A MODEL FOR CONCEPTUALIZING THE KNOWLEDGE IN SUPPLY CHAIN RELATIONSHIPS. CASE STUDY: MANUFACTURING SMEs IN THE STATE OF HIDALGO, MEXICO

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Abstract

We present a conceptual model between the relations of knowledge in small and medium-sized manufacturing enterprises and their supply chains in the State of Hidalgo, Mexico. It is structured according to the dynamics of their environment, features internal this type of organizations and different models identified in the literature, being the premise identification and analysis capabilities of the processes that shape enterprise and chaining with their suppliers and customers.

Keywords: SCM, Relations-of-Knowledge, Manufacturing Enterprises, SMEs

Introduction

The development of the State of Hidalgo has been difficult, since its inception, it has been located among the poorest States of Mexico. Found that the main players in economical, political and social interest in the past did not show enough interest and strategies to harmonize knowledge and start together the industrial development of the State. As a result, regional-industrial development shows disadvantages in the environment.

Knowledge of industrial sectors, their environment and the impact of interrelations chain supplier-customer have strengths and weaknesses

(Montaño *et al*., 2010 and Ludlow, 2013). Polese, Davies and Kochhar (2002) mention that company's progress through stages of sequential knowledge in the implementation and improvement of its processes.

Gumbus and Lussier (2006) indicate that companies of all sizes are good in the development of mission statements and strategies, but poor in the ability to implement them for lack of experience on good practices and lack of knowledge of their processes, on the other hand Horvath (2001), Wu *et al*. (2006) and Ngai *et al*. (2011) described that the motivation for the collaboration of companies consists of understanding and improving the overall performance (*internal and external*) of the supply chain, where intense competition forces to create close relationships with its partners in all direction to facilitate its operation. Accordingly, it is necessary to develop a model that link the knowledge of the supply chain, which taken into account the characteristics of the environment and the human resources linked to the system, which is a necessary tool that will identify which act to control, level, improve and gain access to a better competitive position. On another hand, Maciariello and Calvin (1994) mention that control and systems are the basis for good performance.

Models that identify knowledge and move capabilities are representing the systemic approach and tools that allow decisions supported by feedback from your dynamic media. For example, currently markets are conquered by the organizations that have tools that provide relevant information from the advantages and threats of the environment in which they interact; which allow you to make internal adjustments to time and manner to have controls that are more efficient and make better decisions. The development of a model for identifying the level of knowledge and skills according to the conditions of its environment seeks the following:

- Integration of organizations in systems that support their stay at feedback (benchmarking), knowledge, innovation and its ability to respond quickly;
- Knowledge that provides information in real time *(indicators)*;
- Think in the medium and long term;
- Competitive stability;
- Continuous improvement;
- Sustainability.

Case of Study

The State of Hidalgo is located in the Central Highlands of the Mexican territory, on a surface of 20,905.12 km2, belongs to the South-central subregion, between latitudes 19 ° 35' and 21 ° 25' North latitude and 97 ° 58' and 99 ° 52' West longitude; with a population of 2,732,894 inhabitants. (Government of the State of Hidalgo, 2012). It is comprised of

84 municipalities, organized in 11 economic regions: Pachuca, Tulancingo, Tula, Huichapan, Zimapan, Ixmiquilpan, Actopan, Metztitlán, Molango, Huejutla and Apan (Government of the State of Hidalgo, 1993).

Economic and industrial development of the State of Hidalgo shows an unbalanced progress, which is reflected in the presence of different degrees of progress and well-being between economic regions that make up the entity. According to Mexican Business Information System, in the year 2013 the State of Hidalgo had registered 2,225 companies in the industrial sector, where 1,042 belonged to SMEs, which represent the 1.05% at the national level,

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Table 1. Number of companies in the industrial sector by size in Mexico and the State of Hidalgo according to Mexican Business Information System to the year 2013.

Sector	**Size**					**Total**
	Micro	Small	Medium	Large		
	National					
Industry	54,098	39,876	3,313	1,423		98,710
	Hidalgo State					
Industry	1,167	982	60	16		2,225

The information registered by the Government, found that major efforts are directed toward large companies, as described below:

- Nineteen strategic projects for the industrial sector, which had committed to invest 19 million pesos and support 14,157 new employments, were established between April and March to 2013. Stimulus to innovation programs were also developed in 43 companies in the period of 2011 to 2013, with an investment from the federal Government of 177.5 million pesos and contribution of the private sector by 164.3 million pesos, which went mainly to large companies.
- The Ministry of economy in conjunction with the private sector in the year 2009 developed the study (Evaluation of the performance of Supply Chains in Mexico and generation of national indicators), which was focused on large companies.

On the other hand, does the SMEs CUMex network carry out the study in 2010, which are the main areas where they have experience in sales (40%), Administration (22%), engineering (10%) production (9%) and finance (9%), where we also found that less than 16% of SMEs have lasted

more than five years on the market. Table 2 shows the percentage of the main practices in the State of Hidalgo and the States with which it competes.

Table 2. Leading practices in the companies of the State of Hidalgo, State of México and Puebla**.** according to SMEs CUMex network in 2010.

Include	Hidalgo	Puebla	State of Mexico
Plan development	51 %	54%	45%
Documented procedures	45%	53%	56%
Documented functions	45%	53%	56%
Organization	56%	49%	66%
Training	37%	39%	35%
Use the information technologies (*Internet*)	85%	87%	73%
Using information technologies (*WebSite*)	13%	14%	15%
Company that apply techniques of quality	55%	53%	29%
Company certified in quality	28%	30%	22%
Market research	63%	52%	47%
Analyzes to the competition	36%	19%	19%
Innovation in the final product	32%	39%	52%

The Plan of development state of the State of Hidalgo in the period 2011-2016, describes that despite the significant contribution of micro, small and medium-sized enterprises in the State economy, these not have been able to consolidate as factors for the promotion of development, since in the current economic space of globalization faced many obstacles and delays. Financing, low competitiveness, technology, quality systems and the environment, are some of the factors that determine the capacity of subsistence to economic periods. The micro and SMEs enterprises that recorded better competitive position, were identified by having better trained managers, not be family, think strategically, having appropriate occupational schemes and social security for their workers, as well as for having a technological infrastructure, which makes it possible to create synergies that have an impact on the companies in the same sector.

Accordingly, the needs that the State of Hidalgo will strengthen from its bases, which we grouped into: infrastructure, regulatory, framework agreements based on a strategic vision between Government, economic bodies, political actors, entities that have the knowledge and the capacity for innovation and society. For this reason, been seeking strategies and proposals that will help to achieve better conditions for competitiveness and certainty for investment in small and medium-sized enterprises of the industrial manufacturing sector, when an entrepreneur think placing its capital to see to Hidalgo as their best option (Montiel and Avila, 2009). In Mexico and the State of Hidalgo, SMEs are the base for the employment and business

development, in addition to being the main providers of supplies of large companies, where his area of opportunity is supplying customers in a more direct way and be suppliers of higher quality of large companies. However, one of its limitations are economic resources, access to technology and on all access to the knowledge that enables you to adapt and grow in a globalized world, where the administration of knowledge and its application has taken a critical role for the present and its future development.

Measuring

There must be a system of measurement that specifies in precise and explicit way reaches to understand the system, the environment and their interrelation, the measurements are important because: If systems cannot be measured, they can not be managed, measure is a critical component of any system (Lorino, 1995). The system of measurement and their interpretation affects the behavior both internally and externally, the incorrect indicator and the wrong measurement leads to imprecise knowledge, which results in equivocal or negative knowledge (Sydenham, 2003).

It should be noted that there is no stability, organizations must be administered within a constant change, which can be translated in the change imposed on the company: environment evolves continuously, the innovation does not stop, technologies progress, available in the labour market qualifications are transformed, competition presents new aspects and adopt new strategies. All these movements changed permanently competitive data, and therefore its efficiency.

Many companies employed indicators to measure their skills and development, and compares them to determine whether it meets the competitive standard, which can be a partial perception, because based on the results obtained, it must be understood if the organizational knowledge that has been acquired is sufficient to generate new knowledge, disseminate it among the members of the Organization and materialize it in products and services (Nonaka and Tackeuchi, 1995).

The most famous model of measurement is currently the Balance Scorecard (Kaplan and Norton, 2002) which handles four perspectives (knowledge and learning, processes, customer and financial) of indicators in an organization. Indicators should be aligned and should be capable of providing the causal history of the Organization in terms of past actions and as a guide for the actions of today and tomorrow.

Understanding Supply Chains

Supply chains represent societies of autonomous business, which involved together in the solution of common problems of optimization in multiple operations (Whitman *et al*., 2001). With the collaboration and

collective effort, these businesses reached the progress of each one of its members as in the remaining members of the group, Figure 1.

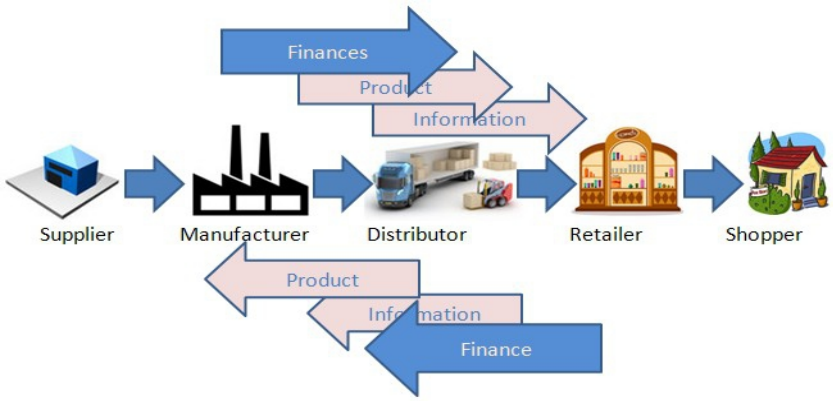

Figure 1. Supply Chains Representation According (Sethupathi *et al*, 2013).

Corrales *et al*. (2012), Flynn *et al*. (2010) and Stank *et al*., (2001), show that the integration of the supply chain consists of three dimensions: internal, with customers and suppliers; the internal integration refers to activities within manufacturing company, and is the degree in which this structure their own strategies, practices and organizational processes in a collaborative way. Integration with customers and suppliers is known as external integration, which is the degree in which the company along with their external partners of the supply chain structure inter-organizational strategies, practices, and collaboration processes, synchronizing its processes.

An important aspect of the supply chain is its management, which has been confused since its inception with the logistics, whether in industry, consultancy or the Academy (Pires and Carter, 2007). According to Arango *et al*. (2008), the management of companies is the comprehensive result of the sum of all parts that make up each of the processes of the Organization and influence the result of the activities that relate to the outside. In 1998, the Council of Logistics Management modified its definition of logistics to indicate that it is a subset or subarea of the management of the supply chain and that the two terms are not synonymous. At the end of the 1990s stipulated the following:

"Logistics is part of the processes of the supply chain which plans, implements and controls the flow of cash and the stock of goods, services and relevant information from the point of origin to the point of consumption in order to meet the needs of customers"

Correa and Gómez (2009) mentioned that the application of information technologies in the management and logistics of supply chain

contributes to the synchronization of processes, but at the same time, stipulate that the main obstacles for its implementation is the trust in the process.

Therefore, the measurement of performance is important and whenever possible in an integrated way, which is difficult to do if they do not know and control subsystems that interact. Currently, the companies with the best competitive performance tend to be have better integrated their key processes with our external suppliers and customers, forming chains of supply consistent and well-defined procedures and purposes, (Simatupang and Sridharan, 2004).

Precursors Model of Change

A systemic approach must be assumed able to study and integrate supply chain, where: is the system dimension and distinguished relations that make up the flow of each of the links. The base is the fulfillment of standards, which are based on the feedback of information, the measurement of the flow of resources, the maturity of knowledge and its application for the correction of deviations, without losing sight that competes with other systems.

We are in a globalized world and high competitiveness, where there are forces vying in the different sectors based on their chains of value (Porter, 2002), in which, every day should be reviewing the market and the strategies, which must be fed back through a benchmarking, supported in the chain of value and indicators that allow to determine best practices. Also, is observed that the majority of SMEs disappear in the early years, by not having the ability to understand and respond to your competitive environment, but as well as they disappear, are also created and that gives an effect of compensation, where the learning curve is cyclic.

It should not be forgotten that we live in an era where companies are increasingly aware of the management of knowledge as a key factor to improve their efficiency and competitiveness (Grundstein, 2008).

Therefore, there is evidence the need for development through:

- Synergy: population, government, research centres, institutes and private initiative;
- Development of scenarios;
- Vision and mission-aligned, shared and attached;
- Utilization of intellectual capital;
- Knowledge management;
- Strategies and alignment;
- Implementation;
- Information systems;

- Logistics; and
- Control of deviations.

Successful companies realize that having a good strategy is not enough. It is necessary to use models that simplify the complexity of the supply chain, such is the case of the SCOR model created by the Supply Chain Council (Huan *et al*., 2004 and Poluha, 2007), which can describe any supply chain in all their amplitude is simple or complex, the model also provides bases to facilitate management and improve the supply chain (Stewart, 1997 and Palmetto III and McCormack, 2004).

Supply chain studies have tried to assess the knowledge and capacity of the processes involved and how their relationship is causal, Netland *et al*. (2007) reviewed several existing models of maturity and developed the above in table 3, where the most representative model is the Palmetto III and McCormack (2004).

Table 3. Models of supply chain based on knowledge
(source: adapted from Netland *et al*., 2007).

Model	Author	Description and Field Study
SCM Process Maturity Model	Lockamy and McCormack (2004)	The model describes the degree of integration of the processes in the supply chain, probably is the most developed maturity model for the supply chain. It uses the structure of the SCOR for Supply Chain Council, and is based on the Capability Maturity Model. The model is based on the orientation of business processes (BPO).
SC Capability map	Srai y Gregory (2005)	The supply chain capabilities maturity is based on the vision and resources.
Benchmarking of logistical operations	Van Landeghem and Persoon (2001)	System audits of the operations of logistics based on best practices within a causal model 84.
Operations Excellence audit scheme	Alfnes, Dreyery Strandhagen (2005)	Scheme of qualitative audit for manufacturing and lean manufacturing operations. It relies on a sheet of operations excellence audit, based on the fifteen best practices of lean manufacturing.
The diagnostic Tool	Foggin, Mentzer and Monroe (2004)	Diagnostic tool to know how to choose supplier, the base is a questionnaire of decision tree.
Global Logistics Capabilities Diagnostic	SC Digest	Global diagnostic of the logistics operations through a questionnaire of simple consultation.
Supply Chain Visibility Roadmap	Aberdeen Group (2006)	Methodology to assess the degree of visibility in the supply chain.
The Supply Chain Maturity Model	IBM (2005)	Description of levels and degree of integration in the supply chain.

Knowledge Management in Supply Chains

In the research and development centres where knowledge management is something essential for his actions daily, are obliged to make decisions, sometimes without a base technical or scientific when evaluating the contribution of the (*know-how*) in logistics consulting services (Ferdows, K. 2006.). In recent years, the activities of innovation and the knowledge management in enterprises have grown significantly and there has been progress in the understanding of the importance for economic development.

In this sense, several years have highlighted several sectors, but it is necessary, however, continue to make efforts in incorporating elements of higher added value, product of intellectual of tangible products as well as the increase of products based on the management of knowledge and the radical in terms of supply chains innovations increased. Knowledge is seen as the apex of a pyramid of intellectual development (Kahn *et al*. (2006) and Anand *et al*. (2010), where the basis is that data from processing and comparison are converted to values of information.

Supply chains have differents events along a logistic channel, the application of knowledge in these events and every link incorporates intangible added value to the processes are redesigned with the aim of achieving better performance, therefore intends to motivate the actors of the logistics scenario to a growing scientific trend in the contribution of intangible value along the supply chain to increase the quality in that string and quantify what really means the knowledge management in logistics chains (Schoenherr, T., *et al*. 2014).

Apparently, the knowledge management is not more than the selection of the appropriate personnel for every job in the company, but that this staff to become a carrier of values to the logistics chain must comply with the ideal requirements. Competition in the daily performance, with relevant search results, initiatives, successful decision-making and high power of self-development pushes the individual to become the focus of the contribution of intangible values.

The (*know-how*) is nothing more than a heap of accumulated experiences or software having an organization that allows you to play activities in certain fields of human knowledge, there are two types of value chain: the intrinsic that is typical of every process in the supply chain, i.e. (transportation, production, storage, sales, etc) the second is given by the relations between each link in the logistics chain (Lee, D., and Van den Steen, E. 2010). Processes in the same are of diverse nature and each one incorporates a knowledge value to it. Become a knowledge sharing relationships between these processes to optimize workflows is a complex of logistic process. Not always achieved, because there are many factors that have to be set:

- Management of Supply (stock analysis, estimation of suppliers, procurement and transportation);
- Transportation Management (types of vehicles, grouping of loads, multimodal, transit, etc.);
- Production Management (projects, commissioning, releases, assessment, control of quality, optimal lots size, etc.);
- Warehouse Management (arrival of goods, review, reception, storage, picking and delivery).

On the other hand, the building on the knowledge-based view and the theoretical distinction between explicit and tacit knowledge, that knowledge management capability across the supply chain manifests itself in explicit and tacit knowledge, which in turn effectuates supply chain performance. Within this setting, key aspects of competitiveness are encapsulated within the knowledge of logistics and supply chain partners, making knowledge management within the supply chain an important area of study. Knowledge management is crucial for managerial decision making in logistics and supply chain management due to the fundamental nature of knowledge for problem solving and ensuing strategy development. Despite considerable research on the creation and management of knowledge, the field has been described as still being in an embryonic stage within the domains of logistics and supply chain management (Madhavaram, S., and Hunt, S.D. 2008). Within this context, supply chain knowledge can be defined as the use of knowledge resources obtained from supply chain members for economic gain.

Specifically, employing the literature on knowledge generation and the Knowledge-Based View (KBV), we contend that the presence of Supply Chain Knowledge Management Capability manifests itself in the two knowledge types of explicit and tacit knowledge (Perols *et al*. 2013). Supply Chain Knowledge Management Capability (SCKMC) is conceptualized as a comprehensive and integrative set of knowledge management competencies consisting of knowledge acquisition, knowledge conversion, knowledge application and knowledge protection. We further theorize the impact of explicit and tacit knowledge on supply chain performance, with tacit knowledge exerting a stronger influence than explicit knowledge. Our contentions are tested with a SMEs, a context which provides a unique opportunity to study knowledge management dynamics (Durst and Edvardsson 2012). SCKMC may be especially valuable for SMEs (Narula 2004), due to their often limited resources in developing specialized expertise inhouse (Lu and Beamish 2001).

Business Analysis Maturity Model (BAMM)

BAMM seek to determine the behavior, attitudes, skills, tools, mechanisms and systems of learning, contributing to the homogeneous growth of organizations, so mapping the cycle of knowledge of organizations is an effort that will help in the categorization of the growth patterns in a systematic, systemic and dynamic way (Churchill and Lewis, 1983).

The proper construction of a model helps to organizeassess and examine the validity (Cabanis, 1998) and wins sense to speak of a certain degree of maturity and make an effort to measure and characterize the maturity of organizations point out routes to keep a continuous process of improvement (Andersen and Jessen, 2003).

Currently most of the models are based conceptually in the Capability Maturaty Model developed by the Software Engineering Institute at Carnegie Mellon University, as well as with Humphrey and his team at IBM in the early 1980s. They are aware that the quality of a software product is directly related to the quality process, which is used for its development and related it the implementation processes of the cycle's Shewart-Deming, PDCA (Plan-Do-Check-Act), which seeks continuous improvement.

For the conceptualization of a maturity model (Montaño *et al*. 2010) accurate to organizations to learn and, insofar as they are learning, are maturing, and according to how are maturing, they can be more efficient.

Maturity is the culmination of a process of growth and development, which consists of the integration of many and diverse qualities; and involving the entire organization; Thus an organization focused on efficiency and success. According to Klimko (2003) and Montano *et al*. (2010), a maturity model could be considered under the following premises:

- Organizations learn sequentially, as this ability increases, increasing the maturity of their processes and the organization;
- The development of an organization is simplified and described as a limited number of levels of maturity;
- The levels are characterized by compliance with certain requirements, which the Organization must carry out in each level;
- Maturity levels are based on the use of their knowledge;
- Maturity levels are sequentially ordered;
- Organizations leverage their knowledge through their strengths and strategies; and
- Each level of maturity can only meet with some degree of strategy.

It is also important to take into account the knowledge transferred among organizations as mentioned by (Cheng, 2011), where he argues that when there is a collaboration between companies and their partners, you can create and maintain a base of constant knowledge sharing, through the

transmission of knowledge, which increases the understanding and mutual expectations.

A Proposed Model

Ribas (2006) and Barth (2003) stated that the skills of the companies will be based on knowledge of its processes and cooperation, arguing that only when the Administration has this knowledge about the internal and external conditions can develop a competitive strategy and an aligned structure that fit at the same time. The competitive ability of a supply chain depends of the level of technological, production and administrative knowledge, where must have the ability to identify, use and assimilate internal and external resources and information to facilitate the activities of the entire (Wu *et al*.2006, and Ngai *et al*., 2011). For the model proposed in the first instance is taken as reference the model developed by Montaño *et al*. (2010) shown in Table 4, which conceptualizes fourteen practices that contribute to the development of a small and medium-sized manufacturing companies of the industrial sector.

Table 4. Model comprising the levels of maturity through practice to SMEs in the industrial sector, according to (Montaño *et al*., 2010).

Practice	**Madurity Lavel**			
	0 - 1	> 1 - 2	> 2 - 3	> 3 - 4
Management Tool				
Politics and Strategy				
Organization				
Planning, Growth and Regeneration				
Human Resources				
Business Continuity Management				
Communication				
Data Analysis Tool				
Enterprise Information Management				
Knowledge Management				
Maintenance				
Control to Financial Economics				
Production				
Renovation Technology Program				

For the causal model proposed, these fourteen practices is classified in tree blocks: 1) structure; 2) knowledge, and; 3) application, which are established in each subsystem of the supply chain (supplier, manufacturer and client), which is supplemented with contributions by Porter (2002), the maturity model developed by SEDESOL (2004) and the systemic approach (Gigch, 2007). Developed conceptual model, Figure 2.

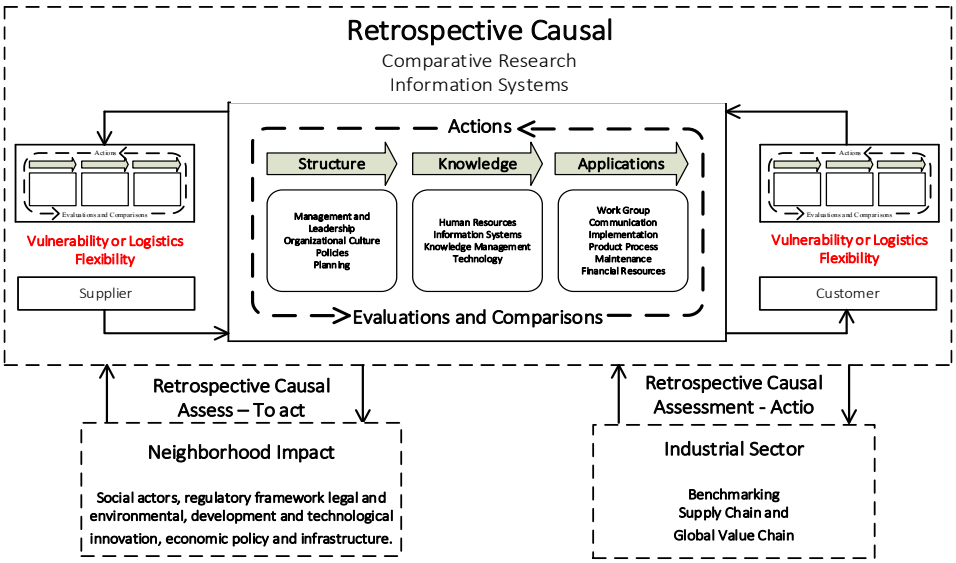

Figure 2. Causal Model of Knowledge for SMEs in Global Supply Chain (Source: own elaboration)

The structure represents the first pillar of the company, refers to functional design and Constitution of the Organization (SEDESOL, 2004) and as the basis for developing joint (Warrior, 2012), is the documentary and regulatory base that supports the realization of the tasks, concerning rules, policies, objectives, organization manuals, guidelines, operating guidelines, procedures, diagrams and forms of work.

Knowledge is the way to understand the functioning of the Organization, which is causal supplier-customer, which means to know the requirements, where the various tools and methodologies leverage to propose and continuously improve its application at different stages of the supply chain, i.e., to innovate. Taking advantage of the intellectual capital and the management of knowledge through information systems, are the basis for development and competitiveness, where the feedback in time, form, specificity, relevance, and place facilitating the management of the company. The application, this is where you create life and has meaning knowledge, its function is to develop an environment in work teams, properly apply the tools and improve them, using production processes according to requirements and the application of financial resources optimally, the goal is to optimize the results in every link and set of supply chain.

It is also important to understand the link between the feedback and assessment, which provides information to detect deviations or successes that it has incurred and the elements in your case to act and correct, which extends to all supply chain where feedback is, evaluate and act. The impact of the environment macro, where normally cannot intervene PyMEs, but if

opportunities or protect themselves against unfavourable events, social actors, are in this link frame legal and environmental regulatory, developments and technological innovations, policies (International, national and regional level), level of development of the infrastructure and economic movements.

We take special attention to logistics and information systems, because they are responsible for detecting and needs in a timely way to the supply chain, which makes it vulnerable but at the same time flexible in his performance (Young and Esqueda, 2004). Finally, the supply chain in which it participates must compare with other chains of the same competitive environment and develop an analysis for this sector (Porter, 2002) which give the guideline for decision-making. As noted by Ludlow (2013) and Fuji (2010) mention productive synchronization isn't enough, you have to take into account each of the components of the chain, innovation, policies of Government, external growth, strategic alliances, where increasingly must see the environment in shorter by the accelerated changes, which takes account of the proposed model.

Conclusion

The maturity models are tools able to identify organizations awareness and capacities of each of the participating processes that integrate supply chain; identifying the factors that affect the performance, providing the elements that help decision makers to know their status and develop better strategies for better positioning, and even simulate what could happen in the future with the decisions taken.

On the other hand, and in accordance with what you mention Diaz *et al*., (2005), corporations must be based on strategic alliances and conceptual models between customer-supplier that analyze critical processes and their collaborative networks in the supply chain, with the aim of generating knowledge and competitive advantages.

Finally, the models that determine the level of maturity are tools that companies should be adopting, because they have to compete in a globalized world, where the abilities and knowledge are the weapons of differentiation that can support the decisions, the success in the implementation of best practices, the further development and a better positioning in the future.

By these reasons; are necessary acquired the knowledge of each of the processes that integrate the supply chain, to determine response capabilities that allow tracking and monitoring their performance.

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