights the strong connection of Technological readiness and the subsequent emergence of personal relationships of networks of SC (Daugherty, 2011; Terpend, Krause, & Dooley, 2011). Also, the results of our study show that it is about an exchange of information with the suppliers but it is almost absent or limited with the carrier which explains the asymmetry of information which leads the bullwhip effect which generally leads to communication problems between the various partners of the SC.

Our model further indicates that researchers should not only include the establishment of SCC as an important antecedent in any study that attempts to explain and predict performance; instead, researchers need to measure the effectiveness of SCCS in three dimensions to account for how could the quality of the SCC system, the quality of service which is provided by SCC, and the quality of information constitute the effectiveness of SCCS. . We used a reflective measure to account this conceptualization. We discussed the foregoing and some other implications on research, practice, and theory in the discussion section.

**Manuscript structure**

This document is structured as follows: first, we briefly developed the theoretical background and the development of the hypotheses. This is where we start by identifying the degree of the impact on the intensity of the communication use systems on the performance of the supply chain, and then moving to the studying of the moderating effect of the predisposition technology and the exchange of information on said relationship and the presentation of hypotheses. Finally, we move to the methodology's research, results and discussion to finish with the conclusion.

**2- Theoretical context and hypotheses**

**2.1- Intensity of the use of communication systems**

The Supply Chain Communication System is "an Information System shared by channel partners to carry electronic transactions, quality and to cost calibration, collaboration in forecasting and planning" (Bowersox et al. 1999). Despite the relevance of the questions of integration of Information Systems, specifically communication systems in the supply chain, this has attracted the attention of only a few questions from a few researchers (Flynn et al., 2010; Ramanathan and Gunasekaran, 2014). It is a very underdeveloped theme and still needs some clarification. Several forms of the supply chain information and management systems have emerged for over 20 years. It is here that Electronic Data Interchange (EDI) and Electronic Funds Transfer (EFT) technologies were first introduced in the late 1970s (Adam et al, 1999).

In this work, we have tried to explore the role of the technologies and information systems in the development of relationships between partners as well as the market and the product development. All of this is in the context of the Supply Chain Communication Systems (SCCS) which is a key component of Supply Chain Management Systems (SCMS) (Thomas SP and al., 2020). Based on the definition of Bowersox et al. (1999) of a SCCS which is an information system shared by partners to carry out electronic transactions, achieve quality and cost calibration. It is obvious that the SCCS incorporates elements that achieve harmonization with the systems of information in a supply chain, such as ERP, CRM, transport management and the warehouse management system (Bowersox et al. 1999).

**The systemic approach, the cornerstone of the discipline**

Indeed, Donald Bowersox is the one who introduced systems theory, from his early work with Edward Smykay and Frank Mossman, into supply chain research and SCM. It will become "the cornerstone of the concept of integrated supply chain" (1987a).

He sees the supply chain system as an open system made up of interacting activities (inventory management, transportation and the warehouse network). These activities are also influenced by changes in the environment (demand in particular, but also the cost of certain factors, the expected level of service or technology). The total cost makes it possible to assess the possible configurations of the system and therefore the flow management methods (management rules).

The decision support tools that Donald Bowersox develops, such as LREPS (Long Range Environmental Planning Simulation) in 1972, for the design of the distribution system, reflect this vision of the functioning of the supply chain system which is a part of the system theory. In general it was spread in the 1960s and 1970s. The Regulation of the system made it possible by the implementation of effective

feedback (taking into account any occuring change in internal and / or external variables) which not only improves the quality of the supply chain response (in terms of cost, service and deadline), but also in its organization (responsiveness, flexibility and agility).

**2.2- Supply Chain performance**

Performance is adopted as an ultimate result. It is measured by sales growth, market and product development (Sarkar et al 2001). The innovation of SCCS was intended to positively affect market performance (Grekova et al., 2016; Fossas-Olalla et al., 2015; Strebinger and Treiblmaier, 2004). This is why a good communication system should help companies to meet customer requirements (Roger et al. 1993) and to get ahead in the market through on-time delivery, efficient ordering and rapid response to changes. Consumer needs (Stank et al, 1999), and more generally market orientation.

**The transaction cost theory**

The theory of transaction cost is the most widespread in the field of information systems and especially in the explanation of the impacts of the use of information systems and technologies on the performance of the supply chain and its structure. In fact, cost transaction of the cost theory views interorganizational information technologies as means to ensure the reduction of transaction costs and to improve the information's manipulation (Reekers and Smithson, 1995). We will use this theory in our research to study the impact of communication systems on the performance of the Supply chain. The transaction cost theory has three major dimensions, namely; (1) the specificity of the base which incorporates the investment in specific bases necessary for the exchange (2) the uncertainty of the transaction process and (3) the degree of the intensity of the exchange (Kurokawa and Manaba , 2002). Indeed, this theory deals with the modes of conception, organization and function of the exchange relations.

Since 1970, the productivity of information technology has been discussed from the level of the economy to the industry, the firm level and the activity level (Brynjolfsson, 1993).

Some researchers find a positive relationship between IT investment and business productivity (Fossas-Olalla et al., 2015; Brynjolfsson and Hitt, 1996). To a narrower extent, information technology also increases the efficiency of several business activities (Stank, Crum, and Arango, 1999) and processes (Mukhopadhyay, Rajiv, and Srinivasan, 1997).

Nevertheless, some researchers report no effect or even a negative influence of information technologies on the productivity of the company and consequently its performance (Kettinger et al, 1994). Powell et al. (1997) also found no relationship between IT deployed and total performance in their study of retailers. The disappointing results of the increased investment in IT raise questions about its vital role in the contemporary organization.

Despite contradictions in the literature, researchers and advisers still have importance on IT which enables companies to achieve more effective and efficient communication between channel partners (Tarafdar and Qrunfleh, 2017; Bowersox, Closs, and Stank , 1999). Indeed, manufacturers need to work closely with suppliers and distributors to reduce unnecessary inventory which typically incurs costs and makes product prices more competitive (Porter et al. 1985).

In addition, the active exchange of information between partners accelerates market reaction and / or changes in the environment, as well as the competitive development of new products. Also, distributors must work closely with new suppliers and retailers to get the point of sale back to the consumer as much as possible in order to reduce the cost of inventory.

***H1: Technological intensity has a positive impact on the performance of the supply chain.***

**2.3- Technological readiness**

The concept of Technological readiness was originally developed by Parasuraman (2000). The Technology Readiness construct can be viewed as a total state of mind that results from a facilitating and inhibiting mental gesture that collectively determines a personal predisposition to use new technologies (Parasuraman, 2000). Parasuraman's (2000) research introduced a new scale called the "Technological readiness Index" (TRI) which is a kind of breakdown of customer optimism (defined as a positive view of technology and as a belief that leads to increased control, flexibility and efficiency), inconvenience (defined as a lack of control over technology and a feeling of being overwhelmed by it), innovation ( defined as a tendency to be a pioneer of technology and a leader of thought) and the insecurity of technology (defined as distrust of technology and skepticism of the ability to work well). Richey (2002) extended Parasuraman's research to a dyadic (two-tailed) SIIO to specifically test the Technological readiness of the relationship between manufacturer and retailer as well as the performance of the supply chain. He concluded in his study that Technological readiness is the key that drives the improvement of supply chain services. In the same framework of

reflection, R. Glenn Richey Jr. et al (2007) examined the importance given to Technological readiness in improving customer expectations as well as in manufacturing efficiency, but they offer a small management insight into Technological readiness and technological implementation on the retailer side. From the retailers's perspective, Technological readiness can be viewed as a critical input which can be categorized as an intangible resource (Dierickx and Refroidit, 1989).

Technological readiness can be thought as a total state of mind that results from a mental manifestation (facilitators and inhibitors) which collectively determines a person's predisposition to use new technologies (Parasuraman, 2000). A 36-item scale was developed based on four dimensions: Optimism (a positive view of technology and a belief that it increases control, flexibility and efficiency); Innovation (a tendency to be a technologically innovator and thought leader); Inconvenience (a perceived lack of control over technology and a feeling of being overwhelmed) and Insecurity (distrust of technology and skepticism about its ability to function properly). Therefore, optimism and innovation form the positive drivers of predisposition; they encourage to use technological products / services, and to hold a positive attitude towards technology. However, inconvenience and insecurity are negative, inhibitory attitudes; they present a range of people unwilling to use the technology (J. Lin and P. Hsieh, 2005). Here is where the following hypothesis arises:

***H2 Technological readiness moderates the relationship between communication systems and supply chain performance.***

**2.4- Information exchange with the supplier and the carrier**

The major advances made in the development of information technologies that constitute a major evolution in the buyer / supplier exchange relationship which are presented as the second economic revolution (Essig and Arnold, 2001). The extended enterprise benefits from the decompartmentalization of organizational boundaries through IT to better collaborate with its trading partners and especially its suppliers (Kalika et al. 2003). This confirms the prognosis of Muller et al. (2003) on the logical change that should take place in the buyer / supplier relationship with the increasingly significant integration of IT into relational processes like the negotiation process. Generally, the exchange of information plays an important role in the attractiveness of the flow of goods and services between the different partners (Bhatti, 2019; Humphreys et al., 2004; Iyer et al., 2014; Jean et al. , 2010; Osborn and Nault, 2012).

**Information processing theory**

Information processing theory is considered among the most widely used theories in the field of information systems. It provides a theoretical basis for understanding and analyzing the impact of information exchange on supply chain performance. It considers the exchange of information to be a central phenomenon in organizations. It has contributed considerably to the understanding of information exchange behaviors which in turn affect the development of inter-organizational relationships (Galbraith, JR, 1974).

In fact, the information processing theory is based on three important concepts: the need for information processing, the information processing capacity, and the adequacy between the two in order to obtain optimal performance (Cooper et al. 2005). In fact, any organization needs to learn about the quality of the environment in order to improve their decision-making process and to deal with uncertainty, which concerns the environment and comes from the complexity and dynamism of the latter or of the frequency of changes in various environmental variables. (Jain, H. et al. 2003)

It is also through the exchange of information in the supply chain that information flows increase, uncertainty it will be reduced and therefore have a more advantageous supply chain. The exchange of information is a very important link in the coordination of the activities of the different units in the supply chain. This is where our hypothesis looks like this:

***H3 Information exchange with the supplier moderates the relationship between communication systems and supply chain performance.***

***H4 Information exchange with the carrier moderates the relationship between communication systems and supply chain performance.***

**3- Research methodology**

The hypotheses of our research and the positivist paradigm influenced our methodological choices. We found it appropriate to use the quantitative approach for this study. Based on this research approach, we used a single paradigm to post positivism (positivist) paradigm which uses deductive logic and quantitative research methods (Rocco et al. (2003: 21). Unlike the constructivism paradigm social (interpretation) which uses inductive logic and qualitative research methods.

Through our positivist position, we adopt the hypothetico-deductive approach. It's a general

specific approach. It is an approach that hinges on formulating a research question based on a general theory: it is the testing of hypotheses in order to invalidate or to confirm them.

We will proceed in our research to the survey method. For Evrard (2003), a sample survey includes the questionnaire which constitutes the measurement instrument.

**3.1- Data and sample**

We choose a measurement scale for each of the variables in our model according to criteria such as the reliability of the scale, its validity, its parsimony and its agreement or divergence with the definitions adopted in this study. The sampling method chosen is the so-called voluntary non-probability method. Our sample is made up of 117 Tunisian companies spread over five sectors of activity, namely the banking sector, hotel sector, industrial sector, building and construction sector and the commercial sector.

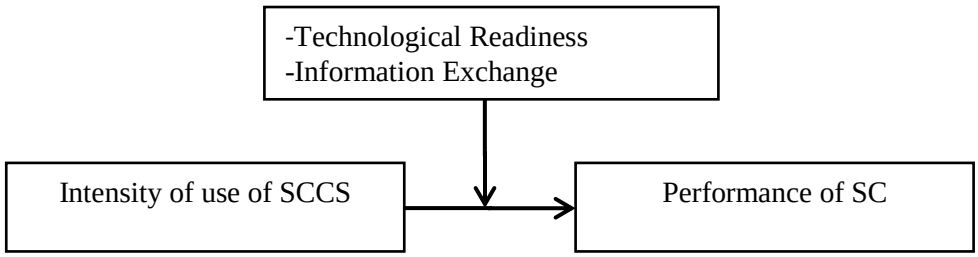


**Figure 1: Conceptual model**

**3.2- Variable measures and scale development**

The survey consists of Likert scale questions ranging from 1 = strongly disagree to 5 = strongly agree. When conducting surveys, it is believed that common method bias occurs frequently, which is why we used the advice of Guide and Ketokivi (2015) and obtained survey data from carriers and suppliers of the different belonging to said sectors.

First, survey respondents were asked questions in random order to prevent them from perceiving patterns. Second, in the middle of the survey, a short mandatory break took place to reduce respondent fatigue. Finally, given that this article focuses on Technological readiness and information exchange, a subject that some might consider predisposed to the problems of respondents' social desirability, anonymity was clearly articulated in the header of the questionnaire. (Dalal and Hakel, 2016; Furr, 2011).

**3.3. Data quality assurance and collection**

The data were analyzed by using Structural Equations Modeling (SEM) based on the Partial Least Squares (PLS) approach via Smart-PLS3.0 software.

The PLS approach is optimal for prediction accuracy and robust for complex models since it doesn't require a large sample size or normally distributed data (Hair *et al.*, 2017). The choice of the type of SEM approaches depends on whether the research is exploratory or confirmatory (Hair *et al.*,2017). In the case of an exploratory study, if applications have little available theory, the predictive accuracy is paramount, and a correct model specification cannot be ensured (Hwang *et al.*, 2010; Wong, 2010), the PLS approach is adopted.

The preliminary exploratory study of the model is conducted by IBMSPSS statistics 23 using the principal components analysis (PCA) with varimax rotation to eliminate non-significant items (with outer-loading <0.4). The confirmation study of the model justifies whether the conceptual research model was valid and reliable. The paper discusses the results from the analysis of the measurement model and assesses the structural model.

Table 1 reports the factor loadings, congeneric reliability (or ρc, Cho, 2016) and validity of the variables of interest. All factor loadings were above .60 and average variances extracted (AVE) were also found to be at satisfactory levels (>.50) (Bagozzi& Yi, 1988; Hair, Black, Babin, Anderson, & Tatham, 1998), which provide evidence of convergent validity. The constructs also showed good discriminant validity. Average item-level correlations *within* each construct are substantially larger than item-level correlations *between* constructs (*diff* = 0.274, *p*= 0.000). The Heterotrait-monotrait (HTMT) ratio, the average of the heterotraithetero method correlations relative to the average of the monotrait-heteromethod correlations, is 0.513, well below the suggested value of 0.85, which provides additional evidence for convergent and discriminant validity (Henseler, Ringle, &Sarsdedt, 2015, Hair, 2017).

The content validity of each construct scale was assessed during the development of the survey instrument with a guidance from three academic subject matter experts who served as judges to determine which questions would remain, be refined, or be eliminated (Wieland et al., 2017, Hair , 2017). We believe leveraging their supply chain knowledge greatly enhanced the appropriateness of our survey instrument.

**Tableau 1 : Reliability of the constructs**

| | **Cronbach's Alpha** | **Rho-A** | **Composite Reliability** | **Average Variance Extracted (AVE)** |
|---|---|---|---|---|
| **exchange-provider** | 0.914 | 0.920 | 0.936 | 0.746 |
| **Exchange-transpotor** | 0.976 | 0.977 | 0.981 | 0.894 |
| **Intensity use SCM** | 0.898 | 0.902 | 0.936 | 0.830 |
| **Readiness** | 0.817 | 0.822 | 0.891 | 0.732 |
| **Perf SCM** | 0.950 | 0.954 | 0.962 | 0.834 |

The convergent validity is justified when the outer-loadings of measurement items are 0.7 or higher (see Table 2). Furthermore, the convergent validity signifies that a set of indicators represents one and the same underlying construct, which can be demonstrated through their unidimensionality (Henseler*et al*., 2009). This is measured by the AVE which should be 0.5 or higher (see Table 1) meaning that a latent variable is able to explain more than half of the variance of its indicators on average (Fornell, Larcker, 1981).

**Table 2 – The loadings of the items**

| | Exchange- Prov | Exchange- Trs | Intensity | Readiness | Perf SCM |
|---|---|---|---|---|---|
| Exchange -prov-1 | 0.894 | | | | |
| Exchange -prov-2 | 0.806 | | | | |
| Exchange -prov-3 | 0.898 | | | | |
| Exchange -prov-5 | 0.804 | | | | |
| Exchange -prov-6 | 0.912 | | | | |
| Exchange -trsp-1 | | 0.949 | | | |
| Exchange -trsp-2 | | 0.944 | | | |
| Exchange -trsp-3 | | 0.951 | | | |
| Exchange -trsp-4 | | 0.942 | | | |
| Exchange -trsp-5 | | 0.935 | | | |
| Exchange -trsp-6 | | 0.950 | | | |
| Intensity-techno-10 | | | 0.912 | | |
| Intensity-techno-7 | | | 0.892 | | |
| Intensity-techno-9 | | | 0.929 | | |
| Readiness-innov -3 | | | | 0.856 | |
| Readiness-incomod-1 | | | | 0.860 | |
| Readiness-optim-3 | | | | 0.850 | |
| Perf-SCM-1 | | | | | 0.941 |
| Perf-SCM-2 | | | | | 0.938 |
| Perf-SCM-3 | | | | | 0.953 |
| Perf-SCM-4 | | | | | 0.923 |
| Perf-SCM-5 | | | | | 0.804 |

Descriptive statistic and correlations for all variables are presented in Table 3. Cook and Weisberg diagnostic for heteroscedasticity were conducted with no significant findings. Subsequently the variance inflation factor (VIF) analysis was utilized to evaluate multicollinearity. All variable results were <1.5, which indicates no significant multicollinearity issues. We also checked distribution of our predictors and the outcome variable. Overall, the skewness for our predictors and the outcome variable is smaller than 0.5, suggesting that distributions of these variables are approximately symmetric.

**Table 3 – Fornell-Larcker Criterion discriminant validity of the constructs**

| | Exchange- Prov | Exchange- Transp | Intensity | Readiness | Perf SCM |
|---|---|---|---|---|---|
| Exchange- Prov | 0.864 | | | | |
| Exchange- Transp | 0.657 | 0.945 | | | |
| Intensity | 0.805 | 0.637 | 0.911 | | |
| Readiness | 0.843 | 0.622 | 0.754 | 0.855 | |
| Perf SCM | 0.636 | 0.553 | 0.727 | 0.557 | 0.913 |

Recently, Hair *et al*. (2017) use the HTMT criterion to assess discriminant validity in PLS-SEM. The confidence interval of the HTMT statistic should not include the value 1 for all combinations of constructs (see Table 4).

**Table 4 – Heterotrait-Monotrait Ratio (HTMT)**

| | Exchange- Prov | Exchange- Transp | Intensity | Readiness | Perf SCM |
|---|---|---|---|---|---|
| Exchange- Prov | | | | | |
| Exchange- Transp | 0.698 | | | | |
| Intensity | 0.890 | 0.680 | | | |
| Readiness | 0.870 | 0.691 | 0.877 | | |
| Perf SCM | 0.664 | 0.563 | 0.773 | 0.613 | |

To summarize, we conclude that the PLS outputs support the conditions of reliability and validity of the measurement model.

## 5- Results

The quality of the model was assessed by examining the coefficient of determination ($R^2$) which indicates the weight of the link between the independent and dependent variables. To designate a satisfactory model, this indicator must be greater than, or equal to, 0.2 or 0.3 (Chin, 1998). Our $R^2$ Value 0.589 for the only dependent variable of the model, showing a good model quality.

A second criterion $Q^2$ could give us an idea on the prediction relevance of the model. Table 5 confirms that all $Q^2$ are above zero. Hence, this provides the evidence that the observed values are well reconstructed and that the model has a predictive relevance.

**Table 5 – Predictive Relevance Calculations $Q^2$**

| | **$Q^2$ (=1-SSE/SSO)** |
|---|---|
| **Perf SCM** | 0.453 |

In addition, the evaluation of the $R^2$ values of all endogenous constructs, the change in the $R^2$ value when a specified exogenous construct are omitted from the model that can be used to evaluate whether the omitted construct which has a substantive impact on the endogenous constructs (Hair *et al.*, 2017). This measure is referred to the $f^2$. The guidelines for assessing $f^2$ are those that values of 0.02, 0.15, and 0.35 respectively represent small, medium, and large effects of the exogenous latent variable. Effect size values of less than 0.02 indicate that there is no effect (Hair *et al*., 2017). Table 6 shows that the values of $f^2$ show the importance of the intensity of use of SCCS on the performance of SC. Also the importance of the information exchange with the provider and the readiness of all members of the SC.

**Table 6 – $F^2$ calculation**

| | **Perf SCM** |
|---|---|
| **Intensity use SCCS** | 0.155 |
| **Moderator effect 1 (Exchange- Prov)** | 0.096 |
| **Moderator effect 2 (Exchange- Transp)** | 0.006 |
| **Moderator effect 3 (Readiness)** | 0.034 |

**Path Coefficients and Significance of Direct Relations**

The direct relation presented by the research is the one that exists between the Intensity of SCCS which use dimensions and performance of SC. In fact, the value of the coefficient is not sufficient to assess the significance of the impact. The t-test is the appropriate technique to reveal the relevance of the path coefficients (see Table 7). Smart-PLS offers the bootstrapping option to evaluate this significance.

**Table 7 – t-test of the Path coefficients after bootstrapping (resampling: 5000)**

| | T Statistitic SC (\|O/STDEV\|) | P Values | Decision |
|---|---|---|---|
| SCCS ⟶ Perf SC | 4.240 | 0.000 | Accepted |
| Moderator Effect1 (Exchange-Prov) ⟶ SCCS and Perf SC | 3.900 | 0.000 | Accepted |
| Moderator Effect 2 (Exchange- T) ⟶ SCCS and Perf SC | 0.747 | 0.456 | Rejected |
| Moderator Effect 3 (Readiness) ⟶ SCCS and Perf SC | 2.068 | 0.039 | Accepted |

The summary of the results shown in table 7, which discloses that the hypotheses H1proposes that the intensity of use of SCCS dimension will be positively associated with the performance of SC.H2, H4proposes that information exchange with the provider and the readiness moderate the relationship between the SCCS and the performance of SC are confirmed and the H3proposes that information exchange with the transporter is rejected based on the significance test.

## 6- Discussion

The competitive pressure due to the globalization and the promises (not always kept) of the internet bubble that have been a very strong driver of business transformation for the most advanced companies in the use of information technologies for strategic purposes, there has been a redefinition of the company's management processes

which has led to the transformation of the roles of internal and external actors in the company (Simonot PY and Roure J, 2007). This transformation is based on a transversal view of the processes which opposed to the more hierarchical approaches that had prevailed until then. It helps to understand the contribution of the creation of value of the major key processes of the company in order to seek efficiency gains and optimize investment.

In this work, we verified the impact of the use's intensity of SCCS on the performance of SC. The overall model to study this impact reveals that the intensity of use of SCCS explains 50.7% of supply chain performance (R-deux 0.589).

This is explained by the fact that the SCCS obviously play an essential role in the control and the coordination of the activities, functions and members of the channel in charge of the physical flow. They make it possible to reduce the response time of the system, guaranteeing productivity gains in a more complex environment (Bowersox, 1983). Indeed, the SCCS that facilitate this integration are now available, whether it is communication, data collection and processing, or tools for optimizing and controlling operations. The results obtained coincide with the work of Bowersox and Daugherty (1995) who emphasizes the potential of technologies in supply chain, then in SCM (Bowersox et al., 2005). In fact, only more reliable and more efficient intra and inter-organizational SSCSC can cope with the growing complexity of flows.

Innovation in logistics, both from an operational (planning, carrying out and optimization of activities) and organizational (increased integration) point of view, necessarily relies on the SCCS and the continuous improvement of the management and the control system they allow.

The divergence of multiple's links of interests of the SC (consumer, customer, distributor, transporter, producer, supplier, subcontractor, supply chain service provider, etc.) inevitably leads to local optimization and maximization of individual profit to the detriment of overall performance for all players in a supply chain. To combat this phenomenon, companies must define a common goal for all the members of the SC, to provide that they are agile and adaptable. This search for alignment should promote the establishment of collaborative practices or strategies between partners.

Our second hypothesis H2, claims that Technological readiness moderates the relationship of the impact of SCCS on SC performance which has been validated. Indeed, Lamming R, (1980) understands the fundamental role that ICT will play in modern companies, and in particular in the management of supply chain networks. Not only does it anticipate the automation of supply chains, but it also alerts managers to the need to adapt their strategies to take into account the considerable impacts of this automation as early as possible. The design of a fluid and flexible management of operations makes it possible to take full advantage of supply chain information systems which amplify this fluidity and flexibility (Bessant et al, 1985). Richard Lamming draws on the work of Richard Schonberger (1982) and the example of Toyota to demonstrate that ICTs are necessary for 'just in time' production and total quality management (TQM). This is how companies will invest in ICT more quickly to gain more.

Our H3 which assumes that the exchange of information with the suppliers moderates the relation of the impact of the SCCS on the performance of the SC has been validated while H4 which claims that the exchange of information with the carrier moderates the said relationship was invalid. In this perspective, Hau Lee (2004) proposes to focus primarily on contracts and agreements between the focal company (the principal) and its partners, by breaking down the terms of risk sharing, costs and benefits more equitably possible. Built on trust and reciprocal commitment, this alignment can sometimes lead to the involvement of an intermediary between the partners of the SC such as supply chain service providers or publishers of application solutions. Hau Lee also points out that company align in several ways. They begin with the alignment of information, so that all providers have access to forecasts and data on demand and plans. Then they align their identities; in other words, the principal must define the roles and responsibilities of each partner so that there is no possibility to conflict. And finally, they align incentives so that when companies seek to maximize their own profits, they also optimize the overall performance of the SC. Recently, the exchange of rich information required the meeting (physical proximity) of participants or the use of dedicated communication channels whose cost and usage constraints limited the number of speakers. On the contrary, the large-scale dissemination of information (high accessibility) required formatting it according to the chosen communication channel, which prohibited personalization and interactivity (low wealth).

This results in organizational modes and decision-making structures adapted to the conditions in which the exchange of information could take place: the organization of the company was designed in such a way that rich information can be exchanged between a small number of people in a hierarchical structure, each vertex of the structure ensuring a

partial dissemination of information to the lower levels of the pyramid.

This hierarchical type of organization model is asymmetric from the point of view of information sharing: communication of rich and personalized information "upwards" (from subordinates to the superior) and distribution of standardized information (therefore less rich) "down". Therefore it does not allow a common and a shared perception of the situation between all the decision-makers at contiguous hierarchical levels, and, a fortiori along the entire decision-making chain. This results in a lack of responsiveness, adaptability and flexibility of the entire decision-making structure which must be based on predefined and intangible procedures to preserve coherent action (Simonot P.Y and Roure J, 2007)

The results obtained from our research show that the relationships between the partners of the company are not always strong and based on mutual trust. We are talking about an information asymmetry mainly between the company and the carrier. It should be noted that the boundaries of the company are defined by the cost-effectiveness of the exchange of information necessary for the performance of its missions. This again results in a model of relationship between the company and its customers based on the asymmetry of information, asymmetry that can be the basis of certain competitive advantages and certain modes of value creation.

## 6- Conclusion

In our study, we have shown that the Technological readiness with the exchange of information can have a great moderating importance on the relationship between the SCCS and the performance of the SC. We have undertaken investigations into the mediating effects of the information exchange, regardless of supplier or carrier, and of Technological readiness. Our results indicate that Technological readiness plays a prominent role in identifying the impact of intensity of use of communication systems on SC performance. In this regard, we corroborate previous research indicating that the potential of technologies positively influences the performance of SC, highlights more reliable and efficient intra and inter-organizational SCCS that can cope with the increasing complexity of flows. Indeed, several studies have provided evidence to support the role of technological potential in carrying out and planning the activities of the organization (Bowersox and Daugherty, 1995; Bowersox et al., 2005). Our study extends there by providing evidence to support the important role of Technological readiness concerning the performance of SC through the case of Tunisian companies.

It turned out that among the effects of the use of communication systems within the supply chain is the exchange of information which appears to be a cornerstone for the achievement of market performance. This exchange has an influence on the coordination and reactivity of the chain (or Responsiveness). This is where its impact on market performance is considerable. Therefore, it is important for managers to understand the different roles of the key activities in improving partner responsiveness and market performance. (G. Silveira and R. Cagliano, 2006; Lavastre O, Carbone V and Ageron B, 2016; Roure J, 2007)

Since we are focused on how to exchange the information with the supplier and with the carrier. Our work, which assumes that this exchange of information moderates the relationship of the impact of SCCS on the performance of the SC, has shown valuable results by studying the case of Tunisian companies in which the exchange of information with the supplier moderation exists and the supplier's degree of involvement in the work of the organization can be indicative of a good performance of the SC. In contrast, our study showed that the exchange of information with the carrier does not moderate the relationship between the impacts of SCCS on SC performance. Although, some previous publications show us an evidence of the positive relationship between information exchange and the impact of SCCS on the performance of SC performance (Lavastre O, Carbone V and Ageron B, 2016; Roure J, 2007) , other studies have not supported these results by speaking about the asymmetry of information following the organizational model of the hierarchical type which considers that in this type of model: the communication of the rich and personalized information "upwards "(From subordinates to the superior) and the dissemination of standardized information (therefore less rich)" downwards ". Therefore, this does not allow a common and shared perception of the situation between all the decision-makers at contiguous hierarchical levels, and a fortiori, along the entire decision-making chain.

This results a lack of responsiveness, adaptability and flexibility on the entire decision-making structure, which must be based on predefined and intangible procedures to preserve coherent action (Simonot P and Roure J, 2007). One of the most powerful sources of the Bullwhip effect is the information asymmetry. This is where sharing information about customer inquiries impacts on the effect of the Bullwhip. This is where Dejonckheere et al. (2004) focused on studying the impact of

information enrichment of the "Bullwhip" effect in the chain. They show that sharing information can significantly reduce this effect, especially at the highest levels in the chain.

Although, our study makes a significant contribution about the SCM literature and its important implications in practicing .Also, it has limitations that may have a great importance in structuring future scientific work.

In fact, the future will invite you to enlarge the sample of companies surveyed and perhaps to specify yourself to a single sector which will be an important point, in order to be able to compare the results of companies belonging to the same sector. Future research should study our SC performance model in other contexts especially during the period of the Covid 19 pandemic and its impact on the SC performance.

Furthermore, with only five constructs, our model is parsimonious and open to further expansion based on theory. However, we have deliberately omitted many constructs and sub-constructs founded in the literature, frequently associated with SC performance such as trust, partner responsiveness and inter-organizational coordination. Therefore, future research should focus on other concepts and longitudinal studies.

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