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How innovation in operations increases
competitiveness in manufacturing SMES in the
metropolitan area of Guadalajara
Cómo la innovación en las operaciones
incrementa la competitividad de las pymes
manufactureras en la zona metropolitana de
Guadalajara

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Resumen

La globalización es un fenómeno que se ha convertido en un paradigma para el mundo, es importante señalar que las PYME necesitan una transformación urgente que les permita permanecer en el mercado. Se analizaron las PYME manufactureras en el área metropolitana de Guadalajara, con el objetivo de encontrar los mecanismos que permiten a las PYME a ser cada vez más competitivas, en un entorno empresarial globalizado y con las entidades que sí tienen los recursos para adquirir o innovar la tecnología utilizada para acelerar procesos. Se aplicó una encuesta a estas empresas sobre aspectos de operaciones, con sus dimensiones; automatización, confiabilidad, desarrollo de personal y control administrativo, además de la variable innovación, donde destacan las barreras para la innovación, así como las actividades para propiciar la innovación. También se abordó el tema de la competitividad con sus dimensiones; desempeño financiero, costos y desarrollo de tecnología. Los resultados indican que existe una fuerte correlación entre el desarrollo de la tecnología y la automatización, fundamentada en la innovación y que impactan positivamente en la competitividad de las pymes manufactureras.

Palabras clave: Innovación, operaciones, competitividad, pymes de manufactura

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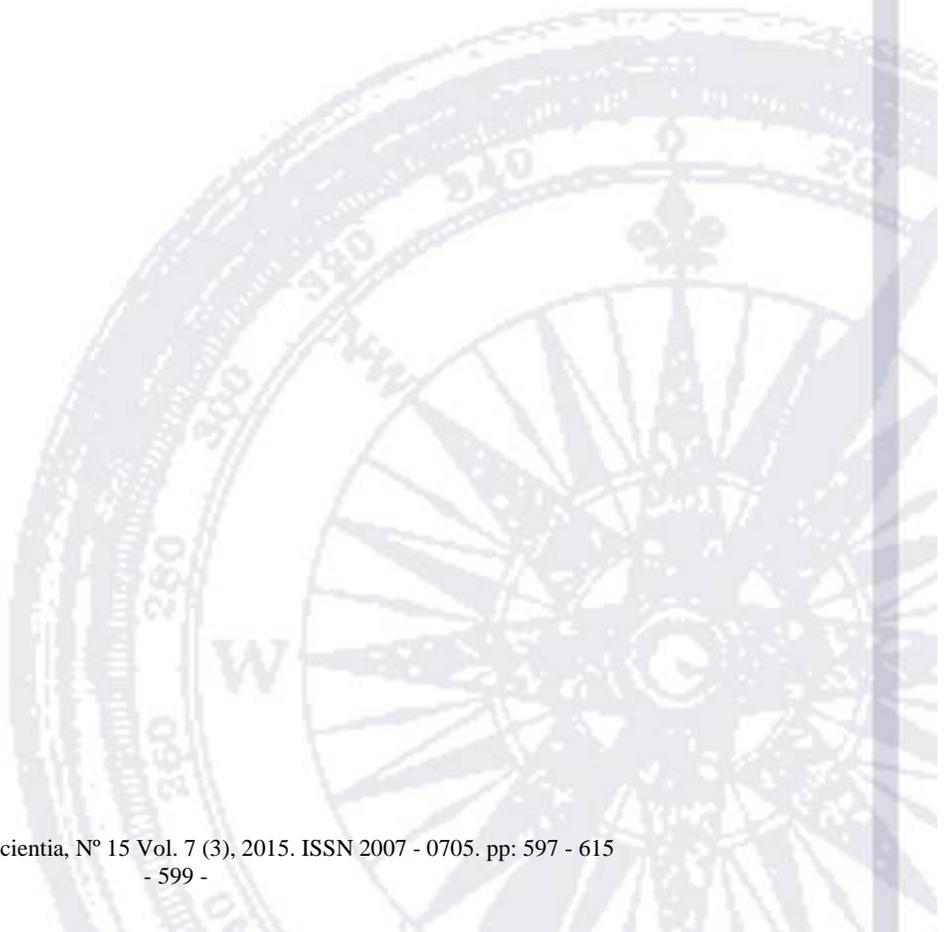
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Abstract

Globalization is a phenomenon that has become a paradigm for the world, it is important to note that SMEs need a transformation to survive in the market. Manufacturing SMEs in Guadalajara were analyzed, looking for the mechanisms that enable SMEs to become more competitive in a globalized business environment, and with big companies that have the resources to develop or innovate technology, improving their processes. A survey was applied, related on aspects of operations, including its dimensions; automation, reliability, personnel development and administrative control, as well as innovation variable, with dimensions: implementation changes,

and innovation barriers. The dependent variable was competitiveness with the dimensions: financial performance, costs and technology use. The results show a higher correlation between technology development and automation, based on innovation and competitive impact in manufacturing SMEs.

Keywords: Innovation, operations, competitiveness, SMEs manufacturing



1. Introduction

At the beginning of the XXI century there is a new interest from the government, civil society and higher education institutions for the potential of SMEs, because they are favorable and contribute to the reorganization of production, and above everything, due to their impact on employment, on gross domestic product and on equity (Rodríguez, 2002.)

The 1980s marked the beginning of a new period for SMEs in industrialized countries, which allowed them to come back and to increase the value of their role inside the process of their economic growth. In most cases, the State noticed such situation and added its efforts to stimulate and support those enterprises (Rodríguez, 2002.)

According to Aragón and Rubio (2005) in regards to competitiveness and the growth of SMEs, there is a scarce number of related research works, since large enterprises are the ones that are overall analyzed. Based on the aforementioned information, they developed a model in which they explain competitiveness based on technology, innovation, financial resources, culture and product or service quality.

2. Literature Review

2.1 Innovation

Innovation is the specific instrument of innovative entrepreneurs. For them, innovation consists of providing resources a new capacity to produce wealth. Innovation creates a resource. Any change in the production potential of already existing wealth is innovation as well.

Innovation is also conceptualized as a key factor for economic wellbeing, and it refers to the development or improvement of products and processes aimed towards problem solving, and profit gaining. Additionally, it is associated with an optimalist vision that defines it as a technological condition inherent to all of the efficiency and efficacy problems.

Regarding the methodological design for this research, three variables were chosen – independent variables, innovation and operations, and competitiveness as a dependent variable.

2.2. Operations

2.2.1 Reliability

An enterprise's reliability is the result of previous actions that make the public, the directors and the investors feel confident. For example, Ninlaphay, Ussahawanitchakit and Boonlua (2012) state that the effectiveness of an internal control can reduce risks inside the company, as well as assuring the reliability of the financial report, thus complying with laws and regulations.

The task of analyzing reliability allows determining the characteristics of uncertainty of the outputs of the system as a function of the uncertainties in the model of the system itself, and the involved stochastic variables. It provides a formal and systematic framework to quantify the uncertainty associated to the output of the system (Mirak-bari and Ganji 2010.)

2.2.2 Automation

Industrialized companies are complex and their dynamic systems show numerous interactions with the environment, the management of successful innovation adoptions in such companies is complex, formidable and a difficult project in which a number of factors, both internal and external, must be taken into consideration (Cho, Leem, Shin, 2008.)

We can talk about the existence of empirical studies that reflect a positive co-relation between processes management and entrepreneurial success (Pérez, Patiño, 2011.)

In the control of operations, the effective use of resources to supply the required inventories in the required period depends on how production is programmed and controlled (Horvathova, 2010.)

2.2.3 Personnel Development

Human capital, which is the addition of knowledge, skills and experiences of the workers, is an additional production factor expressed by the educational level, an easy way to determine it, but it shows the difficulty of not taking other training sources into consideration after graduation (Russu, 2012.)

Employees are a key factor for the system to be successful by implementing their strategies. In a similar way to the internal control system, employees are the key in this system in order to make it successful (Ninlaphay, Ussahawanitchakit, Boonlua, 2012.)

2.2.4 Administrative Control

Organizational culture is reflected in the efficiency of the organizational system of the company, such as the accounting information systems, administrative information systems, among others, which increase effectiveness and the capacity of internal control, in addition to helping managers to get the effectiveness and efficiency of the organizational processes (Al-Qudah, Mustafa, 2011.) Additionally, enterprises have certain strategies that can be defined as the group of actions that are pursued in order to achieve its goals, which encourages and sets a positive environment for entrepreneurial development (Beaver, 2007.)

As a second variable, concepts related to innovation are analyzed.

2.3 Innovation for the competitiveness of SMEs

Innovation is a very important resource for an enterprise to be competitive in the market. Although it is possible to be competitive without being innovative, there is a moment in which implementing changes is necessary when the continuous improvement systems are no longer sufficient. Therefore, in the following section we will analyze two factors that intervene on entrepreneurial innovation, first of all, implementing changes and later on, innovation obstacles.

Enterprises must be capable of innovating in order to provide new products in a fast way, which will allow them to meet the customers' needs, thus allowing the enterprise to keep on going in a environment characterized by fast technological and consumption changes. (Castañeda, et. al 2009.)

In the global economy of the century, innovation has become a powerful term to describe the key to success for companies, for the industry and for national competitiveness (Hemphill, 2012.) From the perspective of knowledge management, innovation is considered as a dynamic capacity that represents the application of explicit and tacit knowledge assets in obtaining new products and processes.

Innovation is one of the main forces that propel development at a global and local scale. The strategies adopted by the companies are essential in order to acquire technological and innovative competences in general, while interacting with the other involved figures or actors with the purpose of improving territorial inequalities. An enterprise can implement a series of innovations in the processes, seeking to increase its productivity and to achieve and/or improve its market position (Quintero, 2009.)

It is necessary to encourage a culture of change, continuous improvement and innovation as a competitiveness factor in SMEs, like this, small and medium-sized enterprises will have rapid growth; they will provide better products and will have greater profits, (Sarmiento, Sánchez, & Cruz, 2009)

2.3.1 Change Implementation

Organizations, mainly small and medium-sized enterprises, have to continuously perform innovation activities in order to keep and to increase their competitive advantages (Wernerfelt, 1984).

Innovation activities are all of those scientific and technological, organizational, financial and commercial operations that effectively lead towards innovation (Armenteros, Medina, Ballesteros, Molina, 2012).

About the competitive context these enterprises are currently living, they must be in continuous innovation in order to achieve competitive advantages to face the dynamic and uncertain world in which they develop themselves, which is a space where there are more and more competitors as well as technology (Rangel, 2012).

Facing the dynamic of the new global economy scenery, SMEs have the challenge of renewing their entrepreneurial design for the efficiency of a larger participation in the international market and in the national productive chains with an international destination (Bloch, & Oddone, 2007.)

2.4 Competitiveness

Given the importance of SMEs in our country, it is fundamental to study the factors that help enterprises to be more competitive both in the national and international environments. (Salazar & Soto, 2009.) The factors that are to be analyzed next are three: the use of technology, financial development and cost optimization.

According to Porter (1990), the foundations of what would be a theory of competitiveness: the progress of a country depends on its competitiveness, which is based in manufacturing, with which produces goods and services, however for this Porterian statement can be met, it also requires that competitiveness is part of the industries, knowledge is crucial because it represents wealth and competitiveness. It's true that economic and social goals are distinct and often competing, but he companies doesn't work isolated from the society, and in the long run these

goals are integrally connected (Porter, 2002). In other hand, Porter (2008) comments that the strategist must have in mind the five forces for competition, but remain focused on structural conditions rather than on fleeting factors, as industry growth rate, technology and innovation, government, and complementary products and services. There is a big mistake in the companies where the competition is based on operational effectiveness alone is mutually destructive, driven by performance pressures but lacking strategic vision (Porter, 2008).

Since based on internal company resources as the basis for competitive advantage Barney (1991) perspective says that information and knowledge have become key factors of successful organizations. Porter (1998), explain that the competition has growth across the clusters, defined as critical masses in one place of unusual competitive success in particular fields enduring competitive advantages (knowledge, relationships, motivation) in a global economy that distant rivals cannot match.

Furthermore, SMEs have to improve their operational strategies, to be more competitive and be able to accept new science and technology advances to have an advantage before their competitors (Gunasekaran, 2011.)

2.4.1 Technology Use

Technology plays a critical role in the enterprise's competitiveness and it is one of the resources that set out a greater difficulty to be managed. The new scenario coincides with the acceleration of technological change and with the shortening of the life cycle of products; thus, the importance of having an effective management of the technology of the productive structure in the company (Pedroza, 2001).

The level or degree of technology can go from the minimum one, in which rudimentary methods are used, to the maximum level, which includes state of the art technology used in processes and products (Ollivier, 2007). Technology is not only reducing the lifecycle products, but it is altering the characteristics of the markets and the nature of the relationships that take place in such market.

2.4.2 Financial Development

Because of the aforementioned aspect, the following key factor for the competitiveness of enterprises is the financial environment.

Nowadays, the financing of enterprises has decreased due to the increasing financial crisis of 2008 and as a consequence of the global economic deceleration caused by the European and the American economies. Because of this, banking institutions are forced to be stricter when granting credits to enterprises; therefore the access to financial support will be more restricted (Sosa, Déniz, Reyes, 2012).

Profitability has become the common financial indicator to measure the level of success or failure in entrepreneurial management. As it allows measuring the enterprise's competitiveness in the environment in which it operates (González Pérez, Correa, Acosta, 2002).

2.4.3 Cost Optimization

Amidst the storm of the economic crisis, enterprises look to optimize their resources, given that cost reduction has become nowadays indispensable for the enterprises – specially small and medium-sized ones – to keep their economic stability. Therefore, the following factor to be analyzed is cost.

Enterprises are currently looking to get competitive advantages to face the dynamic and uncertain world in which they operate, the space in which there are more competitors as well as more technologies, having as a result that products become quickly obsolete and markets change in a hasty way. These competitive advantages will become profits if knowledge is translated into a cost reduction, or into a product differentiation that allows a higher price than those of similar products (Rangel, 2012).

3. Methodology

3.1 Approach to the Problem

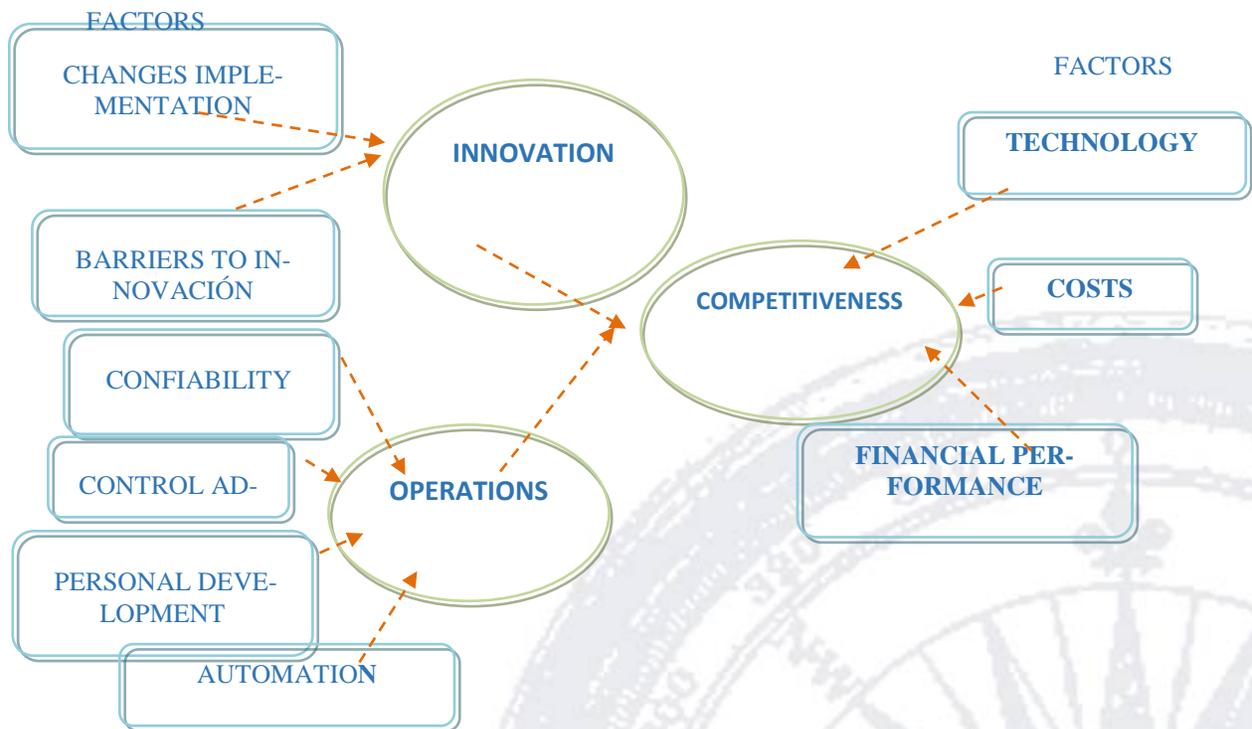
Nowadays, the market has become more demanding and more competitive, therefore, most of the enterprises struggle every day to keep their place in the market. Taking into consideration what SMEs represent for this country, it is very useful to keep them in the market, generating profit.

The problem that SMEs are currently facing is their lack of competitiveness, since most of them are not implementing changes to subsist, thus becoming obsolete and disappearing from the market.

The relevant aspects for the correct functioning of SMEs is supported in cost optimization; taking advantage of all of its total resources, thus avoiding wastes; using technology; investing in updated machinery, in software or internet access; and financial development; getting good financing, and the management of economic resources in an efficient manner.

Therefore, in order for SMEs to become competitive, they must achieve identifying the factors and key aspects that will allow them to compete in an efficient way.

Figure 1. Construct of the research



Research questions:

Which are the elements in the co-relation between innovation and the operations of SMEs in Guadalajara's Metropolitan Area (GMA) to impact their competitiveness levels?

3.3 Supplementary Questions

1. What is the current situation presented by manufacturing SMEs in the country and in GMA?
2. Which are the main factors or dimensions to take into consideration for competitiveness?
3. Which factors – associated to innovation – manage the manufacturing SMEs of GMA to impact their competitiveness levels?

3.4 General Objective

Presenting the main factors used by the manufacturing SMEs in Guadalajara's Metropolitan Area to achieve competitiveness by using innovation.

3.5 Hypotheses

H₁: Higher automation, reliability, administrative control, and personal development to SMEs, higher is operations management.

H₂: Higher changes implementation, and barriers to innovation, greater is the innovation.

H₃: The greater innovation, and operations management, greater is the competitiveness in SMEs.

3.6 Space and time Delimitation

The delimitation of this research was done in such way that it took the manufacturing SMEs of Guadalajara's Metropolitan Area (GMA) into consideration. The GMA include the municipalities of Guadalajara, El Salto, Tlaquepaque, Tlajomulco de Zuñiga, Tonalá and Zapopan. This study was developed to manufacturing SMEs located in Guadalajara, during September 2013 to September 2014.

Sample:

$$n = \frac{Z^2 \cdot N \cdot p \cdot q}{i^2 (N - 1) + Z^2 \cdot p \cdot q}$$

$$n = \frac{2.17^2 \cdot 2847 \cdot 50 \cdot 50}{(0.05)(0.05)(2847 - 1) + 2.17^2 \cdot 50 \cdot 50} = 404 \text{ polls}$$

Table 1. Technical details of the investigation

Concept	CHARACTERISTICS
Universe ¹	2, 847 Manufacturing SMEs
Field of Study	Local
Sampling unit	SMEs with 11-250 employees
Data collection method	Personal interview
Sample type	Simple random
Sample size	404 enterprises
Margin of sampling error	± 4% error margin 97% (p=q= 0.5) level of confidence
Date of fieldwork	September 2013 to September 2014

Fuente: Own elaboration

More than 65% of the SMEs, have incorporated new programming and control operations, due the changes in the automation process.

4. Results

Therefore, the results of the application of the AFC are presented in Table 2 and it shows that the model provides good data adjustment (S-BX2= 894.9750; df = 1321; (p < 0.0000); NFI = .888; NNFI = .919; CFI = .931; RMSEA = .059). Also, Cronbach's alpha and the IFC exceed the 0.70 value recommended by Nunally and Bernstein (1994). Regarding the Extracted Variance Index (EVI), it was calculated for each pair of constructs, having as a result an EVI greater than 0.50 (Fornell & Larcker, 1981). And for the evidence of convergent validity, the AFC results show that all of the items of the related factors are significant (p<0.001) and the size of all of the standardized factorial loads are higher than 0.60 (Bagozzi & Yi, 1988.)

Table 2. Internal consistency and convergent validity

Variable	Indicator	Factor loading	Robust t-Value	Cronbach's α	Composite reliability	AVE
Changes im- plementation	AIC1	0.759***	1.000*	0.892	0.892	0.542
	AIC2	0.761***	21.047			
	AIC3	0.772***	20.925			
	AIC4	0.708***	16.971			
	AIC5	0.728***	16.862			
	AIC6	0.707***	18.748			
	AIC7	0.697***	18.402			
Barriers to	AIB3	0.632***	1.000*	0.905	0.889	0.501

innovation	AIB4	0.722***	12.097	0.675	0.819	0.601
	AIB6	0.754***	13.524			
	AIB7	0.735***	13.043			
	AIB8	0.711***	11.512			
	AIB9	0.780***	12.844			
	AIB11	0.601***	10.189			
	AIB13	0.709***	11.179			
Automation	PA1	0.780***	1.000*	0.675	0.819	0.601
	PA2	0.782***	18.713			
	PA3	0.763***	12.151			
Reliability	PC1	0.704***	1.000*	0.475	0.812	0.523
	PC2	0.816***	15.474			
	PC3	0.777***	15.170			
	PC4	0.572***	10.270			
Administrative control	PO1	0.706***	1.000*	0.885	0.884	0.491
	PO2	0.759***	17.380			
	PO3	0.669***	12.902			
	PO4	0.780***	16.082			
	PO5	0.774***	15.121			
	PO6	0.690***	13.314			
	PO7	0.623***	10.928			
	PO8	0.577***	10.686			
Personal development	PD1	0.684***	1.000*	0.880	0.891	0.674
	PD2	0.832***	16.799			
	PD3	0.912***	18.578			
	PD4	0.840***	14.854			
Financial performance	FP1	0.778***	1.000*	0.877	0.915	0.730
	FP2	0.905***	21.532			
	FP3	0.888***	21.749			
	FP4	0.840***	19.041			
Costs	PC2	0.729***	1.000*	0.791	0.829	0.497
	PC3	0.778***	14.423			
	PC4	0.801***	17.518			
	PC5	0.662***	12.502			
	PC6	0.520***	9.751			
Technology	TE1	0.765***	1.000*	0.917	0.917	0.649
	TE2	0.822***	22.122			
	TE3	0.821***	18.513			
	TE4	0.839***	18.958			
	TE5	0.765***	16.671			
	TE6	0.820***	17.975			
$S-BX^2$ (df 447=) =944.0333 (p < 0.000); NFI =.804 ; NNFI =.871 ; CFI =.860; RMSEA = .052						
* = Value parameters in the identification process						
*** = p < 0.001						

Source: Own.- 2015.

Regarding the indicators of greater relevance or with a greater factorial load, we see that as a part of the innovation variable, indicators such as innovative activity stand out (AIC), having automated production processes (AIB), having machinery that uses some type of software, which allows inferring that having an automated process directly impacts costs, since it increases confidence on the product, as well as sticking to the planning of their elaboration.

Considering another indicator, operational administrative control, it is worth mentioning that the records with a greater factorial load are: (PO) having a statistical control of the production process; (PC) having a reliability of processes; (PA) having a maintenance plan for the machinery and equipment, it allows inferring that they directly have an impact on financial performance, once the projection of the financial statements has a reliable foundation, since it is possible to fulfill the obligations contracted with the customers, and that are related to production volumes, both in quality and in delivery times. In reference to maintenance, it will not become reason for delay.

Finally, the evidence of discriminant validity, the measure is provided in two ways that can be observed in Table 3. Given that, with a confidence interval of 90% of reliability, none of the individual elements of the latent factors of the co-relation matrix includes 1.0 (Anderson & Gerbing, 1988.) Another point worth emphasizing is the extracted variance between the part of the constructs that is higher than 0.50, taken from table 4.4, which refers to the Extracted Variance Index (EVI) (Fornell & Larcker, 1981).

Variables	Changes implementation	Barriers to innovation	Automation	Reliability	Administrative Control	Personal development	Financial performance	Costs	Technology
Changes implementation	0.542	0.942	0.585	0.535	0.435	0.694	0.768	0.354	0.077
Barriers to innovation	0.75 , 1.134	0.501	0.66	0.516	0.469	0.793	0.813	0.4680	0.181
Automation	0.427 , 0.743	0.488 , 0.832	0.601	0.4310	0.415	0.530	0.447	0.3240	0.090
Reliability	0.391 , 0.679	0.37 , 0.662	0.299 , 0.563	0.523	0.611	0.594	0.543	0.2360	-0.011
Administrative Control	0.295 , 0.575	0.321 , 0.617	0.281 , 0.549	0.457 , 0.765	0.491	0.683	0.600	0.2160	0.086
Personal development	0.536 , 0.852	0.625 , 0.961	0.384 , 0.676	0.45 , 0.738	0.523 , 0.843	0.674	0.810	0.4590	0.194
Financial performance	0.598 , 0.938	0.639 , 0.987	0.307 , 0.587	0.399 , 0.687	0.444 , 0.756	0.646 , 0.974	0.730	0.3360	0.164
Costs	0.238 , 0.47	0.338 , 0.598	0.214 , 0.434	0.132 , 0.34	0.112 , 0.32	0.339 , 0.579	0.22 , 0.452	0.497	0.255
Technology	-0.021 , 0.175	0.071 , 0.291	0.004 , 0.176	-0.101 , 0.079	0.008000000000000001 , 0.18	0.092 , 0.296	0.06 , 0.268	0.165 , 0.345	0.649

Source: Own. 2015

Finally, to obtain the statistical results of the hypothesis of this research, a Structural Equation Model was performed (SEM) using the same variables to test the structure of the model and to obtain the results that allow contrasting the presented hypothesis, using the aforementioned EQS 6.1 software (Bentler, 2005; Byrne, 2006; Brown, 2006) As well as nomological validity of the theoretical method, which was analyzed by means of the square Chi test that is the fundamental measure, where the final value of the adjustment function or the minimization function represents the measure of the square chi (Lévy et al. 2005); by means of which the theoretical model was compared to the adjusted model. The obtained results show that the non-significant differences of the theoretical model are good for the explanation of the relationships observed between latent constructs (Anderson & Gerbing, 1988; Hatcher, 1994.) These results of the SEM application are presented in the following Table. 4.

Table 4. Structural model results

Hypotheses	Path	Standardized path coefficients	Robust t- Value	Robust FIT
H1: Higher automation, reliability, administrative control, and personal development to SMEs, higher is operations management.	Reliability, administrative control, and personal development to operations management →	0.75	15.438	S- $BX^2_{(1068)}=2393.34$ $p = 0.000$ NFI = .808 NNFI = .871 CFI = .883 RMSEA = .055
H2: Higher changes implementation, and barriers to innovation, greater is the innovation.	Implementation changes and barriers to innovation → Innovation	0.287	145.55	
H3: The greater innovation, and operations management, greater is the competitiveness in SMEs.	Innovation and operations management to competitiveness →	0.5185	14.990	

*** = p < 0.001

Source: Own.- 2015.

5. Analysis and discussion

Nowadays, automation plays an important role at enterprises, since, once processes are supported by automated activities, reliability, administrative control, and personal development with the help of software, goals can be met in terms of: quality, punctuality for timely deliveries, as well as the quality of the finished product, which impacts directly on costs. Given that, in regards to the results obtained at the statistical and factorial analysis, what has been stated by several different expert authors on the theory of the researched variables could be confirmed; where manufacturing SMEs of Guadalajara’s Metropolitan Area consider that innovation has significant effects on the application of cost reduction. This confirms what was foreseen as H1: Higher automation, reliability, administrative control, and personal development to SMEs, higher is operations management.

Regarding the development of implementation change, all of its attributes were accepted by the people being interviewed as elements to take into consideration for the product to comply in terms of contributing to increase the profitability margin. The elements identified as fundamental

were: personnel recruitment takes place based on a very strict program; also, the obligation to provide periodic training is met. Additionally, the fact that employees have a personal development plan is facilitated, what makes them become a part of a real team. With the aforementioned statement, H2 is proved: Higher changes implementation, and barriers to innovation, greater is the innovation.

Finally, by definition, operational management refers to the control of the resources that flow in a properly structured process, with the idea of adding value so that it fulfills the goals of the organization, while in an environment that generates greater profit than the competitor's, this research demonstrates that, at least in the case of manufacturing SMEs of Guadalajara's metropolitan area, it is achieved. H3 is proved: The greater innovation, and operations management, greater is the competitiveness in SMEs.

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