

The influence of innovation activities and knowledge management on the competitiveness of manufacturing smes: an empirical study**La influencia de las actividades de innovación y la gestión del conocimiento en la competitividad de las PYME manufactureras: un estudio empírico**

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Abstract

This research aims to show the influence of innovation activities and knowledge management on the competitiveness of manufacturing small and medium enterprises (SMEs). For this, with a sample of 150 SMEs in the manufacturing sector in the state of Aguascalientes, Mexico, a multiple linear regression analysis was performed in order to evaluate the correlation among the variables used. The results obtained provide empirical evidence that innovation activities and knowledge management have a positive and significant impact on the competitiveness of the companies studied.

Competitiveness, SMEs, Innovation**Resumen**

Esta investigación tiene como objetivo mostrar la influencia de las actividades de innovación y la gestión del conocimiento en la competitividad de las pequeñas y medianas empresas (PYMES) manufactureras. Para ello, con una muestra de 150 PYMES del sector manufacturero del estado de Aguascalientes, México, se realizó un análisis de regresión lineal múltiple con el fin de evaluar la correlación entre las variables utilizadas. Los resultados obtenidos aportan evidencia empírica de que las actividades de innovación y la gestión del conocimiento tienen un impacto positivo y significativo en la competitividad de las empresas estudiadas.

Competitividad, PYMES, Innovación

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Introduction

In the present day, the importance of small and medium enterprises (SMEs) to the national and international economy is indisputable. According to the figures produced by the most recent economic census carried out by the National Institute for Statistics and Geography (INEGI) in 2009, SMEs in Mexico represent 4.8% of all companies in the country. Furthermore, they generate 26.4% of the Gross Domestic Product and 31.2% of formal employment.

With very similar figures, SMEs are also very important to the state of Aguascalientes with, according to INEGI, 5.14% of businesses being this size. Additionally, SMEs provide 24.85% of the Gross Domestic Product in the state, and 25.81% of economically active people found employed in a business with these characteristics (INEGI, 2009).

The manufacturing industry occupies a position of transition in the state. 10.52% of the manufacturing businesses in the state are small or medium in size (INEGI, 2009). According to the figures produced by INEGI in 2012, Aguascalientes has been one of the states in which the manufacturing industry, with 27.1%, occupies first place in the generation of Gross Domestic Product; furthermore, employment is principally provided by the manufacturing sector, at a level of 30.4%. The total level of remuneration made to people employed by the manufacturing industry rises to 48.7% of the total remunerations to the employed population in the state.

Despite the importance of this type of company, one of the principal problems that they face is a lack of innovation. The 2010 Business Environment Survey —Problems Encountered by Businesses in the Industrial Sector conducted by the National Chamber for the Transformation of Industry (CANACINTRA) identified the principal problems encountered by businesses of this type. The results show that industrial companies are not able to adequately become competitive due to a lack of technological innovation, to which attested 20% of the 472 industrial companies surveyed (Cámara Nacional de la Industria de Transformación, 2010).

Combined with the foregoing, and in order to keep themselves fully functioning, 13% of the companies surveyed do not use new suppliers. Reestablishing relationships with existing suppliers, with whom a greater effort is made to incorporate greater innovation in products, is seen as a viable alternative to follow in order to confront contemporary challenges (Varma, Wadhwa&Deshmukh, 2006). For their part, SME manufacturers are in the same situation in that they find it difficult meeting the challenge of adequately competing with their rivals due to a lack of innovation and development activities (Cámara Nacional de la Industria de Transformación, 2010).

On the other hand, companies are placing ever greater importance on the treatment and conversion of information, knowledge, and abilities in the workforce, and to this end, knowledge management. These changes have been identified by various researchers as processes through which companies' values are displaced into intangible values Jones, 2004; Maldonado, Martínez&García, 2012).

In this sense, Maldonado et al. 2012, quoting McAdam & Reid 2001, show how SME's low competitiveness could be related to a low level of investment in knowledge management.

To be successful in ever more globalized and highly competitive markets, companies need to develop new ideas which translate into useful, transmissible and conservable knowledge. From this emerges the necessity of studying the influence of innovation activities and knowledge management on companies levels of competitiveness. This research, through surveys conducted with managers in a sample of 150 companies from the manufacturing sector in Aguascalientes, obtained the results analyzed here through the technique of Multiple Regression, with support from the statistical program IBM SPSS Statistics version 21. The results show innovation activities and knowledge management as having a positive and significant influence on the competitiveness of SME manufacturers.

Literature review*Innovation activities and the competitiveness of SME manufacturers*

Currently, the growth of organizations demands, among other options, the reinforcement of innovation activities (Jiménez, 2006). To do this, it is important to emphasize that, with the influence of innovation activities, organizations need to have a greater level of competitiveness, especially SME manufacturers Valentinavičius, 2005 . In their research, Pavón& Goodman (1981) consider that innovation activities influence companies in such a way as to be reflected both in business results and in a gradual increase in competitiveness (Brunnermeier&Cohen, 2003).

SME manufacturers, through their staff responsible for operational activities, are concerned with the updating of the methods and strategies that enable them to control their innovation activities in the best way possible, in order to make their company ever more competitive (Cho, Leem& Shin, 2008). In this way, on being developed in organizations, all innovation activity should have as an objective the standardization of operations, such as procedures, on being integrated into the organizational activity of the manufacturing SME (Kickert, 1979; Saren, 1984; Vrakking&Cozijnsen, 1993). This means that it is important that all innovation is for the benefit of the organizations, so that each activity undertaken internally adds elements to ensure that the company has better results and is, therefore, more competitive (Bessant& Grunt, 1986).

It is important, therefore, to show that innovation activity is the result of a process of analysis and study focused on improving some part of the operations on which SME manufacturers rely (Fernández, 1995; Velázquez, 2007;Aguilera, González & Hernández, 2013). To this end, all innovation activity that is carried out in each of the company's internal processes needs to use strategies that deliver both a beneficial system and a registry of the results of each improvement implemented. With this the company can evaluate whether the innovation will be a key element in making it more competitive and, with this, enabling it to perform better (Fernández, 1995; Macdonald, 2000; Aguilera et al., 2013).

The European Commission(2011) considers that innovation activity is a key element for the growth and competitiveness of an organization, which informs those business people seeking to invest in this option, enabling them to see companies as benefitting in each of the instances of this type of investment Jaffe & Palmer, 1997; Mineikaitė, 2013 . Innovation activity has been converted into an essential part of the development of a region and, of course, a company. Currently, for this reason, many researchers associate this activity with business results in terms of the competitiveness of manufacturing companies Sternberg, 2000; Cho et al., 2008; Mineikaitė, 2013.

For the Organization for Economic Cooperation and Development (OECD), innovation activity has been an important element in normalization. As, from the international point of view, this is something that should be established, great efforts have been undertaken in the generation of proposals significant for organizations competitiveness and performance, especially for manufacturing SMEs that demonstrate the following typology (Sternberg, 2000; Panne, Beers &Kleinknecht, 2003; Chía, 2004; Ozcelik&Taymaz, 2004; Fagerberg, Mowery & Nelson 2005; Rodríguez, 2013):

- Innovation in products: Considered as goods and services which are constantly required for cosmetic improvements, the adoption of technology, and functional adaptations, according to the requirements of the market.
- Innovation in processes: Focused on substantial improvements which can be either operational or administrative, and which have a strong impact on companies' productivity, effectiveness, and competitiveness.
- Organizational innovations: These understand improvements and structural adjustments, as well as organizations, from the perspective of the implementation and/or improvement of administrative processes applied to each of the company's operational areas.

Innovation activities are fundamental to making businesses, such as manufacturing SMEs, more competitive (Chía, 2004; Ozcelik&Taymaz, 2004; Rodríguez, 2013). To this end the following hypothesis is proposed:

H1: The competitiveness of the manufacturing SMEs in Aguascalientes is positively and significantly influenced by innovation activities.

Knowledge management and competitiveness in the SME

Based on various studies conducted by other researchers, some authors define knowledge management as the interchange of knowledge between individuals with the aim of constructing an information system which can be used, once information has accumulated (Crnjar, 2006; Bernal, Turriago& Sierra, 2010), to establish a relationship with educational systems. Intervention, in this context, on the part of technology and internet systems, then gives a sense of benefit and positivity to the management of information useful for individuals' development Blanco and Bernal, 2009 . In particular, this benefits manufacturing SMEs in their continual search for improved performance and competitiveness (Andreu, Baiget&Salvaj, 2004; Crnjar, 2006).

It is hoped that knowledge management in organizations will be a key element, whose objective will be to cooperate in the improvement of business systems in order to create more competitive organizations in the face of the dynamic and aggressive contemporary business environment (Bergeron, 2003; Andreuet al., 2004). In this sense, it is important to emphasize that business people must be aware that the knowledge generated by individuals is of great importance to the achievement of business objectives, and to facilitate the sense that, through procedures and techniques, individuals need to learn and grow in order to be better able to carry out their duties Črnjar, 2006.

From an entrepreneurial and business point of view, and through the integration of elements such as strategies, policies, techniques and specific procedures (Earl, 2001), knowledge management is an activity through which an operational system can be established. Besides the business objectives involved, this system focuses on enabling managers to achieve results in terms of manufacturing SME's levels of performance and competitiveness. This development of the individual also has great benefit for the organization in general (Bernal, Fracica& Frost, 2012; Aguilera, Sandoval, Torres & Rodríguez, 2013).

From a strategic point of view, knowledge management requires the interrelationship between implicit and explicit knowledge in all intellectual activity and learning. This allows individuals to find and make collaborative use of knowledge as a group in the interest of ensuring that organizations are seen to benefit from these types of individual actions (Bernal et al., 2012). From the point of view of many companies, knowledge management is the intentional and systematic strategy in which intellectual capital is integrated into business activities with the aim of contributing to the organization's performance and competitiveness Bergeron, 2003; Črnjar, 2006 .

Being of intentional and systematic characters, knowledge management, the administration of human and technological resources, work systems, and other organizational structures all enable companies to optimize their resources, as seen in their contribution to the innovation required by the company for improved performance. For this, the generation of knowledge and its appropriate use enables SME manufacturers to achieve an improved level of development and use of resources. This is so that the operational systems will benefit in that they are able to rely on an accumulation of knowledge generated by the individuals that form part of the company, which will in turn facilitate the work of any other individual working within the same company (Dalkir, 2005).

The basic objective of knowledge management is to develop excellence in a business, and to work to ensure that this type of organization is competitive in the market. For this, it is important to ensure that knowledge is a key element within the organization, guaranteeing its performance and position in these ever more demanding markets. In this sense, knowledge management should consider the following elements: The efficient development of new and existing knowledge, taking into account the strategy of the organization and the objectives of the individual employees; the selective distribution of new knowledge and the transfer of knowledge to other employees; an efficient distribution of knowledge, such as the information given to all those within the organization; and, the optimal use of the knowledge generated Črnjar, 2006 .

For the companies and the individuals involved, knowledge represents a way of having intangible assets whose value depends on how they should be put into practice. This depends on the business policies and practices that enable this knowledge to acquire specific value for both the institution and the individual. Knowledge is an important element to consider in terms of business performance, which leads to the consideration that the measurement of knowledge management is not an exact science, as in the case of accountancy or the basic sciences.

This measurement should, therefore, be broad and conducted depending on the sector on which the knowledge management study is focused (Davidson & Voss, 2002; Črnjar, 2006).

It is important to emphasize that, on effectively taking advantage of the benefits of knowledge management, organizations and especially manufacturing SMEs find it easier to become competitive in that there is an added value to human capital, as much for individuals as the companies themselves (Pascale, 2005; Wiig, 2009). In this sense, among the benefits that companies can obtain through knowledge management are innovation and development, the improvement and optimization of intellectual capital, the increase of knowledge as well as the abilities of the individual, and with these improve both internal and external client services (Despres&Chauvel, 2000; Davidson & Voss, 2002; Črnjar, 2006; Aguilera et al., 2013).

Through the application of knowledge management, a business system can augment its profitability, create a harmonious environment between the employees and ensure the sustainability and competitiveness of the organization. Knowledge management initiatives can create added value for the organizations, based on the fact that the use of knowledge is a key element that can improve the companies' performance and competitiveness, providing a significant benefit for both clients and individuals within the same organization (Sveiby, 2004; Črnjar, 2006; Aguilera et al., 2013).

Knowledge management within an organization naturally involves people, technology and processes. It is important to emphasize the general consensus that knowledge management depends on the context, the processes and forms of execution of other functions and processes. This leads to the emphasis that there are important reasons that a company should promote the following (Navas&Guerras, 1998; Vázquez, Sánchez & Rodríguez, 2012):

- The creation of exponential knowledge benefits for those learning and developing themselves from the same source, with an impact focused on giving them a greater level of performance in the activities generated within the business.
- Develop the capacity of businesses to rapidly respond to clients, the creation of new markets, the development of new products and new dominant technologies, based on the fact that knowledge management takes advantage of and maximizes concentrated information for internal use within the organizations.
- Build mutual confidence between employees and the knowledge held by their manager to the point where, finally, there is an expectation of incrementing and encouraging cooperation in terms of time management for whichever of the tasks assigned to the individuals within the organizations.

- Manage both the knowledge generated by the experts in a field and the retention of the same, with the aim that the information obtained be of advantage to the business dynamic of the organizations in which said information is concentrated.

In this way, the following hypothesis is posited: (Despres&Chauvel, 2000; Davidson & Voss, 2002; Crnjar, 2006; Aguilera et al., 2013)

H2: The competitiveness of manufacturing SMEs in Aguascalientes is positively and significantly influenced by knowledge management.

Theoretical model

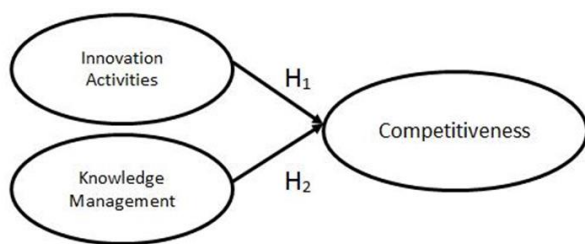


Figure 1 Design of theoretical model

Materials and methods

An empirical study was carried out with a quantitative focus of a correlational and transverse type, through multiple linear regression analysis. The instrument on which the study was based comprises 52 items measured on a Lickert type scale from 1 to 5, which registers from total disagreement up to total agreement, and which was conducted with the managers at manufacturing SMEs in the state of Aguascalientes, México.

The study described above analyzed the use of knowledge management and innovation activities in manufacturing SMEs in Aguascalientes for improved business competitiveness. The 2014 Business Directory database from the Sistema de Información Empresarial de México (the Mexican Business Information System, or SIEM) in the state of Aguascalientes (Department of Finance, 2014), was taken as the reference for the development of this study, in which are registered 5,209 businesses until 14th February of the same year, of which 793 pertain to the industrial sector, and of these, 250 are SMEs.

This study, using a simple random sampling method with a 95% confidence level and a 5.1% margin of error, applied a personalized survey style measurement to a sample of 150 SMEs from the industrial manufacturing sector in Aguascalientes. Said information is presented in Table 1, which makes reference to the research design.

Characteristics	Research
Population*	250 Small and Medium Enterprises
Graphic Area	State of Aguascalientes, México
Object of the study	Manufacturing SMEs of between 11 to 250 workers
Information collection method	Personal interviews with managers
Sampling method	Simple random sampling
Sample size	150 SMEs
Sampling error	±5.1% error, 95% confidence level (p=q=0.5)
Field work	September to October 2012

Table 1 Research design

Source: Sistema de Información Empresarial de México (SIEM), 2014

For the preparation of the measurement instrument, 3 blocks were used: innovation activities, knowledge management, and competitiveness.

To measure innovation activities, innovation in products, innovation in processes, and innovation in management were considered (Zahra &Covin, 1993; Kalantaridis&Pheby, 1999; Frishammar&Hörte, 2005; Madrid-Guijarro et al., 2009). The study had a reliability level of .890, in line with Cronbach's alpha coefficient, as consistency between the variables can be interpreted (Nunnally & Bernstein, 1994).

With respect to knowledge management, the four dimensions proposed by Bozbura (2007) were considered:

- 1) Employee training measured using a scale of 5 items adapted by Bontis (2000) and the OECD (2003).
- 2) Policies and strategies for knowledge management measured with a scale of 13 items and adapted by Bozbura (2004, 2007)

- 3) The creation and acquisition of external knowledge, measured with a scale of 5 items adapted by the OECD (2003) and Bozbura (2007).
- 4) Effects of the organizational culture on knowledge management, measured with a scale of 4 items and adapted by the OECD (2003) and Bozbura (2007), which has a reliability level of .921, in line with Cronbach's alpha coefficient, as consistency between the variables can be interpreted (Nunnally & Bernstein, 1994).

With respect to measurement of competitiveness, the three factors presented by Buckley et al. (1988) were taken into account: 1) financial performance, measured by a scale of 6 items; 2) cost reduction, measured by a scale of 6 items; and 3) the use of technology, measured by a scale of 6 items, with a reliability level of .922, in line with Cronbach's alpha coefficient as consistency between the variables can be interpreted (Nunnally & Bernstein, 1994).

The instrument was submitted to a statistical reliability test, which was carried out using Cronbach's alpha coefficient with the constructs based on the instrument. The results drawn from said test being .952, which can be used to interpret that the study is reliable and that there is consistency between the variables (Nunnally & Bernstein, 1994).

Results

This study aimed to verify the applicability conditions of the multiple linear regression analysis applied to the research model in order to determine the influence of knowledge management and innovation activities on the competitiveness of manufacturing SMEs in Aguascalientes. To this end, normality, homoscedasticity and lineality tests were carried out, finding that the variables which are the objects of this study do not present any type of normality, homoscedasticity and lineality problem. What proceeds from the multiple linear regression analysis conducted using the software SPSS Statistics V21 is presented in Table 2, which gives a model summary, which was used to obtain an R value of .806, and an R² value of .650.

This indicates that, together, the variables of knowledge management and innovation activity are matched by 80.6% with the competitiveness of manufacturing SMEs in Aguascalientes, and that, together, they explain 65% of the competitiveness of manufacturing SMEs in Aguascalientes.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.756 ^a	.571	.568	.526	
2	.806 ^b	.650	.645	.477	1.485

A. Predictor variables: (constant), innovationactivity
 B. Predictor variables: (constant), innovationactivity, knowledgemanagement
 C. Dependent variable: competitiveness

Table 2 Model summary

Source: Original production based on the results of multiple linear regression

From the results of the linear regression presented in Table 3, it can be concluded that around 62.6% of the competitiveness of manufacturing SMEs in Aguascalientes is due to innovation activities. This significantly influences competitiveness, with a value t of 11.643, to a level of significance of 0.001. In same way, the knowledge management variable influences the competitiveness of the manufacturing SMEs in Aguascalientes by 30.9%, with a value t of 5.738. Together, innovation activities and knowledge management explain 64.5% of competitiveness, with a value F of 136.297, which is significant for its value of $p < 0.001$. In terms of the collinearity statistics, an FIV of 1.214 was obtained, which indicates that the model does not present multicollinearity problems due to the proximity to the number one (Hair, et al., 1998).

Variables	Competitiveness
Innovation activities	0.626*** (11.643)
Knowledge management	0.309*** (5.738)
Adjusted R ²	0.645
F-statistic	136.297***
Highest FIV	1.214
***P < 0.001	
The value between parentheses represents the value of "t"	

Table 2 Results of the linear regression analysis

Source: Original production based on the results of the multiple linear regression

The model has also been validated by dividing the sample into two sub-samples and, on being run with the two sub-samples, the results obtained are similar in terms of R^2 , due to there being no more than a 10% difference between these and the original sample (Hair, et al., 1998).

According to the results obtained, equation Y, which represents the competitiveness of manufacturing SMEs in Aguascalientes, is presented below.

$$\text{Competitiveness} = \beta_0 + (\beta_1 * \text{innovation activities}) + (\beta_2 * \text{knowledge management}) + e$$

With the objective of presenting anomalous observations, Figure 2 shows the studentized residuals and whether there are data that serve as outliers. These are presented in the upper part of the graph above the red line, and below the red line in the lower part, which shows the limits of the two standard errors.

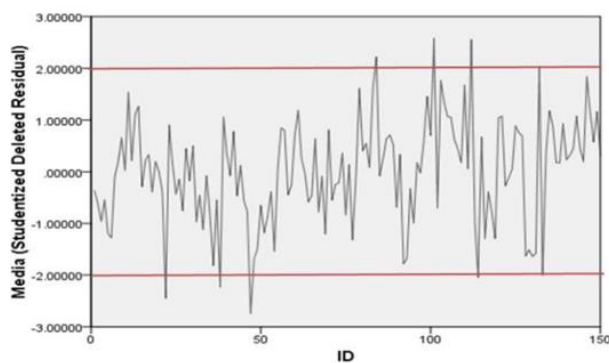


Figure 1 Graph of studentized residuals
Source: Original production based on the results of the multiple linear regression

Therefore, the results obtained in this study verify its hypotheses. Regarding H1, the results ($\beta = 0.626$, $p < 0.001$) indicate that innovation activities have significant effects on the competitiveness of manufacturing SMEs in Aguascalientes. This is due to the fact that innovation activities positively influence the competitiveness of manufacturing SMEs in Aguascalientes by 62.6%, and that, therefore, H1 is accepted. With regard to H2, the results obtained ($\beta = 0.309$, $p < 0.001$) indicate that knowledge management has significant effects on the competitiveness of manufacturing SMEs in Aguascalientes. This is by virtue of the fact that knowledge management positively influences the competitiveness of manufacturing SMEs in Aguascalientes by 30.9%, and that, therefore, H2 is accepted.

Conclusion

In an ever globalized environment, it is important to be prepared to face the challenges of a dynamic, and even unstable, market. Aspects such as innovation and knowledge management represent factors of great importance to the competitiveness of organizations, and, considering the factors shown here, represent a more effective way of confronting the challenges posed by the external environment.

In terms of innovation, great interest in this area has been awoken in researchers, who have taken it into consideration as part of their research, reaffirming it as a determinant in business performance and an influence on competitiveness, a reality shared by manufacturing SMEs in Aguascalientes. The results obtained in this study allow the inference that innovation activity positively influences the competitiveness of the sample of SMEs from the manufacturing industry featured here.

Within innovation activities, it is possible to emphasize the importance of the intervention of specialized external consultancy as an agent of innovation performance, which has repercussions on the competitiveness if the company.

Owing to their high level of specialization in particular themes, specialized external consultancy services, also known as —outsourcing, commonly have greater knowledge of the current situation in the industry itself, which is then manifested in both the organization in question and others. These consultants also provide a more objective perspective, as well as maintaining up-to-date information and future trends useful for the decision-making process, enabling the explosion of innovation activities in SMEs.

On the other hand, SME managers must maintain an awareness of the importance of the generation and consolidation of knowledge in various functions and processes in the company. This enables the motivation of employees in order that the innovations developed are converted into useful.

Knowledge for the organization. Moreover, innovations can be transmitted to colleagues horizontally, diagonally and vertically, both on descending and ascending axes, without leaving to one side their transfer to new staff, who will be able to apply this new dexterity to their functions and facilitate their incorporation into the company.

Finally, it is relevant to emphasize the necessity of establishing mechanisms, through policies and programs, which facilitate and incentivize the generation and development of knowledge. This is with the objective of ensuring that this is consolidated in the company and that those employees who possess this knowledge achieve permanency in their post, and, in the case of retirement, the knowledge generated is passed on and continues being developed in the company.

Limitations

Within the limitations, it should be emphasized that the surveys were answered from the point of view of managers from the companies, which is likely to have lent subjectivity to their answers. Furthermore, the quantity of companies studied may not be representative on comparing them with all the companies in the manufacturing industry in the state of Aguascalientes, which is only slightly above thirty percent. Future research could evaluate the possibility of widening the focus of the study, considering that, with companies of different dimensions, a comparative industrial analysis can be carried out in other geographic areas and/ or sectors of production in order to increment the validity of the theoretical model used. Finally, it is advised that new constructs are established with the variables used to amplify the results and compare them with the conclusions presented in this article.

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