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The Role of Employees' Performance and External Knowledge Transfer on the Supply Chain Flexibility

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Abstract. In this article structural equation models are reported, which relate four latent variables associated with employee performance, knowledge transfer, and supply chain flexibility, which incorporate 17 observed variables. In addition, the latent variables are related through 6 hypotheses that were tested with data from 269 questionnaires applied to the maquiladora industry in Ciudad Juarez, Mexico. Moreover, this model was executed in WarpPLS 6.0 software using the partial least squares technique to analyze the direct, indirect, and total effects. Additionally, the results show that the external knowledge transfer is crucial within the supply chains, since it explains 44.6% of the complexity, 19.5% of the employees' performance, as well as 10.6% of the supply chain flexibility.

Keywords: supply chain, maquiladoras, structural equation modeling.

1 Introduction

During the last two decades from the twentieth century, maquiladora industries have had a great importance in the Mexican economy. The maquiladoras are export assembly and processing plants specialized in labor-intensive products, and since 1965, favorable economic regulations have been established with the United States [1]. Since then, the proximity to the US market and the relatively cheap workforce labor have made Mexico one of the most favored offshore destinations for US companies for a long period of time. In addition, these maquiladoras have established strategies to reduce costs and waste, as well as generally apply advanced production processes and implement new methodologies. Likewise, they are distinguished by importing all raw materials and exporting all finished products, and because of materials flow in their supply chains (SC), which is an area of opportunity for further research [2].

Nowadays, due to the increase of uncertainty and complexity about the SC environment, companies must improve their competitiveness by reducing delivery time and changing the production level, since the company's operating capacity depends on the efficient operation network of supply chains in the company. Slack [3] proposed the concept of supply chain flexibility and noticed that this is the ability of its members to respond in a timely manner, according to customers' needs. Also, flexibility could

reduce the low demand impact, as well as reduce the maintenance costs because of unsold items [4].

Currently, the SC is no longer limited to the physical distribution, the information flow or funds flow [5]. Knowledge transfer (KT) is also added to the supply chains and it is considered as a strategic resource that affects the entire competitive advantage of the SC [5], which is the process where intra- and inter-organizational factors exchange, receive, and are affected by the knowledge from other ones. Also, external knowledge is transferred through collaboration agreements between external aspects (for example, clients, suppliers, and research institutes), and companies [6].

For this reason, SC management (SCM) improves competitive capabilities and performance by integrating the internal functions of the company and associating them with suppliers and customers operations effectively [7]. In order to be successful in SCM, applications that aim to achieve the high supply chain performance, external integration with suppliers and customers is needed, as well as the integration between the internal functions of the company [8], which generates knowledge that must be managed, and that is considered a critical success factor (CSF) in the SCM.

Furthermore, this knowledge is generated from people who are essential for the company success [9], because employees with high commitment consider their organization worthwhile and they are proud to work at [10]. Therefore, they will share all their efforts into working well for the organization, they will do it with greater autonomy, they will develop basic competences more quickly and, in addition, they will tend to be more receptive to any task that is given, and in this way, the probability that the company achieves a better performance will increase. Hence, the implementation of successful management in a supply chain requires effective management from human resources and superior employees' performance [11].

2 Literature Review and Hypothesis

CSF are the few key areas where the favorable results are absolutely necessary for a particular manager to reach their objectives, and it is because these areas are critical, and there must be the adequate information to determine whether the events are working adequately [12]. As a consequence, it is fundamental to identify the CSFs to manage the SCs, since they represent a wide variety of strategies dedicated to improving operational efficiency and competitiveness. [13]. In the literature review, CSF are reported for the appropriate SC management, for instance Kumar, Singh [13], have identified a total of 13 CSFs to implement SCM, such as Senior management commitment, Development of reliable suppliers, Higher flexibility in production systems, among other. On the other hand, Avelar-Sosa, García-Alcaraz [14] identified and classified 77 CSFs into four categories; risk attributes, regional attributes, manufacturing and performance practices, these categories are divided into latent variables, which are related by structural equation models to measure the impact on the SC performance. Also, Özdemir, Simonetti [7] report 25 CSFs, which are divided into 3 latent variables.

As it can be observed, there is a lot of literature review related to CSFs in the SC, and even that relates them through SCM, however, the CSFs from the External knowledge transfer (EKT), Supply chain complexity (SCC), Employee performance (EP), and Supply chain flexibility (SCF) from the maquiladora industries in Ciudad Juarez, Mexico. In the present article, these variables are linked through a SCM, therefore, the CSFs on each of these variables are described through a causal mode, as well as the impact that they have on when the SCF is measured.

2.1 Hypothesis

External Knowledge Transfer

The current globalization and innovation trend in the business environment has brought many external and internal challenges for modern companies, such as the volatile and changing market, large organizations, different product choices, etc. [15]. In addition, this change also increases the complexity and, therefore, threatens companies' performance. For instance, one area that is seriously affected is the SC, which requires the ascending and descending relationships with suppliers and customers management in order to deliver high quality to the customer at a lower cost along with the supply chain as a whole [16]. Consequently, the following hypothesis can be proposed:

H_1: The EKT has a direct and positive effect on the SCC.

The knowledge transfer is a system created to address client's needs and expectations in a more technical way to avoid misunderstandings and errors that may result in inefficiencies [17]. For companies that operate in the manufacturing industry, knowledge can be seen as the cornerstone of the business to complete quality products with success, elimination of waste, and defects in a short period of time, as well as deliver the product as needed according to clients [18]. In addition, it is a complex process involving education, learning, knowledge communication and promotion to employees and leaders [19]. Also, the employees' performance is key for the success of any organization; in manufacturing, employees are still relevant in the production process, but most important are the initiators and drivers of changes as well as improvements in design, monitoring and evaluation, therefore, the following hypothesis can be presented:

H_2: The EKT has a direct and positive effect on EP.

Supply Chain Complexity

The SC complexity grows as the client requirements, the competitive environment, and the industry changes, as well as SC companies are part of strategic alliances, carry out mergers and acquisitions, subcontract functions to third factors, adopt new technologies and launch new products/services, and extend their operations to new geographies, time zones, and markets. Due to its complexity, SC networks are difficult to understand, describe, predict, and control, in order to reduce the level of uncertainty in these networks, it is necessary to understand the different roles of the members in the SC, their interactions and the transition models that they use to interact with each other. In

addition, employee commitment is a relevant tool to help each organization to strive to obtain a competitive advantage over others, since people are a factor that cannot be duplicated or imitated by competitors, and it is considered the most important asset if it is properly managed and performed [20]. Also, employees' performance is basically the results obtained and the achievements in work. Performance refers to maintaining plans while aiming some results [20].

H_3: The SCC has a direct and positive effect on EP.

Employees Performance

Work performance is the result of three factors that work together: skills, efforts, and the nature of working conditions [21]. In addition, an appropriate employees' performance in an organization has many implications, such as great motivation, outstanding ability, an acceptable climate, and organizational infrastructure, excellent leadership that can maintain the relationship and productivity as well as an adequate relationship with the staff [21].

Moreover, KT is related to continuous improvement to achieve a high level of productivity [19]. In addition, significant sources of new knowledge and innovations are suggestions for employees and partners established in the production network (for example, suppliers and customers), as well as the commitment of highly qualified people. Also, the knowledge transfer is not only essential for people and/or companies to seek for a better performance, but it has also been increasingly recognized as a moral challenge in organizations [22]. Therefore, the following hypothesis can be proposed:

H_4: The EKT has a direct and positive effect on EP.

Supply Chain Flexibility

A SC is definitely a complex system that integrates a large number and a variety of relationships, processes, and interactions between and within companies, dynamic processes and interactions where several levels of the system and a large amount of data is involved. Also, some companies in cyclical industries increasingly face a volatile demand and must adjust their production volume quickly without incurring significant costs [23], since there is a high probability that customers will suddenly increase, reduce, cancel or advance or regress their orders, factors in the supply chain must be more flexible in many ways [24]. Therefore, the following hypothesis can be established:

H_5: The SCC has a direct and positive effect on the SCF.

Moreover, SCs must be more responsive to the customers changing requirements, as well as offer an added value above the average, therefore, the manufacture flexibility and the SC is becoming one of the key objectives for manufacturers [23]. Also, the commitment to training and development of multidisciplinary workforce may improve the workers capabilities to manage different products as well as handle different operations and tools, while contributing to increase the ability of companies to move from the production of a product to another in a combination with other products, and

minimize transition penalties, which contribute to higher levels of product flexibility [25].

In this way, the following hypothesis is proposed:

H_6: EP has a direct and positive effect on the SCF

Figure 1 presents the hypotheses that related the variables.

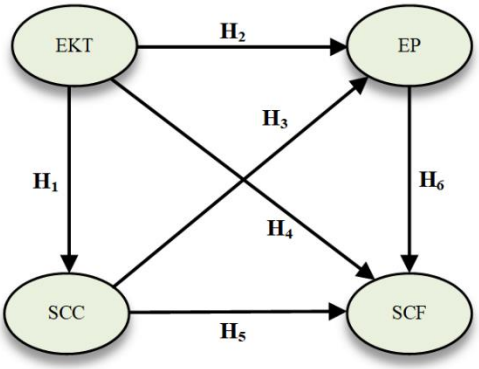

Fig. 1. Proposed model.

3 Methodology

3.1 Questionnaire Development

In order to carry out this research, the questionnaire by Blome, Schoenherr [26] was implemented, which other study variables were added, such as, for example, employees and SCs performance. In the first part, demographic data are requested while the second part consists of 33 items divided into seven different variables. In addition, in the current work, only four variables were used; EKT, SCF, SCC and EP.

Furthermore, the items for each of the latent variables are the following: EKT (Suppliers are able to share their experiences in new technology with researchers, there were frequent meetings with suppliers to develop new knowledge, where the purchaser-provider relationship is technical addressed to integrate the supplier into our new products and processes); SCF (Short-term adjusting of suppliers' order of goods and services, adjusting deliveries to customer changes, reducing manufacturing lead time, reducing development cycle times, adjusting manufacturing process capacity, increasing frequencies of new product introductions); SSC (The number of our direct suppliers is high, long-term plans of our procurement activities are hampered by high dynamism, our suppliers often do not supply on time or the desired quality), and EP (High employee morale, high employee productivity, fast troubleshooting, high usage of employees skills and abilities, internal customers' concept is widely understood).

Finally, in order to answer each of the questions, a Likert scale of five points was used, where 1 represents that the activity that is never performed whereas 5 indicates that it is always done.

3.2 Questionnaire Validity

The data registration and purification were performed in the SPSS 21® software, where the standard deviation of each questionnaire was calculated, as well as missing values are identified as extreme values, which are replaced by the median. In order to validate the latent variables analyzed in the model, several indexes are used, such as R^2 and Adj. R^2 to measure the predictive validity, the Compound Reliability Index and the Cronbach's alpha are used for internal reliability, the Average Variance Extracted (AVE) to measure the predictive validity, the average full collinearity VIF to measure the multicollinearity, finally, Q^2 is used to measure the nonparametric predictive validity.

3.3 Equation Structural Modeling

The proposed hypotheses in Fig. 1 are tested using the structural equation modeling (SEM) technique in WarpPLS 6.0® software. In addition, the efficiency indexes from the analyzed models are: average path coefficient (APC), average R^2 (ARS), average variance inflation factor (AVIF), and average full collinearity VIF (AFVIF), and Tenenhaus (GoF), all proposed by Kock [27].

Moreover, the relationships between variables are called effects, the direct effects are represented by arrows (each one represents a hypothesis), the indirect effects that occur between an independent variable on a dependent variable, through a mediating variable, and the total effects, which are the sum of the indirect effects plus the direct effects. In order to determine the significance of each effect, the P values associated with a β value are estimated for a hypothesis test with a level of significance of 0.95, that is, H0: $\beta = 0$; H1: $\beta \neq 0$, and the size effect (SE) is also reported for each dependent latent variable [28].

4 Results

4.1 Descriptive Analysis of the Sample

From the questionnaire application and after the database debugging, a total of 269 valid cases of individuals working in the companies were obtained, where, 53.15% (143) have between one to two years in the position, 17.47% (47) have up to 5 years, and, 29.3% (79) have over 5 years working within the industry. In the same way, the industrial sectors that participated are distributed as follows: automotive sector with 119, electronic sector with 42, machinery with 27, aeronautical with 25, medical with 15, also 10 questionnaires were from different sectors to those already mentioned. Finally, 22 participants left that question without an answer.

4.2 Questionnaire Statistic Validation

In Table 1, the values of the indexes for each latent variable used in the model are shown, where it can be observed that they are achieved, and the analysis is proceeded.

Table 1. Variables validation.

	SCF	*EKT*	*EP*	*SCC*
R^2	0.415		0.453	0.446
Adj. R^2	0.409		0.449	0.444
Composite Reliability	0.911	0.901	0.934	0.876
Cronbach´s Alpha	0.877	0.835	0.911	0.830
Avg. Var. Extracted	0.671	0.752	0.738	0.541
Full Collin. VIF	1.687	1.968	2.013	2.087
Q^2	0.418		0.455	0.444

4.3 Structural Equation Modeling

The results from the efficiency indexes of the model are the following: APC = 0.357 and a value P <0.001, ARS = 0.438, P value <0.001, AARS = 0.434, and a P value <0.001, which shows that they are statistically significant. In addition, the values AVIF = 1.892 and AFVIF = 2.628 demonstrate that there is no collinearity problems, finally, according to the GoF value = 0.589 index, it is concluded that the model has enough explanatory power.

Direct Effects

In Fig. 2 the β and P values can be observed for each of the direct effects or proposed hypotheses in the model from Fig. 1, it can be seen that each of these hypotheses are statistically significant since the P value for each is under 0.05.

Indirect Effects

Table 2 presents the four indirect effects, which are integrated by two segments, where it is observed that all values are statistically significant according to the associated p value.

Total Effects

Table 3 portrays the total effects (sum of the direct and indirect effects), likewise, the P values are shown for each of them, and it is observed that all values are statistically significant. Also, the largest effect within this model is caused by the EKT towards the SCC with a value of 0.668

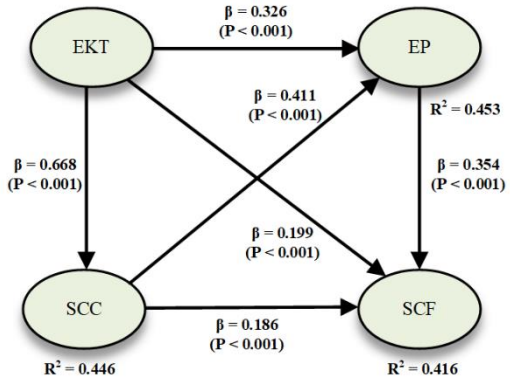

Fig. 2. Evaluated model.

Table 2. Indirect effects for 2 ways segments.

	Independent Variables	
Dependent Variables	EKT	SCC
SCF	0.240 P < 0.001 ES = 0.128	0.145 P < 0.001 ES = 0.079
EP	0.274 P < 0.001 ES = 0.164	

Table 3. Total effects.

	Independent Variables		
Dependent Variables	EKT	EP	SCC
SCF	0.536 P < 0.001 ES = 0.285	0.354 P < 0.001 ES = 0.209	0.332 P < 0.001 ES = 0.179
EP	0.600 P < 0.001 ES = 0.359		0.411 P < 0.001 ES = 0.258
SCC	0.668 P < 0.001 ES = 0.446		

5 Conclusions

According to direct effect results, the following can be concluded:

- It is observed that the largest effects are those from the EKT variable.
- The 0.453 from the EP is explained by 0.195 because of the EKT while 0.258 because of the SCC variable.
- Finally, the 0.416 from the SCF is explained in 0.106 by the EKT, in 0.209 by EP, and in 0. 101 by the SCC variable.

- As it was already mentioned, the external knowledge transfer is an essential for companies, since it is vital that the relationship between supplier-purchaser is very close, in order that the data is shared in real time, therefore overcome the changes in the demands.
- The employees' participation in the flexibility is relevant, since they are the ones who develop the activities to overcome the changes in the demand, as well as they are the ones that make them fit in the production processes to fulfill on it.
- It is important to have an adequate number of suppliers and avoid having more than required in order to avoid delays and low-quality products that may delay tasks.

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