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Effects of information sharing, decision synchronization and goal congruence on SC performance

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ABSTRACT

Nowadays, supply chain performance is measured since it is essential in globalized companies as maquiladoras. They import all raw material and import and export all final products, with high information, material, and money flow, having complex networks. This article reports findings from a structural equation model integrating four latent variables: Decision synchronization, Goal congruence, and Information sharing as independent variables, and Supply chain performance as the dependent variable related through six hypotheses to know their relationship. Hypotheses were tested using information from 143 responses to a questionnaire applied to the maquiladora industry in northern Mexico. The structural equation model is evaluated using the partial least squares (PLS) method integrated into WarpPLS 6.0 software. Findings indicate that five hypotheses are statistically significant, and it is concluded that Goal congruence, Information sharing, and Decision synchronization directly affect supply chain performance. The most critical variable to guarantee it is Goal congruence among partners.

1. Introduction

A supply chain (SC) is defined as a network of companies that participate through up and downlinks in different processes to create products or services and deliver them to a final customer (Christopher, 2016). Several operations occur in a SC, such as the raw materials acquisition, transformation into finished products, and final distribution to customers (Novais, Maqueira, & Ortiz-Bas, 2019). However, Information sharing (*IS*) is necessary to get SC integration and achieve efficiency, and it is expected that all members collaborate in activities such as material management (Bian, Shang, & Zhang, 2016). *IS* refers to the practice of making the information available to other partners along with the SC to increase collaboration and SC optimization (Dominguez, Cannella, & Framinan, 2014).

IS appears when a SC collaboration and companies organize their operations (Cai, He, & He, 2020). Liao, Hu, and Ding (2017) indicate that enterprises working collaboratively have better resource management, fast decision-making, and rewards when competing for limited resources. Narayanan, Narasimhan, and Schoenherr (2015) point out that SC collaboration can generate significant benefits for partners, for example, risks mitigation, transaction costs, and access to complementary resources. That SC collaboration can be assumed vertically with suppliers and customers, and horizontally, on the same level, even between competitors (Raweewan & Ferrell, 2018); also, companies can have consistent mutual objectives, and partners are motivated to implement cooperative actions, such as communication, mutual online support, adaptation, and commitment with common goals (Jap & Anderson, 2003). Considering that SC integration is aimed to improve its

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performance and fulfill the customer expectations; therefore, measures and performance metrics are needed to value its effectiveness and efficiency (Reddy. K, Rao. A, & L, 2019). Performance measurement is the process of evaluating the efficiency and efficacy quantitatively or qualitatively in an enterprise (Reddy. K et al., 2019). In SC, it is affected by partners and *IS* intensity among them for promoting collaboration and integration, and as a result, improving their performance (Dominguez et al., 2014). According to Ahi and Searcy (2015), the benefits gained by SC performance (*SCP*) evaluation are ease of evaluating and monitoring progress, highlighting joint achievements, a better understanding of critical processes, identifying potential problems, and accessing the information on improvement actions in the future.

Currently, several structural equation models are reported in the literature, indicating how *SCP* is measured. For example, it is measured by the effect of national and international logistics policies. For instance, Liliana Avelar-Sosa, García-Alcaraz, Vergara-Villegas, Maldonado-Macías, and Alor-Hernández (2015) and Reddy. K et al. (2019) report a literature review with the mean used metrics; Zhang and Cao (2018) report a second-order structural equation model (SEM) for modeling *Goal congruence (GC), IS,* and *Decision synchronization* (*DS*) as a variable called collective and inter-organizational systems. Their findings showed that SC collaboration and low collaborative culture affect *SCP*, indicating that collaborative culture helps companies gain benefits.

Similarly, Cao and Zhang (2011) measure the relationship these variables have on the competitive advantage and the companies' performance and integrate the company size as a moderating variable in a second-order SEM. Their findings indicate that SC collaboration increases the collaborative advantage that positively influences the companies' performance. Liao et al. (2017) report a SEM to analyze the relationship between SC collaborative innovation with capabilities, the competitive advantage, and the *SCP* in Taiwan, and findings show that the relationships between innovation in SC collaboration, the SC capacity, and the competitive advantage are related and that the SC capacity is a complete mediator.

Similarly, Li (2014) reports a SEM for examining the effects of social resources on supporting the practice of *IS* and the company's performance. The findings indicate that relational capital and cognitive capital have a positive effect on *IS*.

In conclusion, the effect of *GC*, *DS*, and *IS* on *SCP* has been studied in several research papers and geographical contexts, but not in the maquiladora industry. A maquiladora is defined as a company established in a hosting country, but with headquarter in other and usually, they are duty-free and tariff-free, making them unique. The maquiladora factories import raw materials to assemble, manufacture, or process them in the twin plan in the host country and export the finished product, having globalized SCs that require GC, DS, and IS to be competitive. Sometimes the cost associated with logistics is 70% of production cost, and maquiladora companies save cost if they are closer to their primary customer (Pettersson & Segerstedt, 2013).

Currently, there are 5,121 maquiladora Industries in México, and only 5 Mexican states bordering the United States of America (USA) have 3,014 (58.8%%). Specifically, Ciudad Juárez in Chihuahua state has 326 maquiladora companies (6.36% national). Those maquiladoras take economic advances of commercial agreements between Mexico and the USA because they have low or preferential tariffs for importation and exportation (IMMEX, 2021a).

From January to September 2020, maquiladora companies imported 184,868 US millions and exported 188,645 US millions, but Chihuahua state imported 22,184 US millions and exported 22,637 US millions. Specifically, in the same period, Ciudad Juárez imported 16,638 US million and exported 16,978 US million (IMMEX, 2021b).

The intensive raw materials and final products flow in the maquiladora sector require *GC* among partners (suppliers, maquiladoras, customers, and their headquarter) because they are established in different countries. Those maquiladoras also need *IS* regarding demand and forecasting, given that a mistake in SC represents a high cost in transport due to wrong production orders, raw material returns, final product devolution, warehousing, and sometimes, technical stoppages due to lack of raw materials supply; and *DS* among partners associated to new production plans, market studies, inventory management and work in fast and tangible solution when problems occur.

Although there are studies that report the importance of *GC, IS,* and *DS* in the manufacturing industry of other countries, the nature of the maquiladora industry is unique since they are subsidiary companies with distant headquarters, importing their raw materials and exporting their finished products, where extensive coordination is required among all the members of the SC, with a flow of information and joint decisions. In that sense, this research aims to measure the effect those three independent latent variables (*GC*, *IS*, and *DS*) have on *SCP* in the maquiladora industry. Also, a sensitivity analysis is reported, based on conditional probabilities for their relationship, and this is the first paper reviewing the interactions among those variables from that point of view. To do this, a SEM is used to validate six hypotheses established for relating those variables, which was validated using information obtained from the Mexican maquiladora industrial sector based in Ciudad Juárez.

The rest of the article is distributed as follows. First, in section 2, the latent variables are described, and then the six hypotheses are proposed; in section 3, the methodology is described, section 4 presents the results obtained, and in section 5, the conclusions of the industrial implications are presented.

2. Literature review and hypothesis

2.1. Goal congruence (GC)

GC means the degree to which some associated enterprises participate jointly in achieving common activities in a collaborative way (Samaddar, Nargundkar, & Daley, 2006). According to *GC* is an essential element of successful collaboration, such as the development of performance measures, joint goals, and objectives, IT standardization, defining roles and responsibilities of each partner, formalizing the nature of information shared, alignment of collaborative schedules, and joint development of an implementation plan (Lejeune & Yakova, 2005).

Collaboration can be defined as working with partners to complete activities and reach shared goals. It is a recursive process where two or more organizations (or persons) work collectively to achieve a shared objective (Liao et al., 2017). For Zhang and Cao (2018), *GC* is the process where the company perceives if its goals are met by completing the SC objectives and indicates the degree of agreement of objectives among partners in a SC. In the spirit of true congruence of objectives, companies believe that their goals can be achieved in case of discrepancy as a result of working aimed to obtain the SC objectives (Zhang & Cao, 2018). In this research, *GC* variable is evaluated with the following five items (Um & Kim, 2019; Yan & Dooley, 2013; Zhang & Cao, 2018) that consider joint goals as the strategic interaction among partners aimed to obtain a common benefit as defined by Tuomela (1990):

- The company and SC partners have an agreement on the SC goals.
- The company and SC partners have an agreement regarding the importance of SC collaboration.
- The company and SC partners have an agreement on the importance of improvements that benefit it.
- The company and SC partners have agreed that their own goals can be achieved through working together.
- The company and SC partners jointly layout the collaboration and plan implementation to achieve goals.

2.2. Information sharing (IS)

As the success of any product relies on customers' response towards a product, companies must get customer satisfaction through efficiency

and effectiveness in SC (Ramanathan, 2014), which is possible through the SC collaboration among, suppliers and *IS* supports it. In that sense, *IS* in SC means that all nodes share information on demand, warehouse inventory, and production progress through *IS* platforms, such as network technology, logistics information systems, communication technologies, and equipment (Carrus & Pinna, 2011). Thus, *IS* can be defined as the voluntary act of making information possessed by one entity available to another entity (Asli Yagmur & Jaideep, 2008).

However, the *IS* success is determined by all components of CS and not by the performance of individual entities, be they manufacturing companies, suppliers, or transportation services (Nagurney & Li, 2016). Aspects studied in *IS* in CS include: sharing information at the point of sale to forecast product demand, using shared information to help suppliers determine order quantities, leveraging data about retailers' inventory levels and manufacturers' limited capabilities (Gaonkar & Viswanadham, 2001). SC *IS* is used to share inventory information, sales data, sales forecasts, order status tracking, new product development, SC operating parameters (such as product lead time, station queuing delays, and service), among others (Feng, 2012).

The true value of *IS* within a SC can be defined by the fact that the benefits achieved outweigh the costs involved. These costs include information systems investment and charges by customers or suppliers for providing the information (Lotfi, Mukhtar, Sahran, & Zadeh, 2013). Companies collaborating towards shared goals and *IS* can create processes or products together, share the cost in investments, mitigate and reduce risk, and have a fast and joint decision-making process (Pham, Nguyen, McDonald, & Tran-Kieu, 2019). According to Huang, Hung, and Ho (2017), more information available means a greater space for negotiation, cooperation, and risk mitigation.

However, *IS* can negatively affect companies, and Wang, Pfohl, Berbner, and Keck (2016) indicate that sharing much information among customers and suppliers can reduce the relational rents or financial income challenging to negotiate prices and favor the creation of monopolies. Likewise, *IS* can generate a better position for some suppliers or customers in the SC structure (Wang et al., 2016). Therefore, in this research, the following items are used to evaluate the *IS* variable (Kim & Chai, 2017; Pérez-López et al., 2019; Pham et al., 2019):

- The company and SC partners exchange critical information as demand forecast.
- The company and SC partners exchange timely information.
- The company and SC partners exchange accurate information.
- The company and SC partners exchange complete information.
- The company and SC partners exchange classified information.
- There is *IS* between the SC department and others.

Companies with *GC* will only share strategic information to reach beneficial joint objectives since *IS* tasks are considered a competitive advantage (Kim & Chai, 2017). If companies do not have common goals, they will not have any motivation to participate in the inter-organizational information exchange (Samaddar et al., 2006). Effective *IS* can be used for strengthening teamwork and alleviate conflicts of objectives among partners. For example, in supplier selection, purchasing companies must consider the cost, delivery time, and quality; however, it is necessary to understand the objectives and reliability of suppliers. Conflicts of dysfunctional goals can appear, and opportunistic behavior diminishes the willingness to *IS* and compromises relationships' longevity (Wang et al., 2016).

Therefore, the following hypothesis is proposed:

H_1: *Goal congruence* has a direct and positive effect on *Information sharing* in maquiladora companies.

2.3. Decision synchronization (DS)

DS refers to a process where SC partners organize joint decisions aimed at SC optimization through their planning and operational strategy (Zhang & Cao, 2018). According to Simatupang and Sridharan (2002) and Kwon and Suh (2004), in *DS*, partners coordinate planning and operations activities to optimize benefits that help to resolve conflicts or disagreements. *In addition, DS* includes the design of collaborative decision-making processes, reassignment of decision rights to synchronize planning and execution of the SC that seeks to match demand with supply (Yee, Gijsbrechts, & Boute, 2021).

There are several critical managerial decisions in SC, such as demand management, strategy planning, purchasing, and production scheduling. In the planning process, joint decisions are necessary among partners to identify the most efficient and effective way to use and optimize resources to achieve a specific set of objectives (Cao & Zhang, 2011). Joint decisions also may include sales and order forecasts, inventory, replenishment, order placement, order delivery, customer service level, and pricing (Yee et al., 2021).

Joint planning lets to align all partners and to make operational decisions associated with replenishment of inventory and periodicity of delivery (Cao & Zhang, 2011), forecasting sharing (Van Belle, Guns, & Verbeke, 2021), and inventory management for bullwhip effect mitigation due to a fast decision making process and solution to problems in SC (Dai, Peng, & Li, 2017). In addition, the *DS* helps the SC members perform productive actions associated with the integrated processes, such as replenishment, transportation, and customer service (Yee et al., 2021).

Effective decision timing relies on its effects on the precise response to meet customer demands (i.e. logistics benefits) and SC profitability (i.e. business benefits) (Corbett, Blackburn, & Van Wassenhove, 1999). In this work, the following items are used to evaluate the *DS* variable (Bhattacharya et al., 2014; Um & Kim, 2019):

- The company and SC partners jointly plan on promotional events.
- The company and SC partners jointly develop demand forecasts.
- The company and SC partners jointly manage inventory.
- The company and SC partners jointly plan on product assortment.
- The company and SC partners jointly work out solutions.

GC in inter-organizational cooperation is often framed as a facilitator for creating value for the organizations involved (Ding, Dong, Liang, & Zhu, 2017). The concept of congruence presents the notion that SC collaboration needs a certain degree of understanding and mutual agreement between specific attributes, beliefs, and business practices (Cao & Zhang, 2013). In a successful collaboration, individuals invest resources to create bonds that transcend individual exchanges by creating a collective bond network (Cuevas, Julkunen, & Gabrielsson, 2015). Joint decision-making with SC partners is critical to carry out inter-organizational operations and the development of long-term plans. In this way, partners can make collective decisions regarding demand forecasting, inventory management, agreed delivery time, and jointly shared common objectives throughout the SC (Pradabwong, Braziotis, Pawar, & Tannock, 2015). Therefore, the following hypothesis can be proposed:

H_2: *Goal congruence* has a direct and positive effect on *Decision synchro* in maquiladora companies.

Collaboration among partners changes the way of doing business in a SC. According to Rodriguez Rodriguez (2008), companies evolve from cooperation to collaboration and always require IS. SC members' information spontaneously shared through their daily collaborative relationships must be a platform to develop a deeper insight into the SC that requires innovation (Liao et al., 2017). The amount of information provided along the SC can be inferred through collaborative relationships to improve the effectiveness in SC capacity through synchronized and jointly decisions, giving agility and flexibility (Liao et al., 2017). *IS* (including orders, market demand, inventory, backlog, etc.) reduces inventory levels and reduces service levels by increasing the processing requirements for backorders. This according to a study by (Lau, Huang, & Mak, 2004). According to Wei, Zhao, and Hou (2019), *IS* always

benefits the manufacturer and benefits the retailer and the whole SC under certain conditions; *IS* increases/decreases the positive effect of the retailer's/manufacturer's forecast on the optimal pricing strategies in its SC; however, its impact depends on the parameter conditions in the other complementary SC. In a SC, information is shared horizontally and/or vertically or combined with these two types of *IS* to increase the *SCP* and benefits gained using joint decisions (Wei et al., 2019). According to Yee et al. (2021), to ensure effective collaboration between SC members, defining mutual goals and associated performance measures clearly and linking these to *DS*, *IS*, and incentives alignment for mutual benefit.

In that sense, the following hypothesis can be presented:

H_3: *Information sharing* has a direct and positive effect on *Decision synchro* in maquiladora companies.

2.4. Supply chain performance (SCP)

The basic premise of service metrics is to measure how well customers are being served to anticipate, capture and satisfy customer demand with customized products and on-time delivery (Hausman, 2004). Performance measurement is a process or activity that aims to collect, analyze and evaluate data on the success of an individual, a department, a division, a business organization, or even an entire SC (Taschner & Charifzadeh, 2020). For Liliana Avelar-Sosa, García-Alcaraz, and Maldonado-Macías (2019a), *SCP* is the ability to understand the customers' needs associated with product accessibility, timely deliveries, and inventory levels.

SCP is a construct that measures and quantifies the efficiency and effectiveness of the SC processes (Maestrini, Luzzini, Caniato, Maccarrone, & Ronchi, 2018). Then, to evolve to an efficient and effective SC, SC management must be assessed for its performance, which is a critical problem in several industries (Delic & Eyers, 2020).

According to Lihong (2012), *SCP* can be measured in two ways: (1) measuring the level of customer satisfaction and (2) monitoring the total costs incurred. Other authors indicate that *SCP* can be divided into operational and organizational metrics. The first focuses on internal processes and their indexes as inventory rotation, lead and delivery time, and financial health. At the same time, organizational metrics concentrate on culture, leadership, employee training and preparation, and market sharing (L. Avelar-Sosa, García-Alcaraz, & Cedillo-Campos, 2014).

Tripathi and Gupta (2019) present 40 key performance indicators of SCs within which are: accuracy, asset management, efficiency, employee development, environment-friendly, flexibility, free from error, management commitment, among others.

Measuring costs is the first choice when assessing efficiency in a CS, focusing on analyzing its processes (Taschner & Charifzadeh, 2020). However, customer satisfaction is also a vital quality indicator measured by questionnaires covering different product characteristics and the perceived relevance of these characteristics. It can also be done by customer complaints (lower complaints, higher satisfaction), abandonment rates, or loyalty measures (Taschner & Charifzadeh, 2020).

Another factor in measuring the *SCP* is the delivery time since it allows monitoring its reliability in speed and time. Usually, the percentage of orders delivered by the supplier on the agreed delivery date is measured (Wisner, Tan, & Leong, 2014). Likewise, SC cycle time measures the total time required to fulfill a new order if all internal and upstream inventory levels were zero. It is estimated by summing the most extended lead times (bottlenecks) at each SC stage (Hausman, 2004).

Companies also measure SC visibility levels (Szymczak, Szuster, Wieteska, & Baraniecka, 2013) for achieving customer satisfaction levels of at least 96%, reduced inventory levels of 20% to 30%, and are twice as probability as their competitors to have on-time delivery rates of 95% or higher (Ross, 2015).

Finally, synergy is another metric in *SCP* where partners combine complementary resources to achieve indirect benefits (Cao & Zhang, 2010). Synergy triggers collaboration among SC partners, which generates commitments among them to improve performance indices, which requires the commitment and willingness of the parties ((Xu, Bo, & Chen, 2021). In summary, better collaboration among CS partners increases profits due to synergy through complementary resources and collaborative processes (Tanriverdi, 2006).

However, evaluating the *SCP* is not an easy task because SC integrates several partners who cooperate to achieve logistical and strategic objectives (Lihong, 2012). For example, Mokhtar, Genovese, Brint, and Kumar (2019) have studied the leadership and governance mechanisms as variables for improving *SCP*, while Mani, Gunasekaran, and Delgado (2018) have analyzed the supplier social sustainability. For a resume about quantitative models and variables used for *SCP* evaluation, please read the Lima-Junior and Carpinetti (2017) report. For a deep analysis regarding *SCP*, its collaboration, alignment, and coordination, please read Botta-Genoulaz, Campagne, Llerena, and Pellegrin (2010). Concluding, the *SCP* function and its metrics must be carefully chosen to decide how to organize the SC (Rasool, Greco, & Grimaldi, 2021).

In this research, *SCP* variable is evaluated by the following items (Liliana Avelar-Sosa, García-Alcaraz, & Maldonado-Macías, 2019b; Reddy. K et al., 2019):

- Deliveries to customers are complete and on time.
- Customers are completely satisfied; there are no claims.
- The *SCP* is continuously improving.
- Cycle time from suppliers to customer delivery is low.
- Focus on cost reduction.
- The *SCP* allows economic flow.
- A visible SC.
- Level of product customization.
- SC synergy.

Companies that collaborate with their customers and suppliers can generate many benefits, including reduced time for new product development and manufacturing (Zhang & Cao, 2018). Companies and their SC members who work collaboratively in opening communication, sharing resources and goals, risks, and rewards should enjoy reciprocal benefits (Pradabwong et al., 2015). Therefore, generating relationships between partners instead of working individually can represent a competitive advantage, causing improved organizational performance (Um & Kim, 2019). In that sense, the following hypothesis can be proposed:

H_4: *Goal congruence* has a direct and positive effect on the *SC performance* in maquiladora companies.

IS generates benefits for companies, such as reducing inventories and costs, better monitoring and optimized capacity utilization, higher trades, and a superior understanding of demand (Kaipia, 2006). Pérez-López et al. (2019) indicate that *IS* also involves performance criteria associated with production-quality data, early achievement date, and production capacities among partners. *IS* helps reduce the bullwhip effect by exchanging information with clients and reducing delivery time (Pamulety & Pillai, 2011). SC members who exchange information efficiently can better understand the customer needs and respond faster to market volatility (Wang et al., 2016).

Building a trust relationship in SC contributes to sharing sensitive information such as forecasts and customer demand between buyer and supplier (Swink, Melnyk, Cooper, & Hartley, 2014). Hall and Saygin (2012) analyzed, through simulation, the effect of *IS* through factors such as capacity limitation, resource reliability, and the different modes of information exchange (sharing reliability information, customer demand, and inventory level) on *SCP* in terms of lead times and total cost. Their findings show that these factors are statistically significant but that the modes of information exchange function were uniquely when the main and interaction effects are analyzed. Yuan, Viet, and Behdani

(2019) studied the value of horizontal logistics collaboration in the Dutch horticultural SC using a simulation model to study the possible factors influencing performance in such partnerships. Their findings show that a higher frequency of information exchange can improve performance.

Marinagi, Trivellas, and Reklitis (2015) analyzed the *IS* as a mediating effect between the quality of the *IS* and the *SCP* of manufacturing companies in Greece and concluded that the *IS* between partners facilitates a greater overall performance, as a result of SC management that increases the reliability and quality of information. Costantino, Di Gravio, Shaban, and Tronci (2015) analyzed the effect of *IS* on ordering policies by comparing traditional policies and a coordination mechanism based on ordering policy to improve *SCP* through a simulation model. The results show that the *IS* successfully achieved an acceptable performance in terms of the bullwhip effect and inventory variation. As can be seen, SC partners must share information appropriately and reliably for better SCP.

Otherwise, an interruption (intentional or not) of information shared can significantly impact the profits, and the beneficiary of these profits must ensure that they obtain reliable information and transmit this information to the other partners in the. SC (Rached, Bahroun, & Campagne, 2015) Therefore, to know if the *IS* influences the performance of the SC in maquiladora companies, as has been demonstrated using simulation by Hall and Saygin (2012), the following hypothesis is proposed.

H_5: *Information sharing* has a direct and positive effect on SCP in maquiladora companies.

is how SC partners coordinate activities in planning and operations to improve SC benefits (Simatupang & Sridharan, 2005). Among these activities, there is the joint development of demand forecasts, inventory management, and solutions. That is why forecasting and demand planning are critical factors in a successful SC implementation as a management strategy. With collaborative forecasting, all SC partners in demand decisions are compromised (Helms Marilyn, 2000). A better forecast facilitates increasing supplier supply rates, improving stock levels, and reducing reserve stock; however, decisions in demand forecasting require the dependence among SC partners to provide detailed, precise, and timely information regarding the demand (Rodriguez Rodriguez, 2008).

The precision and demand efficiency communication throughout the SC is directly connected inventory and customer service (Helms Marilyn, 2000). In the same way, SC members must decide the quantity and type of products to be supplied or delivered to customers. In that sense, Umpfenbach, Dalkiran, Chinnam, and Murat (2018) define assortment as the set of products a manufacturer builds and offers to its customers. It is essential to planning the assortment to maximizes sales, profits, or gross margin while satisfying numerous limitations, budget, shelf space, and capacity (Kök, Fisher, & Vaidyanathan, 2009).

According to that discussion, the following hypothesis is proposed:

H_6: *Decision synchro* has a direct and positive effect on the *SC performance* in maquiladora companies.

Fig. 1 resumes the proposed hypotheses, illustrating the dependent and independent variables.

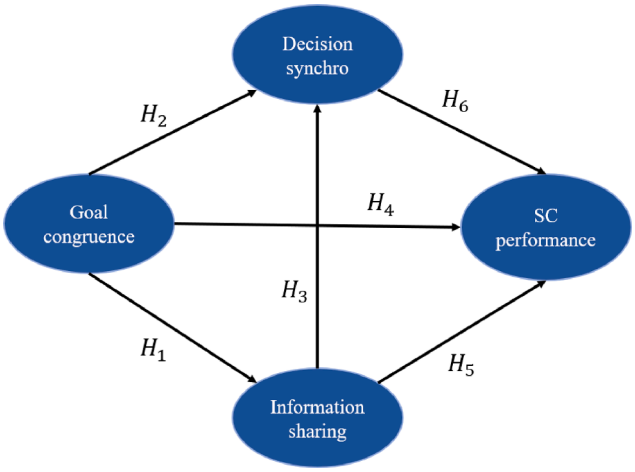

Fig. 1. Proposed model.

3. Materials and methods

3.1. Model validation

In this research, some activities were performed as described below:

As a first step, a questionnaire is developed based on a literature review carried out in different databases such as ScienceDirect, springer, and Scopus to search for relevant SC information about the four latent variables in the model. Within that literature review, a questionnaire prepared by Cao and Zhang (2011) was found to assess the SC collaboration impact on competitive advantage and companies performance, which was used as the basis in this research. Similarly, an independent variable called *SCP* was created with nine items from the literature review.

Four academics and three managers did review the proposed questionnaire to guarantee an adequate translation and adequacy to the maquiladora context. The final questionnaire must be responded in a five-point Likert scale and was applied to personnel in the maquiladora industry in northern Mexico, specifically in Ciudad Juarez, which was done through face-to-face interviews. Participants were selected by stratification from all industrial subsectors.

The information obtained from questionnaires is registered in a SPSS 25® software database for its debugging by estimating the standard deviation for responses in each questionnaire to identify uncommitted participants. If the value is under 0.5, the questionnaire is discarded (Arnab, 2017). Next, the missing values are identified, and if the total of these is over 10%, then the questionnaire is eliminated; otherwise, the missing values are replaced by the median (Hair, Black, Babin, & Anderson, 2010).

Extreme values are identified by standardizing the items, and if the absolute value is over four, it is replaced by the median (Hoffman, 2019). Finally, the validation of the variable is carried out. The following indexes are used (N. Kock, 2019): R^2 and Adjusted R^2 for parametric predictive validity (better if > 0.2), Q^2 for non-parametric predictive validity (better if > 0), Cronbach's alpha and composite reliability index for internal consistency (better if > 0.7), the average variance extracted (AVE) for convergent validity (better if > 0.5), and variance inflation factor (VIF) for collinearity (better if < 3.3).

Once the latent variables are validated, they are integrated into the structural equation model (SEM) executed in the WarpPLS v.6.0® software. SEM is a statistical technique used in business science and engineering because it can model latent variables and test complete theories (Henseler, Hubona, & Ray, 2017). The partial least squares (PLS) method is chosen since it is recommended when samples are small, observed variables do not have a normal distribution, or information is obtained from valuations (Ned Kock, 2015), as in this research.

Before interpreting the model results, its efficiency indexes are analyzed, where a 95% confidence level is used for its estimation. The indexes are as follows (N. Kock, 2018):

- Average path coefficient (APC)
- Average R-squared (ARS) with a 95% hypothesis test
- Adjusted Average R Squared (AARS)
- Variance inflation factor (VIF)
- Average block variance inflation factor (AFVIF) with acceptable values under 5
- The goodness of Fit (GoF) with acceptable values over 0.36

- Once the model is validated, it analyzes the effects involved in the model; these effects are direct, indirect, and total.

3.2. Sensitivity analysis

WarpPLS reports standardized values for latent variables, and conditional probabilities can be estimated and used for sensitivity analysis (N. Kock, 2018). In this research, we investigate different scenarios for every hypothesis tested in Fig. 2. The scenarios analyzed are for variables in high when P(Z > 1) and low when P(Z < -1). Specifically, the following probabilities are reported:

1. The probability that a latent variable is presented isolated in a low or high scenario, for P(Z < -1) and P(Z > 1), respectively.
   a. The probability that both variables in and hypothesis co-occurs in combined levels according to the following way: $P(Z_i > 1 \cap P(Z_d > 1)$.
   b. $P(Z_i > 1 \cap P(Z_d < -1)$
   c. $P(Z_i < -1 \cap P(Z_d > 1)$and
   d. $P(Z_i < -1) \cap P(Z_d < -1)$.

a. The conditional probability of finding a scenario in a latent dependent variable, given that a scenario has occurred in an independent latent variable. The combinations are:$P(Z_d > 1)/P(Z_i > 1)$

b. $P(Z_d > 1)/P(Zi < -1)$

c. $P(Z_d < -1)/P(Z_i > 1)$ and

d. $P(Z_d < -1)/P(Z_i < -1)$.

$P(Z_d)$ represents the probability of a standardized dependent latent variable and $P(Z_i)$ for an independent latent variable.

4. Results

4.1. Sample: Descriptive analysis

From the application of the questionnaires, 143 persons did answer the questionnaire. Table 1 indicates the gender and years of experience for managers who respond to the questionnaire. It is observed that 51 (35.66%) have more than ten years of experience, indicating that information comes from experts. In contrast, Table 2 shows the job position and industrial sector.

4.2. Latent variables validation

Table 3 shows the validation indexes for the latent variables in the model. According to that information, there is enough predictive validity from a parametric point of view due to the R-squared, and Adj R-squared values are >0.5. Also, there is internal consistency since, for each latent variable, the composite reliability and Cronbach alpha indexes are >0.7. There are no collinearity problems in the same way because the Full collinearity VIF is lower than 3.3 in all variables. There is also non-parametric predictive validity since the Q-squared values are over 0.5 and similar to the R-squared values. Therefore, it is concluded that latent variables can be integrated into the SEM.

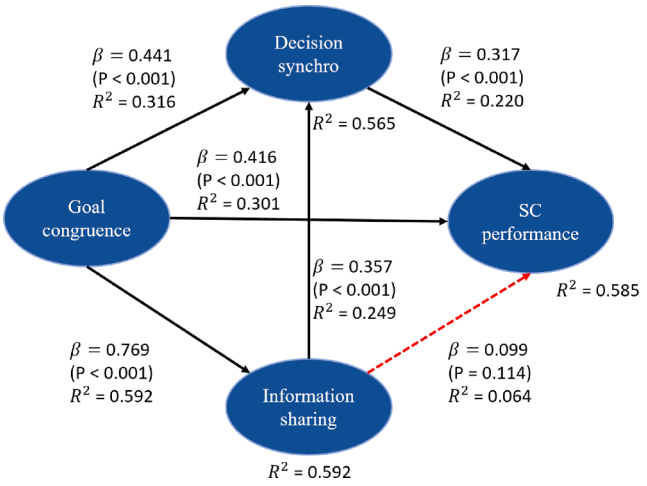

Fig. 2. Evaluated model.

Table 1
Sample description: years of experience and gender.

Gender	Years of experience				
	>1 - <2	2 -<5	5- <10	> 10	Total
Female	11	15	11	18	55
Male	16	26	13	33	88
Total	27	41	24	51	143

4.3. Structural equation model

Table 4 presents the model fit and quality indexes. Based on values for APC, ARS, and AARS indexes and their p-value, the model has enough predictive validity. According to the values under 3.3 for AVIF and AFVIF indexes, it is concluded that collinearity is not a problem. Finally, according to the GoF = 0.610, it is concluded that the data has a good fit for the model. As a general conclusion, the direct, indirect, and total effects can be estimated.

4.3.1. Direct effects

Fig. 2 shows the model evaluated, and three different values can be observed on each arrow. The β value for measuring the direct effect between latent variables, their p-values as a statistical test for validating that relationship, and, finally, the R^2 value as a measure of variance explained. In Fig. 2, five out of the six hypotheses proposed are statistically significant since their p-value is under the significance level of 0.05 (95% confidence level). For example, in H_1, the *GC* variable directly and positively affects *IS* with a value of β = 0.769, meaning that *IS* increases by 0.769 units when *GC* increases its standard deviation in one unit. Likewise, *GC* explains a $R^2 = 0.592$ of the *IS* variable. The same results apply to the other four hypotheses. The H_5 hypothesis is not statistically significant since the p-value is >0.05, marked with a dotted line in red color.

4.3.2. Indirect effects

Table 5 shows the indirect effects. For example, there is a direct effect from *the GC* variable on *SCP*. However, there are two indirect effects with two arrow segments and an indirect effect with three arrow segments, which has a value of β = 0.303 that represents an effect size (ES) = 0.219, which means the variance explained indirectly. The same happens with the *IS* variable on *SCP*; the DS variable has an indirect effect with a β = 0.113 value and an ES = 0.073, but here the indirect effect between these two variables is statistically significant; that is, *IS* has a relationship with *SCP*; however, in this model, it has this influence through the *DS* variable.

4.3.3. Total effects

Finally, Table 6 shows the total effects presented in the model of Fig. 2. It is observed that the effects with the highest value are those provided by the *GC* variable on the three dependent variables: *IS* (β = 0.769, ES = 0.592), *SCP* (β = 0.179, ES = 0.520), and *DS* (β = 0.716, ES = 0.513), which makes it the most critical variable in the model, since it is the one that contributes the most directly to the variance.

4.4. Sensitivity analysis

Table 7 illustrates the sensitivity analysis, where high levels are indicated with a (+) symbol and (-) symbol for a low level in latent

Table 2
Sample description: job position and industrial sector.

	Automotive	Aeronautic	Electric	Electronic	Logistic	Machining	Medical	Other	Total
Manager	35	4	4	4	4	9	2	2	64
Supervisor	19	0	3	0	3	1	2	2	30
Engineer	32	1	3	5	2	4	1	1	49
Total	86	5	10	9	9	14	5	5	143

Table 3
Validation of latent variables.

	SC performance	*Information sharing*	*Goal congruence*	*Decision synchro*
R-squared	0.585	0.592		0.566
Adj. R-squared	0.576	0.589		0.559
Composite reliability	0.922	0.920	0.890	0.910
Cronbach alpha	0.904	0.895	0.834	0.877
Average variance extracted	0.567	0.658	0.669	0.670
Full collinearity VIF	2.339	2.631	3.244	2.379
Q-squared	0.591	0.593		0.567

Table 4
Model fit and quality index.

Index	Value	p-value
APC	0.400	$p < 0.001$
ARS	0.581	$p < 0.001$
AARS	0.575	$p < 0.001$
AVI	2.624	
AFVIF	2.648	
Tenenhaus GoF (GoF)	0.610	

Table 5
Indirect effects.

From	To	Beta	ES	p-value
Goal congruence	*Decision synchro*	0.275	0.197	$P < 0.001$
Goal congruence	*SC performance*	0.303	0.219	$P < 0.001$
Information sharing	*SC performance*	0.113	0.073	$P = 0.026$

Table 6
Total effects.

From	To	β	ES	p-value
Goal congruence	*Information sharing*	0.769	0.592	$P < 0.001$
Goal congruence	*Decision synchro*	0.716	0.513	$P < 0.001$
Goal congruence	*SC performance*	0.719	0.520	$P < 0.001$
Information sharing	*Decision synchro*	0.357	0.249	$P < 0.001$
Information sharing	*SC performance*	0.212	0.137	$P = 0.004$
Decision synchro	*SC performance*	0.317	0.220	$P < 0.001$

variables. If two variables appear simultaneously in some scenarios or levels, they are represented by the "&" symbol and conditional probabilities by "if".

For example, for hypothesis H_1, there is a probability of 0.091 of having *IS* and *GC* at their high level simultaneously and having *IS* at a high level given that *GC* is at its high level is 0.565. Regarding the H_2 hypothesis, the probability that *DS* appears at a high level and *GC* at a high level simultaneously is 0.119. The probability that *DS* will be presented at a high level, given that *GC* is presented at its high level, is 0.739.

Therefore, managers, supervisors, or administrators must ensure that agreements on common objectives are fulfilled because that is essential for cooperation and collaboration among partners in SC.

5. Conclusions

According to findings obtained in Fig. 1, it is concluded that five hypotheses can be accepted, and one rejected, and Table 8 resumes the conclusions.

For the relationship between *GC* and *IS* in H_1, it can be concluded that there is a direct and positive effect of 0.766, implying that if SC partners have joint agreements on strategic objectives and perform collaboration, then companies require timely, accurate, complete information exchange. The most important thing is that this activity is facilitated through information and communication technologies implementation. This finding is similar to the report given by Pérez-López et al. (2019) that indicates that ICT promotes *IS* and *DS* in a maquiladora SC.

From sensitivity analysis, it is observed that there is a probability of 0.091 that *GC*+ and *IS*+ co-occur, and 0.565 to find *IS*+ given that *GC*+ has happened, which indicates the need to integrate common goals among partners and this is supported by Samaddar et al. (2006) in the automotive sector. However, there is a probability of 0.091 to find *GC*- and *IS*- simultaneously and a probability of 0.565 to find *IS*- given that *GC*- has occurred. That means that if there are no common goals among SC partners, then adequate information flow cannot be guaranteed.

For hypothesis H_2, there is a direct effect of 0.441 from *GC* on *DS*, indicating that if SC partners have mutual goals, there will be a better process of joint decision-making associated with demand forecasts, inventory flow, and product distribution. Besides, the sensitivity analysis for these variables indicates a probability of 0.119 that both co-occur at their high level. However, there is a probability of 0.739 to get *DS*+ given that *GC*+ has occurred, indicating that common goals favor joint decision-making. Our findings support the report from Yan and Dooley (2013), indicating that *GC* and communication among partners are associated with project performance due to a fast joint decision-making process. Besides, there is a probability of 0.077 that those variables occur at their low levels and a probability of 0.478 that *DS*- is present given that *GC*-, and that is why managers must procure a GC+ among partners and that is confirmed, because a *GC*- never generates a *DS*+ since the probability is zero.

For H_3, it is concluded that *IS* has a direct and positive effect of 0.357 on *DS*, indicating that correct *IS* among SC partners generates an efficient decision-making process (accurate and on time). That generates better forecasts on demand, joint inventory management, product assortment, and fast solutions to problems. These findings are similar to Wei, Wang, and Lu (2021) reports, indicating that *IS* facilitates *DS* during product greening improvement and facilitates the optimal joint pricing strategies. From sensitivity analysis is observed that there is a probability of 0.098 that IC+ and *DS*+ co-occur. Also, there is a probability of 0.538 that *IS*+ generates *DS*+; however, there is a probability of 0.458 to find *DS*- if companies have *IS*-, which is a high risk for managers. In other words, if managers do not ensure an adequate information flow, good decisions cannot be taken jointly, which is confirmed by observing that *IS*- does not generate *DS*+ since the probability is zero.

Regarding H_4, GC on SCP has a positive and direct effect because $\beta = 0.416$, indicating that if partners have common and *GC*, they will have full- and on-time deliveries. The sensitivity analysis suggests a

Table 7
Sensitivity analysis.

			Dependent variables					
			Information sharing		*Decision synchro*		*SC performance*	
Independent variables		Level	+	–	+	–	+	–
		P(Z)	0.182	0.168	0.203	0.154	0.203	0.196
Goal congruence	+	0.161	& = 0.091	& = 0.000	& = 0.119	& = 0.000	& = 0.084	& = 0.000
			If = 0.565	If = 0.000	If = 0.739	If = 0.000	If = 0.522	If = 0.000
	–	0.161	& = 0.000	& = 0.091	& = 0.000	& = 0.077	& = 0.000	& = 0.133
			If = 0.000	If = 0.565	If = 0.000	If = 0.478	If = 0.000	If = 0.826
Information sharing	+	0.182			& = 0.098	& = 0.000	& = 0.091	& = 0.000
					If = 0.538	If = 0.000	If = 0.500	If = 0.000
	–	0.168			& = 0.000	& = 0.077	& = 0.000	& = 0.091
					If = 0.000	If = 0.458	If = 0.000	If = 0.542
Decision synchro	+	0.203					& = 0.119	& = 0.000
							If = 0.586	If = 0.000
	–	0.154					& = 0.000	& = 0.098
							If = 0.000	If = 0.636

Table 8
Conclusion for hypotheses.

H_i	Independent latent variable	Dependent latent variable	p-value	β	Conclusion
H_1	*Goal congruence*	*Information sharing*	<0.001	0.769	Accept
H_2	*Goal congruence*	*Decision synchro*	<0.001	0.441	Accept
H_3	*Information sharing*	*Decision synchro*	<0.001	0.357	Accept
H_4	*Goal congruence*	*SC performance*	<0.001	0.416	Accept
H_5	*Information sharing*	*SC performance*	0.114	0.099	Reject
H_6	*Decision synchro*	*SC performance*	<0.001	0.317	Accept

probability of 0.084 that *GC*+ and *SCP*+ co-occur and 0.133 occur at their low level, which is a high risk for managers. Similarly, there is a probability of 0.522 of having *SCP*+, given that *GC*+ has occurred, which indicates a high relationship between these variables. As Cuevas et al. (2015) indicate, *GC* guarantees trust among SC members in large European organizations at the food sector. Also, there is a probability of 0.826 that *SCP*- occurs given that *GC*- has occurred, which denotes the importance of having high *GC* with partners to avoid that scenario. Also, *GC*- never is associated with *SCP*+ and *GC*+ never is associated with *SCP*-, that is, managers with high *GC*+ always will reach benefits associated with CS performance.

For H_5, statistical evidence declares that *IS* does not directly affect *SCP* because the p-value associated with β is higher than 0.05. This result is different from Pérez-López et al. (2019) regarding operational *SCP*. However, we find an indirect and total effect statistically significant, indicating the critical role of *DS* as a mediator variable for decision agility. From sensitivity analysis is observed that there is a probability of 0.091 to find *IS*+ and *SCP*+ simultaneously. However, there is a probability of 0.500 to find *SCP*+ given that *IS*+ had occurred, confirming the indirect relationship among them, and managers must pay attention to *DS*+ to facilitate *SCP*. However, if *IS*- has occurred, then *SCP*- can occur with a probability of 0.542, which means a high risk for SC managers. Also, *IS* never is associated with *SCP*+ and *IS*+ or with *SCP*-, confirming the indirect relationship. However, this finding differs from Hall and Saygin (2012) and requires profound research in maquiladora due to its location nature and *IS* requirements for headquarters companies in other countries.

Regarding H_6, it is concluded that *DS* has a direct and positive effect on *SCP*, since $\beta = 0.317$, indicating that decisions making synchronized among SC members allows a better delivery time to customers, low costs, greater SC visibility, among others. Sensitivity analysis shows a probability of 0.119 that *DS*+ and *SCP*+ co-occurring and 0.098 for *DS*- and *SCP*-; therefore, managers should focus on achieving a *DS*+ in their SC. However, there is a probability of 0.586 of having *SCP*+, given that *DS*+ has occurred, but there is also a risk of 0.636 to occur *SCP*-, given that there is *DS*-. It is also observed that *DS*+ is not associated with *SCP*- and that *DS*- does not generate *SCP*+, since those probabilities are zero, enforcing managers' efforts to develop a good *DS*.

Finally, it is essential to mention that *IS*, *DS*, and *GC* are the only crucial variables studied for increasing SCP, which is a limitation. Other authors as Asamoah, Agyei-Owusu, Andoh-Baidoo, and Ayaburi (2020) have studied the inter-organizational systems and SC management capacities for improving *SCP*; Goh and Eldridge (2019) have analyzed the effect of sales, operation planning, and coordination mechanisms on *SCP* and also Katiyar, Meena, Barua, Tibrewala, and Kumar (2018) have studied the impact of sustainability and manufacturing practices on *SCP* in India. This means that similar research is necessary on the maquiladora industry, given its unique characteristics as the high volume in the production process, the energy required, environmental impact, direct and indirect effects on human resources health, government regulations, and regional infrastructure to grow. All those topics are opportunities for future research.

CRediT authorship contribution statement

Jorge Luis García-Alcaraz: Methodology, Software, Validation, Formal analysis, Writing – original draft, Writing – review & editing. **José Roberto Díaz-Reza:** Conceptualization, Investigation, Project administration, Visualization, Supervision. **Francisco Javier Flor Montalvo:** Software, Investigation, Writing – original draft, Writing – review & editing. **Emilio Jiménez-Macías:** Conceptualization, Methodology, Software. **Julio Blanco-Fernández:** Data curation, Investigation, Formal analysis.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cie.2021.107744.

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