Knowledge Management as Intellectual Property: Evidence from Mexican Manufacturing SMEs

Abstract

Purpose - The present paper explores the relationship between knowledge management and creation of intellectual property within the context of small and medium size manufacturing enterprises.

Design/methodology/approach - A hypothesis was formulated and tested using structural equation modelling (SEM). Data was collected through an instrument that was developed based on key constructs adapted from the literature and that was first validated using Confirmatory Factor Analysis (CFA). A Cronbach's alpha test was also conducted and the Composite Reliability Index (CRI) was calculated to ensure reliability of the theoretical model. The instrument was distributed among manufacturing SMEs in the Aguascalientes region of Mexico, from were 125 valid responses were obtained.

Findings - In general, the results indicate that knowledge management has positive effects on the creation of intellectual property in manufacturing SMEs. This suggests that SMEs can create more intellectual property if they dedicate more efforts to the management of knowledge.

Practical implications - The implication of this research and its findings may inform the strategies formulated by policy makers, and the managerial practices that manufacturing SMEs can adopt to protect their knowledge.

Originality/value - Evidence suggests that studies focused on investigating the relationship between knowledge and intellectual property are limited. This paper provides a refined understanding of the relationship between knowledge management and intellectual property creation.

Keywords: Knowledge management, intellectual property, SMEs, Mexico.

1. Introduction

In the business economy of the new millennium, knowledge has become an essential competitive factor, especially for manufacturing SMEs. As a consequence, its management and protection are now an integral part of the competitive strategies of many of these organisations (Hanel, 2006). In particular, innovation activities that are developed by companies as part of its relationship and interactions with clients and suppliers require the management and protection of the knowledge that is created inside the companies (Wiig, 1997; Jacobides and Billinger, 2006; Dittrich and Duysters, 2007; Elmquis *et al.*, 2009). This is because the exchange and management of knowledge during these relationships and interactions can produce innovations that must be protected by means of intellectual property rights (Luoma *et al.*, 2010; Rabino and Enayati, 1995).

Similarly, the economy of the 21st century uses knowledge as its basis. Thus, this intangible resource has become a paramount activity for every organisation (Wang, 2011; Villar *et al.*, 2014; Boisot *et al.*, 2007). An example of this is the research done by Nakamura (2003), who showed that private companies in the United States increased their investment in intangible resources from one to five trillion dollars per year. It is therefore important that the management and assessment of knowledge produced by companies do not get abandoned but rather protected by intellectual property rights (Hands and Lev, 2003).

Intellectual property rights play an essential role in the safety and protection of the knowledge produced by a company's employees since the knowledge economy (in which all the company's personnel participates and even other companies that cooperate with such organisation) needs the intellectual property as a mean to safeguard the rights of such knowledge (Boisot *et al.*, 2007; Bostworth and Yang, 2000). Intellectual property rights are only a small part of the total knowledge produced by organisations. For this reason, it is important to understand that knowledge is not only subjective but that it can also be transferred to other people (Weidenfeld *et al.*, 2010; Vaara *et al.*, 2012; Hatak and Roessl, 2013).

As individual subjects, the management of knowledge and intellectual property have been explored, based on different priorities and directions, as separated research streams. For example, according to Perçin (2010), research on knowledge management has been mainly concentrated on defining and exploring the effects that different independent factors such as organisational structure and processes, resources, measurement, people, strategy, culture, training and education, and technology have on the success of an effective knowledge management strategy (Wong, 2005; Holsapple and Joshi, 2000; Davenport *et al.*, 1998; Liebowitz, 2001; O'Dell *et al.*, 1999; Forcadell and Guadamillas, 2002; Gold *et al.*, 2001; Grover and Davenport, 2001; Lee and Kim, 2001; Lee and Choi, 2003). On the other hand, Horn and Brem (2013) suggest that two of the main research streams, over the last few years, of intellectual property have been centred on its use and the use of external innovation networks (Lerner, 2009; Lichtenthaler, 2010) as well as trading with it (Horn and Brem, 2013).

However, despite the relatively broad body of knowledge and research on knowledge management and intellectual property, there is little empirical evidence, in the current literature, on the effect of knowledge management on the creation of intellectual property. In this context, a limited number of studies have been dedicated to explore this relationship, for example: Perri and Adersson (2014), Yang *et al.* (2004), Carlaw *et al.* (2006), Marinova and Raven (2006), Boisot *et al.* (2007), Lücking and Pernicka (2009), Orozco (2010), Paasi *et al.* (2010). Nevertheless, although these studies explore such relationship, they fail to specifically and quantitatively estimate the effect of dedicated efforts of knowledge management on intellectual property creation. In addition, given the importance and positive contribution that SMEs have on the economy (OECD, 2014) these studies have fallen short to investigate the relationship within this context. Thus, solid empirical support of the effect of knowledge on intellectual property in SMEs is currently limited. In this way, the present study addresses this shortcoming in the literature by empirically analysing the relationship between knowledge management and intellectual property within the context of SMEs from an emerging country (i.e. Mexico). For the purpose of this research, knowledge management is defined as the "systematic and integrative process of co-ordination organization-wide activities of acquiring, creating, storing, sharing, diffusing, developing, and deploying knowledge by individuals and groups in pursuit of major organizational goals" (Rastogi, 2000).

The paper has been organised in the following order: the second section discusses the theoretical framework, the empirical studies carried out previously, and formulates the research hypothesis tested through this work. The third section presents the methodology followed to conduct this research, including the design of the data collection instrument as well as its validation and distribution. The fourth section analyses the obtained results. Finally, the fifth section discusses the results and limitations of the research as well as presents the conclusions and future research agenda derived from this work.

2. Literature review

The protection of intellectual property rights is one of the essential elements of capitalism and a market economy. Rabino and Enayati (1995) reported that US companies potentially lose billions of dollars annually as a result of inadequate intellectual property protection from foreign companies. For example, intellectual property violations by Asian organisations cost

US computer software companies more than USD$6bn and pharmaceutical companies more than $500m a year (Pearce II, 2006). Intellectual property is one of the few constructs published that give certainty to private property of creations or innovations produced by human knowledge (Carlaw *et al.*, 2006). A basic argument that promotes the establishment of intellectual property rights is that they are implemented without the needed intervention of other market elements because the market automatically provides the rewards produced by the protection of intellectual property rights of knowledge generated by firms (Batabyal and Beladi, 2001).

Hence, knowledge and human creativity go beyond time, the globalisation of market economies and the geographical advantages that can be provided by the industrial group to which companies belong to (Marinova and Raven, 2006). Intellectual property ensures different financial benefits by registering patents, for example, even in the least developed areas or in the groups of society with the biggest disadvantages (Harry, 2001). Similarly, intellectual property associated to trade and distribution of benefits that produce the use of patents is an essential element that highlights the economic, environmental, social, cultural and spiritual value of information and human knowledge (Marinova and Raven, 2006).

Additionally, the literature provides important insights into knowledge dynamics demonstrating its significant effects on business performance and countries wealth. In general, such insights regard characteristics of specific knowledge management processes, like knowledge transfer, sharing and creation, and even human perceptions about knowledge. Sorenson *et al.* (2006), for instance, investigated the flow of knowledge as a search process, or innovation, by examining patent data, firstly concluding that proximity of social actors, participating in the process, determine greater advantages over distant ones. Secondly their study demonstrated that complex knowledge flows poorly, even with closer actors. The process of knowledge creation appears to be done by individuals and groups while doing and interacting with the environment, especially in highly innovative companies like software industry (Spraggon and Bodolica, 2008); and practices like rapid prototyping, virtual interactions, trial-and-error are exposed to have great impact on the knowledge creation process.

Besides, the intangible perspective of knowledge urges the need to measure contributions or benefits of this intangible capital onto companies' competitiveness and R&D activities. Subsequently, three indicators are suggested by Cotora (2007), in their patented tool to measure value creation in intangible assets; 1) dynamic, 2) impact, and 3) return. However, these insights about the knowledge dynamics agree that employees' behaviour is an important condition or cause of successful effects and measurements from any knowledge management effort. In fact, Andriessen (2006) suggests that the way metaphors are created and used to conceptualize knowledge itself may affect how knowledge is actually managed in companies, mainly if these are literally followed. The two most common metaphors are knowledge as resource and knowledge as capital (Andriessen, 2006). Therefore, if managers intensify knowledge dynamics they might have better control and improve their decision-making, policymaking, and strategies deployment that positively impact their business performance. In fact, knowledge sharing demonstrates to improve knowledge acquisition in firms, as Appleyard (1996) states, knowledge is a key competitive variable and it is important to recognize the different effects from the restricted levels of knowledge use and access channels in firms, and especially recognized in institutional patent systems, that have important effects on company's performance and economy countries growth.

The protection of intellectual property has been widely used to measure the return on investment of R&D in different industries such as those of the medical and pharmaceutical sectors (Brockhoff *et al.*, 1999; Kingston 2001), which have become two of the most profitable industries in the world (OECD, 2001). However, in the current literature, these industries have usually been accused of exploiting the traditional knowledge of plants to produce new drugs or products without any acknowledgement or economic benefits to the people that have developed and preserved this information (Posey and Dutfield, 1996). That is why is important to

register the intellectual property rights of products made by firms.

A clear example of the registration of intellectual property rights that produces the exploration and exploitation of knowledge is Nokia, which has created a structural alliance of long-term collaboration with other companies of intensive knowledge to increase local and international innovation activities (Dittrich and Duysters, 2007). However, there are other sectors, such as information technologies, in which there are few researches that have analysed the relationship between knowledge management and intellectual property and that allow a clear identification of the registration of intellectual property from innovations (Paasi *et al.*, 2010).

Furthermore, there is empirical evidence in the literature regarding the exploration and exploitation of knowledge in the field of management sciences. For example, March (1991) considered that both the production and exploitation of knowledge can be protected through intellectual property rights. Also, Grant and Baden-Fuller (2004), from the theory of knowledge management, distinguished the acquisition and access to knowledge in company alliances, which could be protected by intellectual property rights. Consequently, the access to knowledge between company alliances can be used in the creation of new businesses while the acquisition of knowledge in company alliances can produce a higher activity of innovation (Paasi *et al.*, 2010).

In this sense, an alliance among companies commonly generates new knowledge that is used by the companies participating in such collaboration process, where knowledge is transformed into new products or services that will provide economic and financial resources to organisations in order to continue generating new knowledge (Grant and Bade-Fuller, 2004). However, this knowledge belongs to both suppliers and manufacturing enterprises. Alternatively, two or more companies participating in the alliance should protect such knowledge by intellectual property rights in order to ensure its exclusive usage by those that have created it (Paasi *et al.*, 2010).

Similarly, suppliers usually have greater knowledge about its clients' products; also, they have enough information about clients and final consumers' tastes and needs. Thus, this knowledge can be shared with the manufacturing companies if stated in an agreement of mutual alliance, with the aim of generating new knowledge that can be transformed into better or new products (Paasi *et al.*, 2010). Therefore, this type of alliances between companies (supplier-buyer) may have greater access to such knowledge generated in the market, and thereby, an endeavour to protect it by intellectual property rights (Enkel *et al.*, 2005; Blomqvis *et al.*, 2008).

On the other hand, both knowledge management and intellectual property interact inside firms and they usually produce innovation activities that change constantly with suppliers and customers because, according to Polanyi (1966), every type of knowledge has a tacit element which can become explicit knowledge (including intellectual property) through organisations (Erden *et al.*, 2014; Teece, 1998; Qvortrup, 2006). In other words, the implicit knowledge that employees have is not useful to the organisation until this becomes explicit; specifically when it is transformed into new products or services it represents important components of innovation activities in businesses. For that reason, a company has to protect new knowledge, which has been transformed into novel products or services, through intellectual property rights.

Additionally, Polanyi (1966) states that once companies have developed new knowledge, they must obtain its intellectual property rights in order to protect the gained knowledge from any usurpation or appropriation by its main competitors, allowing companies to take advantage of such knowledge at any given time and to continue generating new knowledge. Therefore, the transaction that involves only the intellectual property rights usually does not produce the creation of new products or services as it requires the transfer of tacit knowledge into explicit knowledge (Boiral, 2002; Paasi *et al.*, 2010).

Heisig and Vorbeck (2001) differentiate information from knowledge, where information

is the raw material of knowledge, and knowledge as information with execution or application. In consequence, for instance, the continuous acquisition of information in relation to customers can help companies to avoid recurrent operational mistakes and to anticipate customer needs, consequently, to improve business performance. Additionally, knowledge can flow in the form of new technologies and/or best practices dissemination (Davenport and Prusak, 1998). Hence, knowledge improve business performance by allowing better decision-making and action taking in companies; and for that to happen Nonaka *et al.* (2001) comments that knowledge requires context, otherwise it is only information. Therefore, in summary, knowledge management is a key strategy, to help companies in implementing a systematic and dynamic control of such intangible assets, in its own company context, which is a fundamental aspect of innovation (Hislop, 2009). In conclusion, it can be argued that knowledge management enables sustainable competitive advantage for corporate success (Alavi and Leidner, 1999).

For this reason, it is necessary for organisations to implement and carry out inter-organisational activities collaboratively as an alternative to increasing the transaction of intellectual property rights. However, due to the changing environments, and therefore constantly changing businesses strategies, in the intellectual property arena, there is an important consideration, which is the need to collaborate with agents external to a company. This forces companies to more integrated relationships with those external agents, for instance, suppliers. In fact, there is a classification to view these kind of relationships: 1) stick (damage recovery), 2) defense (posturing), 3) carrot (attracting potential suitors), 4) consortium (standard setting), and 5) market (industry-wide usage) (Thomas *et al.*, 2004).

This in turn can also increase the creation of innovations, even when these collaborative activities imply additional risks (Pisano and Teece, 1989; Enkel *et al.*, 2005). Thus, the biggest risk that companies can have is the inadequate use of strategic knowledge because their suppliers can use this knowledge for their own benefit or to carry out business activities with their main competitors. Similarly, creating innovations with commercial value may also attract the attention of competitors, who will try to imitate them and enter the market (Hurmelinna-Laukkanen, 2009). For these reasons, knowledge must be protected by means of intellectual property (Enkel *et al.*, 2005; Blomqvist *et al.*, 2008; Powell and Ambrosini, 2012).

If this is not done, the negotiations between firms and suppliers can end in strong legal battles regarding the property of ideas in the innovation processes when knowledge management activities are carried out in a collaborative form (Hagedoorn, 2003). This is because firms can think that all the ideas that are produced in the innovation process of new products or services belong to them, which can cause a conflict if the suppliers consider that they have also contributed with their knowledge to the creation of new products (Paasi *et al.*, 2010). The opposite can also happen, especially if the supplier is a large firm and the customer only a SME. SMEs normally have less negotiation power than large firms and this can create a loss of their knowledge (Blomqvist *et al.*, 2008; Olander *et al.*, 2009).

Then, in order to avoid any problems that may arise, there is a wide variety of formal and informal mechanisms that organisations, especially SMEs, can employ during collaborative activities with other firms in order to protect their knowledge and intellectual property (Kitching and Blackburn, 1999; PRO INNO Europe, 2007; Leiponen, 2008; Olander *et al.*, 2009; Luoma *et al.*, 2010). Protection mechanisms such as patents, copyrights, trademarks, trade names, utility models and trade secrets are among the most common appropriability mechanisms used by organisations (Olander *et al.*, 2014), and they have been extensively studied (Hertzfeld *et al.*, 2006; Davis, 2004; Lang, 2001). However, contracts (Hertzfeld *et al.*, 2006; Klein Woolthuis *et al.*, 2005) geared to protecting knowledge seem to be the most common form of appropriability used by firms for the establishment and management of both knowledge and innovation activities that they carry out with other companies (Lee, 2008).

As a result, the exchange of knowledge produced by firms in innovation processes can change drastically if the established contracts are violated. This is another reason as to why

knowledge has to be protected by intellectual property rights (Paasi *et al.*, 2010). Therefore, intellectual property rights must be conceived by companies as the most efficient way to protect either an invention idea or the new creation of a specific product or service. In this context, intellectual property ensures the private use of knowledge management rights and the innovation practices that are carried out by firms (Lee, 2009; Olander *et al.*, 2014).

In this regard, there has been a significant increase in the number of patents applications in the last decade, mostly by companies that have emphasised knowledge management in innovation activities and those that have considered collaboration activities with their suppliers as a second option to improve their innovation (Hagedoorn, 2003). On the other hand, if the participant firms in the collaboration process do not consider patent applications as an effective option, then there are other choices that can be used to protect the usage rights of the innovation results (Paasi *et al.*, 2010).

Similarly, considering that the acquisition of rights of new creations produced by knowledge management tends to be faster and less burdensome for companies, and the fact that it can be done for a wide variety of applications, the current literature suggests that there is a positive correlation between knowledge management and intellectual property (Carlaw *et al.*, 2006; Marinova and Raven, 2006; Boisot *et al.*, 2007; Lücking and Pernicka, 2009; Orozco, 2010; Paasi *et al.*, 2010), as well as between intellectual property and knowledge transformed in innovations (Levin *et al.*, 1987). Based on this, the following hypothesis is formulated:

H1: The intensification of efforts dedicated to knowledge management positively affects the creation of intellectual property.

The next section describes the research methodology followed in this paper to test the proposed hypothesis.

3. Research methodology – data collection instrument design, distribution and validation

In order to test the formulated hypothesis regarding the theoretical model of knowledge management and intellectual property, an empirical research was conducted in 130 manufacturing SMEs from the Aguascalientes region of Mexico. The organisations were selected taking into consideration and using as a point of reference the directory of the Business Information System of México, particularly, for the Aguascalientes region. This directory consisted of 130 registered SME firms with between 20 and 250 workers. Out of the 130 organisations that comprised the directory, 19 percent had a minimum of one registered patent while 66 percent had some trademark registration, all of which had been filed in the Mexican Institute of Industrial Property. Furthermore, the 80 percent of the organisations studied invested on product image improvements. According to the Mexican Institute of Industrial Property, the Aguascalientes region is in line with the national average in regards to the number of patents, industrial designs and utility models produced and filed in the country (IMPI, 2014). Since the resulting population of SMEs operating in the region was relatively small, it was considered feasible to carry out a census including all 130 SMEs (i.e. 100 percent of manufacturing SMEs in the Aguascalientes region); with a reliability level of 99 percent and a sampling error of ±1 percent. Similarly, the data collection instrument was designed to be answered by managers of the SMEs involved in the study. It was administered by means of face-to-face interviews to the 130 selected firms. From these, 125 questionnaires were validated, which resulted in a response rate of 96 percent.

In order to measure knowledge management efforts, the most updated measures found in the academic literature were considered. The measures, proposed by Bozbura (2007), included: 1) *Employees training*, which was measured by means of a five-item scale adapted from Bontis (2000) and OECD (2003); 2) *Policies and strategies*, which was measured by means of a thirteen-item scale adapted from Bozbura (2004, 2007); 3) *Creation and acquisition of*

knowledge, which was measured by means of a five-item scale adapted from the OECD (2003) and Bozbura (2007); and, 4) *Effects of organisational culture in knowledge management*, which was measured by means of a four-item scale adapted from Bozbura (2007) and OECD (2003). Similarly, all items were measured by means of a Likert-type scale of five points that ranged from 1 = totally disagree to 5 = totally agree as limits.

In order to measure intellectual property, managers were asked to indicate if their company had done any type of patent registration, distinctive signs or investment in the firm and or products' image improvement (1 = Yes, 0 = No). For those companies that answered "yes", they were asked to measure the degree of importance by means of a Likert-type scale of five points that ranged from 1 = not important to 5 = very important as limits. Additionally, three factors, adapted from WIPO (2003) and Jensen and Webster (2006), were considered to measure intellectual property. These included 1) *Patents* measured by means of a four-item scale, 2) *Registration of brands* measured by means of a four-item scale, and 3) *Image investment* measured by means of a nine-item scale.

In order to measure the reliability and validity of the measurement scales, a Confirmatory Factor Analysis (CFA) was carried out using the maximum likelihood method with the software EQS 6.1 (Bentler, 2005; Brown, 2006; Byrne, 2006; Bandalos, 2014). The reliability of the theoretical model was evaluated by means of Cronbach's alpha and the Composite Reliability Index (CRI) (Bagozzi and Yi, 1988). Additionally, the recommendations made by Chou et al. (1991) and by Hu et al. (1992) were taken into consideration. These recommendations related to the correction of statistics of the theoretical model when it is considered that the normalcy of data is present, by using also robust statistics which give a better statistical adjustment of data (Satorra and Bentler, 1988).

Similarly, the fit indices considered were the Normalized Fit Index (NFI), Not Normalized Fit Index (NNFI), Comparative Fit Index (CFI) and Root Mean Square Error Approximation (RMSEA) (Bentler and Bonnet, 1980; Byrne, 1989; Bentler, 1990; Hair et al., 1995; Chau, 1997; Heck, 1998). For this reason, Segars and Grover (1993) considered that if the NFI, NNFI and CFI have an average value from 0.80 to 0.89, it is considered that there is a reasonable adjustment of the theoretical model. Conversely, if the average of these indices is equal or above 0.90, then there is evidence of an excellent adjustment of the theoretical model (Jöreskog and Sörbom, 1986; Byrne, 1989; Papke-Shields *et al.*, 2002; Kumar, 2011) and when the value of RMSEA is below 0.080, it is considered acceptable (Jöreskog and Sörbom, 1986; Hair et al., 1995).

The CFA results are shown in Table 1. They indicate that the theoretical model of knowledge management and intellectual property have a good adjustment ($S\text{-}BX^2 = 85.796$; $df = 443$; p = 0.000; $NFI = 0.881$; $NNFI = 0.928$; $CFI = 0.935$; and $RMSEA = 0.079$). All the items of related factors are significant (p < 0.01). The sizes of all the standardised factorial loads are above the value 0.60 (Bagozzi and Yi, 1988). Cronbach's alpha and CRI have a value above 0.70 and the Variance Extracted Index (VEI) has a value above 0.50 (Fornell and Larcker, 1981). These values indicate that there is sufficient evidence of convergent validity and reliability, which justifies the internal reliability of the scales used (Nunally and Bernstein, 1994; Hair *et al.*, 1995).

Table 1. Internal consistency and convergent validity of the theoretical model

Variable	Indicator	Factor loadings	Robust t value	Loading average	Cronbach's alpha	CRI	VEI
Training of employees	EE1	0.765***	1.000[a]	0.809	0.882	0.884	0.657
	EE3	0.809***	9.332				
	EE4	0.843***	10.103				
	EE5	0.822***	10.834				
Policies and Strategies	PE1	0.828***	1.000[a]	0.740	0.907	0.907	0.552
	PE2	0.826***	12.093				

	PE3	0.796***	14.684				
	PE4	0.749***	13.580				
	PE6	0.706***	9.710				
	PE7	0.632***	7.962				
	PE9	0.672***	11.100				
	PE13	0.712***	15.448				
Creation and Acquisition of Knowledge	CA1	0.752***	1.000[a]	0.730	0.849	0.851	0.535
	CA2	0.777***	12.541				
	CA3	0.761***	10.074				
	CA4	0.654***	9.887				
	CA5	0.706***	11.658				
Effects of Organizational Culture	EC1	0.818***	1.000[a]	0.835	0.896	0.903	0.701
	EC2	0.819***	13.361				
	EC3	0.923***	18.426				
	EC4	0.782***	11.169				
Patents	PA1	0.727***	1.000[a]	0.738	0.764	0.784	0.550
	PA2	0.659***	5.150				
	PA3	0.828***	6.978				
Registration of Brands	RM1	0.826***	1.000[a]	0.719	0.701	0.711	0.529
	RM2	0.673***	6.786				
Image Investment	II1	0.817***	1.000[a]	0.832	0.931	0.931	0.694
	II2	0.843***	30.736				
	II3	0.862***	26.195				
	II4	0.824***	24.279				
	II5	0.828***	20.612				
	II6	0.822***	17.119				
$S\text{-}BX^2$ (df = 443) = 85.796; p < 0.000; NFI = 0.881; NNFI = 0.928; CFI = 0.935; RMSEA = 0.079							

[a] = Parameters constrained to that value in the identification process

*** = p < 0.01

Regarding the discriminant validity of the theoretical model of knowledge management and intellectual property, the evidence obtained from the analysis can be interpreted in two forms, see Table 2. Firstly, the confidence interval test, proposed by Anderson and Gerbing (1988), suggests that, with an interval of 95 percent of reliability, none of the individual elements of the latent factors of the correlation matrix have a value of 1.0. Secondly, the extracted variance test, proposed by Fornell and Larcker (1981), suggests that the variance extracted between each pair of constructs is higher than their corresponding VEI. Therefore, according to the results obtained from both tests, it can be concluded that both measurements show enough evidence of discriminant validity from the theoretical model.

Table 2. Discriminant validity of the theoretical model

Variables	1	2	3	4	5	6	7
1. Employee training	**0.657**	0.178	0.143	0.196	0.145	0.093	0.139
2. Policies and Strategies	0.314 0.530	**0.552**	0.159	0.181	0.096	0.100	0.097

	1	2	3	4	5	6	7
3. **Knowledge Acquisition**	0.289 0.509	0.287 0.511	**0.535**	0.123	0.104	0.117	0.120
4. **Culture Effects**	0.337 0.549	0.316 0.536	0.237 0.465	**0.701**	0.114	0.138	0.119
5. **Patents**	0.258 0.494	0.185 0.437	0.205 0.441	0.214 0.462	**0.550**	0.050	0.126
6. **Registration of Brands**	0.172 0.440	0.175 0.459	0.209 0.477	0.230 0.514	0.091 0.359	**0.529**	0.091
7. **Image Investment**	0.251 0.495	0.183 0.443	0.223 0.471	0.220 0.472	0.232 0.480	0.171 0.435	**0.694**

The diagonal results represent the Variance Extracted Index whereas the results above the diagonal ones show the part of the variance (the correlation of the frame). Under the diagonal results, the estimation of correlation of factors can be seen with a confidence interval of 95%.

4. Survey questionnaire results and analysis

4.1 Organisations and subjects' profile

From the 125 manufacturing SMEs that responded the questionnaire, 80 (65%) of them had between 10-50 employees while the rest 25 (35%) were medium size organisations with between 51-250 employees. The respondent organisations competed in various manufacturing sectors that included metalworking (43 companies, 34%), furniture (30 companies, 24%), apparel (30 companies, 24%), and agro-industrial (22 companies, 18%).

In terms of the individual respondents, 90 (72%) were middle managers. Garza-Reyes *et al.* (2012) suggest that middle management is one of the most effective and important sources of information for operational activities, which arguably includes the management of knowledge. Therefore, whenever possible, middle managers were selected to respond the questionnaire. The rest of the questionnaire (35 respondents, 28%) was completed by directors of departments. Finally, 50 (40%) of the respondents had less than 5 years of experience in their position, 33 (26%) had between 5-10, and 42 (34%) had more than 10 years. The credibility of the study is supported by the overall subjects' profile, combination of job roles manufacturing, and their industry experience.

4.2 Hypothesis analysis and results

In order to prove the hypothesis presented in the theoretical model regarding knowledge management and intellectual property, a Structural Equation Modelling (SEM) analysis was performed using EQS 6.1 software and by means of a CFA of second order (Bentler, 2005; Byrne, 2006; Brown, 2006). In the analysis, the nomological validity of the theoretical model was examined through the Chi square test, which compared the results obtained between the theoretical model and the measurement model. The results indicate that the differences between both models are not significant. This offers an explanation of the relationships observed among the latent constructs (Anderson and Gerbing, 1988; Hatcher, 1994). Table 3 presents these results.
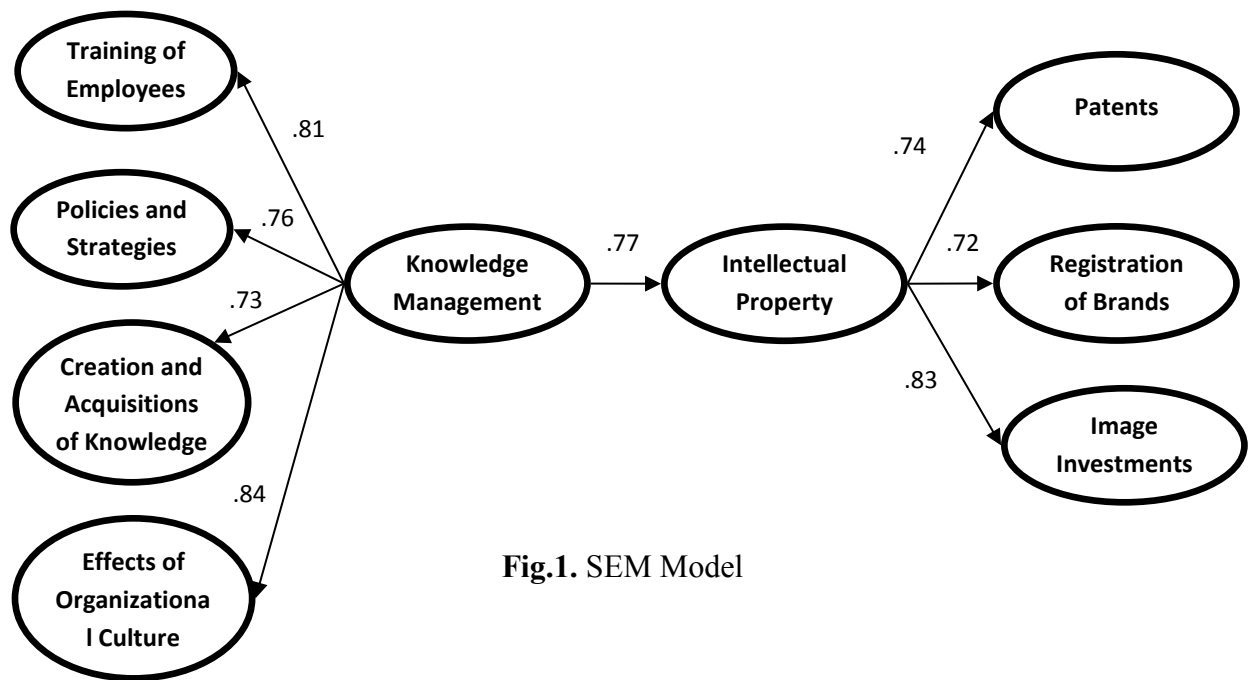
Fig.1. SEM Model

Table 3. Results of the Structural Equation Modelling

Hypothesis	Structural Relation	Standardized Coefficient	Robust t value
H₁: Higher knowledge management, higher level of intellectual property.	Knowledge M. → Intellectual P.	0.771***	13.361
S-BX² (df = 432) = 873.553; p < 0.000; NFI = 0.884; NNFI = 0.928; CFI = 0.937; RMSEA = 0.071			

*** = P < 0.01

Table 3 contains the results of the structural equation model (Fig. 1) of second order conducted to test **H₁**. The results obtained (i.e. β = 0.771, p < 0.01) indicate that knowledge management has statistically significant positive effects on the intellectual property of manufacturing SMEs in the Aguascalientes region of Mexico.

5. Discussion of results

The results obtained from the SEM analysis presented in Section 4 indicated the non-rejection of *H1*. This suggests that the more efforts a SME dedicates to manage its knowledge, the higher the intellectual property that this type of organisations can create. Thus, the results show that knowledge management efforts have direct implications in the creation of intellectual property within SMEs. In practical terms this indicates that if firms intensify the effort dedicated to manage their knowledge, there will be an improvement regarding the legal protection of such knowledge through intellectual property. Therefore, knowledge management will be more efficient and effective, as long as SMEs implement the corresponding activities and actions that enable the legal protection of current and future knowledge created within the business. As a consequence, the findings suggest that SMEs have to intensify and make every activity related

to knowledge management (both explicit and tacit) more efficient so all this knowledge produced in the company turns into more innovations, more intellectual property, and consequently, higher opportunities to increase the market participation and position.

Despite this study has focused on exploring the relationship between knowledge management and the creation of intellectual property, the results obtained from it draw important individual conclusions regarding these two constructs. For instance, Hanel (2006) comments that knowledge management has nowadays become one of the most valuable and worthy intangible activities of firms. In this context, the result of this study indicate that more and more SMEs are implementing a series of business strategies aimed at improving the management of knowledge generated inside, as well as acquiring or owning the knowledge that is produced outside the company. Therefore, the results of this study emphasise that knowledge management should be part of the total actions and activities implemented by departments or functional areas of firms, particularly SMEs. This will enable them to share the knowledge, among the company's personnel, and create new intelligence that at some point should translate into intellectual property.

In terms of the intellectual property construct, this study suggests that it plays an essential role not only for large companies (Rabino and Enayati, 1995; Pearce II, 2006) but also for SMEs. Intellectual property is one of the most common and effective strategies that organisations can adopt to legally protect the creation and use of the knowledge that they generate (Pisano, 2006). For this reason, it has become one of the most important tools to protect innovations made by firms in current products as well as services, and even to safeguard the rights of new products and services that are being developed. In particular, the results of this study show that manufacturing SMEs in the Aguascalientes region of Mexico are aware of the importance of knowledge management, and hence they should benefit from the creation of more intellectual property if they dedicate more efforts to effectively manage such knowledge.

6. Conclusions

This paper explores the prevalence relationship between knowledge management and creation of intellectual property within the context of small and medium size manufacturing enterprises. The results signify the idyllic positive effects that knowledge management has on the creation of intellectual property in manufacturing SMEs.

In a highly globalised and competitive market where manufacturing SMEs are currently competing, all companies should incorporate knowledge management as part of their business strategies. This can smooth the path to share knowledge among all their employees as well as to produce new knowledge that can be transformed into new processes, products or services. However, SMEs must protect such knowledge through intellectual property, so the economic benefits produced by such knowledge as well as their commercial use can belong only and exclusively to the firm. Thus, this research contributes to the literature of management sciences with a refined understanding of the relationship between knowledge management and intellectual property creation. Additionally, the paper can stimulate scholars to further study such relationship, leading to a better understanding of the dynamics of managing knowledge and the creation of intellectual property. Finally, the findings of this study also inform and hence may encourage scholars of developing economies to investigate this linkage in their economy and provide supporting empirical evidence that will increase the generasibility of the findings. On the other hand, the practical implications of this research offer insights of the strategies and managerial practices that SMEs can adopt to effectively protect their knowledge. From this, managers will be able to take better and more effective decisions regarding the creation, management and protection of the knowledge their organisations create and acquire. In addition, policy makers can benefit from the findings of this study, which can inform the design of policy interventions that support business innovation in SMEs aimed to promote economic growth.

In terms of the research limitations, various constraints were encountered with confounding factors that are important to be highlighted for their consideration in similar future studies. One of them is related to the use of measurement scales for both knowledge management and intellectual property as only four factors or dimensions were considered to gauge knowledge management, and three other factors to measure intellectual property. Thus, for further researches it would be suggested to incorporate other factors or dimensions that may include copyrights and industrial designs to verify the results obtained. The second limitation is the use of binary variables (i.e. Yes/No) such as patent registration. For this reason, further researches will need the incorporation of continuous variables that may include knowledge application, knowledge sharing and knowledge capture to verify the repeatability and consistency of results. This is in line with the use of only seven and six items to respectively measure knowledge management and intellectual property. Hence, further researches would need to consider the use of other items, for example, techniques, policies and tools for knowledge sharing, application and capture, or a higher number of items to measure both constructs. This would provide an even more comprehensive and complete analysis of the relationships between knowledge management and intellectual property. A third limitation is that the face-to-face interviews only included managers of the participant SMEs. As consequence, the results may vary significantly if a different population (e.g. customers and suppliers) is considered for the analysis. Further researches could incorporate these respondents to verify and expand the results obtained in this paper. Finally, this research has undertaken a purely cross sectional quantitative research approach while a combination of a panel data quantitative and qualitative research approach would have yield deeper insights into the relationship studied. In this context, the inclusion of a qualitative approach would have also enabled the identification of potential barriers and/or incentives to the creation of intellectual property.

Lastly, it is advisable to go beyond the results obtained in this paper to explore how the findings of this study connect to other stages of the overall SMEs' performance. For example, what would be the effect of this knowledge management and intellectual property relationship within the overall context of the innovation value chain as proposed by Roper et al. (2008)? What would be the contribution of knowledge management and intellectual property creation to the overall business performance in terms of labour productivity, sales and employment growth? These questions could be addressed in further researches and are thus considered part of the future research agenda derived and proposed from the research presented in this paper.

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