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The effect of leadership, organizational learning, and knowledge management on the perception of innovation by operational personnel in Mexico City

El efecto del liderazgo, aprendizaje organizacional y administración del conocimiento en la percepción de la innovación del personal operativo en la Ciudad de México

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Abstract

The aim of this study is to provide an explanation of the factors that have an impact on the perception of innovation among operational personnel in Mexican companies. Through an exploratory study, 26 attributes of innovation were detected. An instrument was designed to measure the perception of compliance with these attributes. A sample of 925 people at the operational level from Mexican manufacturing and service companies was integrated. The attributes were grouped into four dimensions using a confirmatory factor analysis. A regression model and two structural models were developed to analyze the impact of the dimensions on innovation. The structural analyses showed that the factors of organizational learning, knowledge management, and leadership have a significant impact on the perception of innovation by operational personnel. From these factors, leadership obtained the highest statistical weights in the structural models and a significant effect on innovation.

JEL Code: M10, M13, M16
Keywords: Innovation; organizational performance; Mexican companies

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Resumen

El objetivo de este estudio es ofrecer una explicación de los factores que tienen un impacto en la percepción de la innovación del personal operativo en empresas mexicanas. Mediante un estudio exploratorio, se detectaron 26 atributos de la innovación. Se diseñó un instrumento para medir la percepción sobre el cumplimiento de estos atributos. Se integró una muestra de 925 personas de nivel operativo de empresas mexicanas manufactureras y de servicio. Los atributos se agruparon en cuatro dimensiones mediante un análisis factorial confirmatorio. Para analizar el impacto de las dimensiones en la innovación se desarrollaron: un modelo de regresión y dos modelos estructurales. Los análisis estructurales arrojaron que los factores aprendizaje organizacional, administración del conocimiento y liderazgo, generan un impacto significativo en la percepción de la innovación por parte del personal operativo. De estos factores, el liderazgo obtuvo los pesos estadísticos más altos en los modelos estructurales y un efecto significativo sobre la innovación.

Código JEL: M10, M13, M16
Palabras clave: Innovación; Desempeño organizacional; Empresas mexicanas

Introduction

The study of innovation has shown an evolution over time in its conceptualization, incorporating elements to clarify its characteristics and addressing various levels of analysis as can be seen in: Schumpeter (1934, 1942), Jiménez-Jiménez and Sanz-Valle (2011), García-Morales *et al*. (2008, 2012), Grigoriou and Rothaermel (2014), Christensen (1997), and Christensen *et al*. (2015), to mention a few.

The factors that tend to have an important effect on innovation are varied and have been addressed by several authors in previous studies, with leadership being relevant for the present study (García-Morales *et al*., 2008, 2012; Noruzy *et al*., 2013; among others), organizational learning (Jiménez-Jiménez and Sanz-Valle, 2011; Hu, 2014; among others), and knowledge management (Wu et *al*., 2014; Ugalde-Binda *et al*., 2014; among others).

Thus, the purpose of this work is to analyze whether there is an incidence of the factors leadership, organizational learning, and knowledge management in the innovation of operational personnel in Mexican companies. This is a contribution to the understanding of innovation in the context of operational personnel in Mexico, as well as to the identification of the main factors involved in making innovation happen in Mexican companies. The work developed is pioneering in the context of Mexico, given that the vast majority of the studies reviewed have been developed in other countries and the development of this research, unlike the others, took into account the perspective of operational personnel in Mexican companies.

Leadership

Leadership considers the definitions of García-Morales *et al*. (2012, 2008), who focus on transformational leadership which is a leadership style that raises awareness of the collective interest among members of the organization and helps them achieve their collective goals. On the other hand, Bass and Avolio (1999) focus on transactional leadership, which focuses

on promoting the individual interests of leaders and their followers in order to achieve the satisfaction of contractual obligations on the part of both, through the establishment of objectives and the monitoring and control of results. Additionally, Graen *et al*. (1982) observe transactional leadership (Leader-Member-Exchange) by applying a perspective to the theory of leadership based on dyads and exchanges, while Scandura and Graen (1984) assess the quality of the leader-member terms of trade, particularly between the immediate supervisor and the study participant using questionnaires with a scale validated by previous leadership and innovation research.

Organizational learning

Organizational learning is based on the definition of Jiménez-Jiménez and Sanz-Valle (2011), who consider that organizational learning is a process by which the firm develops new knowledge and understandings from the experiences of people in the organization and point out that learning has the potential to influence behaviors and improve the capabilities of the company. From this perspective, organizational learning is the basis for acquiring a sustainable competitive advantage and a key variable in boosting organizational performance. Companies that are able to learn have a better chance of identifying events and trends in the market and, as a result, are companies that are more flexible and respond more quickly to new challenges than their competitors, allowing them to maintain their competitive advantages in the long term.

Knowledge management

Knowledge management is based on the approach of Wang and Lin (2013), who consider that knowledge management is a relative propensity of the organization to build on its achieved knowledge (memory), as well as to share, assimilate (absorb), and be receptive to new knowledge. Under this perspective, organizational memory is the information that comes from the history of the organization and often influences decisions; knowledge sharing refers to the transfer of knowledge, skills, and technology among the subunits of the organization; absorption is the ability to recognize the value of new knowledge, assimilate and apply it; and receptivity reflects the ease with which new ideas are taken within the company.

Innovation

Innovation is addressed in this study by considering several approaches. From the point of view of the company resources, Tsai and Yang (2014) consider that the capacity of the company for innovation is its permanent openness to new ideas as an aspect of the company culture. García-Morales *et al*. (2012, 2008) use the definition formulated by the Association for Product Development and Management that analyzes innovation as a new idea, method or device, the act of creating a new product, service or process. Cepeda-Carrion *et al*. (2012) indicate that the innovation capacity of the company involves the degree of support and permeability towards innovation in the organization in terms of the development of new products or processes, the opening of new markets, or the development of a new strategic direction. Akman and

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Yilmaz (2008) define innovative capacity as an important factor in facilitating an innovative organizational culture, considering the characteristics of internal promotional activities and the capacities for understanding and responding appropriately to the external environment.

Measurement of innovation and its factors

The contributions of several authors were considered and are shown in Table 1.

Table 1
Relation of authors and theoretical approximation.

Dimension	Author	Visualization	Dependent variable
Innovation	Anderson *et al*. (2014)	An integrative definition of innovation that considers creativity and innovation as essential parts of the same process and applies a framework for studying levels of analysis to review innovation research.	Innovation (Definition)
	McKinley *et al*. (2014)	Flexible and inflexible innovations as factors that can lead to organizational change and build four scenarios for organizations that innovate or respond in a rigid or flexible way.	Innovation (Capabilities)
	Seidel and O'Mahony (2014)	Practices to produce unity in product concept and achieve understanding of desired attributes to support the coordination of innovation and particularly product design tasks.	Innovation (Capabilities)
	Alexander and Van Knippenberg (2014)	Drivers of innovation that allow work teams to effectively address the challenges of developing radical innovations such as high uncertainty and the risk of failure, as well as unanticipated challenges that require team efforts to be concerted.	Innovation (Drivers)
	Verre *et al*. (2014)	Strategy of appropriability of the value of technological innovation and the risks associated with the support of external sources of knowledge. Public-private cooperation for innovation is important for the evaluation of the effects of the ownership strategy.	Innovation (Value appropriation)

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Dimension	Author	Visualization	Independent Variable
Organizational learning	Wang *et al*. (2014)	Innovation is doubly embedded in a social network of collaboration between researchers and in a knowledge network comprised of links between elements of knowledge. Two elements for innovation are presented: structural gaps and the degree of centrality in the networks.	Organizational learning (Networks)
	Funk (2014)	The geographical proximity of colleagues in an industry can encourage the generation of innovation by companies. The unmoderated effects of the network of intra-organizational structures.	Organizational learning (Geographical proximity)
	Molina-Morales *et al*. (2014)	The cognitive proximity or in terms of goals and culture directs the companies belonging to a territorial conglomerate to reach the acquisition of knowledge, obtaining as a result a relevant innovation.	Organizational learning (Cognitive proximity)
	Hu (2014)	Organizational learning as a total mediator in the relation between business models focused on efficiency and technological innovation and a partial mediator between business models focused on novelty and technological innovation.	Organizational learning (Business models)
	Cepeda-Carrion *et al*. (2012)	Capacity to absorb knowledge as a determining factor in developing innovation and identify potential contexts and capacities that can act as its drivers.	Organizational learning (Absorption)
	Jiménez-Jiménez and Sanz-Valle (2011)	Organizational learning positively affects performance and innovation. The effect of organizational learning and the effect of innovation contribute positively to business performance.	Organizational learning (Driver)
	Yeung *et al*. (2007)	Impact of organizational learning on innovation, internal efficiency, consumer satisfaction, and financial performance. The impacts of organizational learning on variables depend on the organizational contexts of the company.	Organizational learning (Organizational context)

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Dimension	Author	Visualization	Independent Variable
Knowledge management	Grigoriou and Rothaermel (2014)	Relations between individuals to perform effectively in knowledge generation activities, relying on intra-organizational knowledge networks that emerge through individual collaboration.	Knowledge management (Knowledge networks)
	Rogan and Mors (2014)	The contact networks of managers to gain knowledge and information as drivers of their skills to balance the decision between exploring new businesses and exploiting existing ones.	Knowledge management (Knowledge and information)
	Capaldo *et al*. (2014)	Contingent perspective of the value of innovation with the distance and maturity of knowledge in the industry.	Knowledge management (Value of innovation)
	Tuertscher *et al*. (2014)	Collaborations to develop and deploy complex technological systems that involve experimentation and adjustment can serve as a basis for organizational transformation.	Knowledge management (Collaboration)
	Wu *et al*. (2014	The need for cognition, or the tendency of an individual to engage and enjoy thought, is associated with innovative individual behavior.	Knowledge management (Cognition)
	Ugalde-Binda *et al*. (2014)	The influence of intellectual capital and the personal characteristics of entrepreneurs on innovation results are positively and significantly related to each other.	Knowledge management (Intellectual capital)

Dimension	Author	Visualization	Independent Variable
Leadership	Noruzy *et al*. (2013)	Relations between transformational leadership, organizational learning, knowledge management, organizational innovation, and organizational performance among manufacturing companies.	Leadership (Innovation driver)
	Wallace *et al*. (2013)	Effects of the employee engagement climate on the innovation process at the individual level, linking the focus on employee regulation to innovation through a sense of vitality and learning at work.	Leadership (Organizational climate)
	Criscuolo *et al*. (2013)	Unofficial or informal research and development efforts help individuals to develop innovations based on the exploration of unmapped territory and the delayed evaluation of ideas at an embryonic stage.	Leadership (Culture)
	García-Morales *et al*. (2012)	Influences of transformational leadership on organizational performance through the dynamic capabilities of organizational learning and innovation.	Leadership (Performance driver)
	Nissan *et al*. (2012)	Relation between culture and innovation, considering that there is a direct and indirect effect of culture on innovation through new business ventures.	Leadership (Culture)
	García-Morales *et al*. (2008)	Interrelationships between transformational leadership and organizational performance through the effects of knowledge generation and disclosure, knowledge absorption capacity, tacit knowledge, organizational learning, and innovation.	Leadership (Driver of organizational learning and innovation)

Source: Own elaboration

Effect of leadership, organizational learning, and knowledge management on the perception of innovation

Effect of leadership on innovation

Noruzy *et al*. (2013) determine the relation between transformational leadership, organizational learning, knowledge management, organizational innovation, and organizational performance. The relation between culture and innovation is studied through an empirical study by Nissan *et al*. (2012). Wallace *et al*. (2013) examine the effects of engagement climate of the employee on the innovation process at the individual level. Criscuolo *et al*. (2013) state that informal or unofficial efforts by individuals are associated with the achievement of high levels of innovative performance. In addition, the influences of transformational leadership on organizational performance are analyzed through the dynamic capacities of organizational learning and innovation, corroborating in an empirical manner the theoretically identified influences (García-Morales *et al*., 2012). García-Morales *et al*. (2008) study the interrelationships between transformational leadership and organizational performance through the effects of knowledge generation and disclosure, knowledge absorption capacity, tacit knowledge, organizational learning, and innovation.

Effect of organizational learning on innovation

Wang *et al*. (2014) indicate that innovation is doubly embedded in a social network of collaboration between researchers and in a knowledge network composed of links between knowledge elements. It has been found that, although the geographical proximity of colleagues in an industry can foster performance, the effects are moderated by the network of intra-organizational structures (Funk, 2014). Similarly, Molina-Morales *et al*. (2014) explore the relative influence of geographic and cognitive proximity to explain innovation performance. Hu (2014) examines the effect of business models on performance in technological innovation through a mediating role in organizational learning. Cepeda-Carrion *et al*. (2012) consider the capacity to absorb knowledge as a determining factor for the development of innovation and to identify potential contexts and capacities that can act as its drivers. Jiménez-Jiménez and Sanz-Valle (2011) observe a positive relation between organizational learning and both performance and innovation. Yeung *et al*. (2007) study the impact of organizational learning on innovation, internal efficiency, consumer satisfaction, and financial performance.

Effect of knowledge management on innovation

Grigoriou and Rothaermel (2014) emphasize the importance of the relations between individuals to perform effectively in knowledge generation activities. Rogan and Mors (2014) identify the contact networks of managers to obtain knowledge and information as drivers of their decision-making skills. Capaldo *et al*. (2014) point out that the scientific value of an innovation increases with the maturity in the knowledge on which it is based, but beyond that point the value declines. Tuertscher *et al*. (2014) explore multi-stakeholder collaborations to

develop and deploy complex technology systems. Wu *et al*. (2014) propose that the need for cognition, or the tendency of the individual to engage and enjoy thought, is associated with innovative individual behavior.

Table 2 shows the reference authors for measuring the factors in this paper. The first column shows the concepts and the second column reports the authors and date of publication.

Table 2
Concepts and reference authors for measurement.

Study concept	Authors and date
Innovation	García-Morales et al. (2012), García-Morales et al. (2008), Cepeda-Carrion et al. (2012), Akman and Yilmaz (2008), Tsai and Yang (2014).
Organizational learning	Jiménez-Jiménez and Sanz-Valle (2011).
Knowledge management	Wang and Lin (2013).
Leadership	García-Morales et al. (2012), García-Morales et al. (2008), Bass and Avolio (1999), Graen et al. (1982), Scandura and Graen (1984).

Source: Own elaboration.

Approach

A preliminary exploratory study was carried out with the purpose of detecting the factors that act on the company for the generation of innovation. As part of this preliminary study, 20 employees were interviewed in depth and, in addition, the factors that act on the company to generate innovation were detected with the review of the literature.

In this manner, 3 hypotheses were put forth, in which it is expected that there will be a positive effect of each of the factors towards innovation.

These hypotheses are outlined in Figure 1.

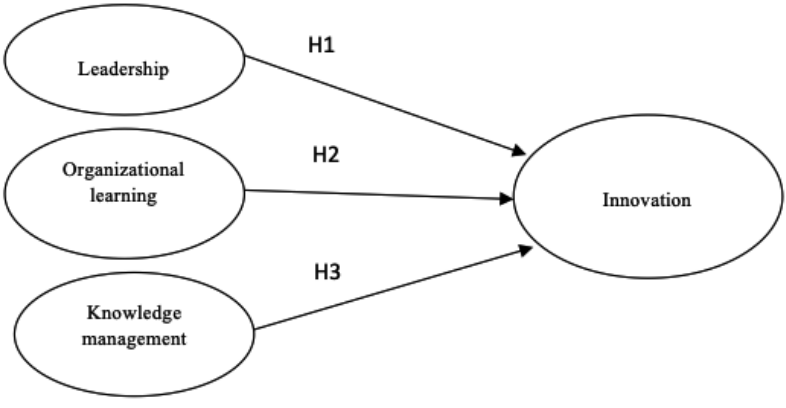

Figure 1. Approach and initial hypotheses.
Source: Own elaboration.

Although there are more factors that can influence innovation, in the case of this study the relation is only between leadership, organizational learning and knowledge management (as independent variables), and innovation as a final dependent variable.

Methodology

Because the objective of the study is to determine the incidence of the above-mentioned factors, a design of the correlational-causal research of a non-experimental type was carried out (Kerlinger, 1979; Kerlinger and Lee, 2002; Hernández *et al*., 2010). As mentioned above, 20 employees were interviewed in depth and, in addition, with the review of the literature the factors that act to generate innovation were identified and a data collection instrument was developed. Twenty-six attributes were detected in total.

The reactants that were used to measure each of the concepts, as they appear in the questionnaire, can be seen in Table 3. The questions were presented randomly for each concept in the study, and the reactants were associated with a seven-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = neither agree nor disagree, 5 = slightly agree, 6 = agree, 7 = fully agree). The questionnaire was designed to be applied to operational personnel to assess their perception of innovation in the company. A sample of n=925 people of operational level was formed, selected by a non-probabilistic procedure of sampling for convenience and considering different areas of Mexico City in companies of the manufacturing and services sectors.

Preliminary data analysis

For data analysis, confirmatory factor analysis was first carried out to corroborate a consistent separation of concepts including innovation measurements. In this way, four components (dimensions) were generated: organizational learning, knowledge management, leadership, and one innovation dimension that later played the role of latent dependent variable in the structural analysis. The integration of these components resulting from the factor analysis can be seen in Table 3. This consistent separation of concepts provides evidence of the measurement validity of the constructs and the resulting dimensions (latent variables).

Table 3
Confirmatory factor analysis of model dimensions. Rotation varimax. Factor loads (standard matrix)

	Components			
Attributes (observed variable)	1	2	3	4
The strengths and weaknesses of the personnel of the organization are known.	.49			
The company shares the changes to be made in its operation.	.67			
We know the new products or services offered by our company.	.52			
All members of the organization share the same goal to which they feel committed.	.76			
Employees share knowledge and experience in their area of work by communicating with each other.		.72		
We quickly evaluate new ideas that arise in our company.		.57		
We often share ideas with other people who have common interest even if they are in different areas.		.81		
New ideas are disseminated to improve the operation of the organization.		.78		
Meetings are held where people share knowledge and learn from each other.		.61		
Knowledge and experiences are shared among employees in different areas.		.82		
By sharing information and knowledge, we often generate new ideas to improve our business.		.66		
The company has updated its customer information.		.46		
My supervisor spends time teaching me and/or advising me on my work activities.			.69	
There is enough trust with my supervisor to accept and provide feedback on their decisions.			.73	
I rely on the recommendations of my supervisor for improvement as an employee.			.75	
The management of the company motivates the personnel to achieve their objectives.			.61	
The manager motivates the employees to improve the activities developed in the organization.			.56	
The organization has leaders who are able to motivate and guide their colleagues at work.			.67	
My supervisor is optimistic about the future.			.85	
The behavior of my supervisor is an example to follow in the organization.			.77	
Employees are supported in the development of products and/or services, the improvement of innovation processes, and the generation of new ideas.				.58
In our company, innovation is easily accepted by management.				.71
In our company we help each other develop our activities.				.57
New ideas are quickly accepted in our company.				.73
The company adopts new technologies for its daily operations.				.65
Innovation is perceived as an opportunity and is welcomed in the company.				.75

Solution of 26 variables to 4 components with eigenvalues higher than 1 that explain 70.1% of the original variability. Extraction method: Analysis of main components. Rotation method: Varimax with Kaiser standardization.

Rotation converged in 8 iterations.
Source: Own elaboration.

For the factor analysis and to achieve the separation of components, a varimax rotation was used—this is a rotation method that minimizes the number of variables that have high loads in each factor. The structural analysis provides good support, and in many cases assumes some correlation between latent independent variables as a common phenomenon. Thus, when interpreting the content of the components with respect to the factorial loads of each attribute, it was determined that the components obtained are the following: Leadership (X_1), Organizational Learning (X_2), Knowledge Management (X_3), and Innovation (Y). Of these four components, three correspond to the dimensions of organizational learning, knowledge management and leadership, which were identified in the approach. These three dimensions are used as independent latent variables in each of the three hypotheses that were raised above. Dimension number four (innovation) would correspond to the latent dependent variable in these assumptions. The reactants that are grouped in these four dimensions (latent variables) can be seen in Table 4.

Measurements

To confirm the reliability of the measurements, reliability analyses were performed using Cronbach's alpha. For these analyses, we obtained the reliability index of the reactants (attributes) that make up the scale that considers the dimensions obtained in the factor analysis of Table 2 and that are then used as variables observed in the structural analysis. Cronbach's alpha is a highly reliable statistic for determining the internal consistency of single-dimensional multiple reactant components (Gliem and Gliem, 2003). Table 3 shows that an alpha coefficient was obtained for the reactants associated with the dimensions (latent variables), which may indicate high levels of internal consistency in the measurement according to George and Mallery (2003) and Gliem and Gliem (2003).

The reactants used to measure satisfaction are consistent with those used in previous studies in a very generalized manner, as can be seen in: Jiménez-Jiménez and Sanz-Valle (2011), Wang and Lin (2013), García-Morales *et al*. (2012) and Tsai and Yang (2014), among others. Although different models have been proposed to measure satisfaction, the reactants used in this study are consistent with the approach proposed by Noruzy *et al*. (2013), where innovation is preceded by organizational learning, knowledge management, and leadership.

Results of the descriptive analysis and regression model

Table 5 shows the descriptive results of the study. Within the descriptive statistics tests, central trend measures such as mean, median, mode, standard deviation, asymmetry, and kurtosis were considered.

The table also shows the results of the t-test for mean difference, which is used to verify whether the questions have the capacity to discriminate the answers of the respondents. The means of the first and fourth quartile were compared and the 26 questions were found to have a level of significance of less than 0.05.

Table 4
Reactants (observable variables) by components (latent variables) and reliability of the measurement scale

Dimension (latent variable)	Indicator (observed variables)	Alpha (α)
Leadership	My supervisor spends time teaching me and/or advising me on my work activities.	.93
	I rely on the recommendations of my supervisor to improve as an employee.	
	Company management motivates the personnel to achieve their objectives.	
	The manager motivates the employees to improve the activities developed in the organization.	
	The organization has leaders who are able to motivate and guide their colleagues at work.	
	My supervisor speaks with optimism regarding the future.	
	The behavior of my supervisor is an example to follow in the organization.	
Organizational learning	The strengths and weaknesses of the personnel of the organization are known.	.82
	The company shares the changes to be made in its operation.	
	We know the new products or services offered by our company.	
	All members of the organization share the same goal to which they feel committed.	
Knowledge management	Employees share knowledge and experience in their area of work by communicating with each other.	.91
	We quickly evaluate new ideas that arise in our company.	
	We often share ideas with other people who have common interests even if they are in different areas.	
	New ideas are disseminated to improve the operation of the organization.	
	Meetings are held where people share knowledge and learn from each other.	
	Knowledge and experiences are shared among employees in different areas.	
	By sharing information and knowledge, we often generate new ideas to improve our business.	
	The company has updated its customer information.	
Innovation	Employees are supported in the development of products and/or services, the improvement of innovation processes, and the generation of new ideas.	.90
	In our company, innovation is easily accepted by management.	
	In our company we help each other to develop our activities.	
	New ideas are quickly accepted in our company.	
	The company adopts new technologies in its daily operations.	
	Innovation is perceived as an opportunity and is welcomed in the company.	

Alpha (α) Coefficient of internal reliability Cronbach's Alpha
α of the whole scale =.96
Source: Own elaboration

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Table 5
Results by reactant. Mean, standard deviation, asymmetry, kurtosis, and mean difference t-test.

Reactant (observed variable)	Mean	Standard Deviation	Asymmetry	Kurtosis	pdm
Employees are supported in the development of products and/or services, the improvement of innovation processes, and the generation of new ideas.	3.46	1.81	.02	-.70	*
In our company, innovation is easily accepted by management.	4.04	1.81	-.20	-.72	*
In our company we help each other develop our activities.	4.38	1.90	-.47	-.93	*
New ideas are quickly accepted in our company.	3.90	1.74	-.11	-.51	*
The company adopts new technologies for its daily operations.	4.28	1.75	-.48	-.37	*
Innovation is perceived as an opportunity and is welcomed in the company.	4.19	1.78	-.36	-.42	*
The strengths and weaknesses of the personnel of the organization are known.	4.49	1.81	-.53	-.59	*
The company shares the changes to be made in its operation.	4.48	1.90	-.53	-.56	*
We know the new products or services offered by our company.	4.18	1.98	-.41	-.81	*
All members of the organization share the same goal to which they feel committed.	4.53	1.77	-.59	-.33	*
My supervisor spends time teaching me and/or advising me on my work activities.	4.24	1.73	-.24	-.42	*
There is enough trust with my supervisor to accept and provide feedback on their decisions.	4.99	1.63	-.65	-.25	*
I rely on the recommendations of my supervisor to improve as an employee.	5.05	1.48	-.78	.29	*
Company management motivates the personnel to achieve their objectives.	4.58	1.77	-.66	-.22	*
The manager motivates the employees to improve the activities developed in the organization.	4.30	1.81	-.36	-.68	*
The organization has leaders who are able to motivate and guide their colleagues at work.	4.30	1.87	-.32	-.64	*
My supervisor is optimistic about the future.	4.74	1.87	-.80	-.14	*
The behavior of my supervisor is an example to follow in the organization.	4.43	1.72	-.57	-.18	*
Employees share knowledge and experience in their area of work by communicating with each other.	4.58	1.81	-.47	-.59	*
We quickly evaluate new ideas that arise in our company.	3.45	1.70	.04	-.25	*

We often share ideas with other people who have common interests even if they are in different areas.	3.81	1.72	-.10	-.59	*
New ideas are disseminated to improve the operation of the organization.	3.86	1.73	-.21	-.31	*
Meetings are held where people share knowledge and learn from each other.	3.33	1.98	.31	-.84	*
Knowledge and experiences are shared among employees in different areas.	3.75	1.93	-.10	-.91	*
By sharing information and knowledge, we often generate new ideas to improve our business.	4.05	1.93	-.09	-.88	*
The company has updated customer information.	4.99	1.66	-.93	.75	*

pdm: mean difference t-test. Significant differences * at .05.
Source: Own elaboration.

For a first approximation to a causality analysis, a model with multiple regression analysis was generated. For this model the dependent variable used was the innovation measurement (observed innovation variables). As independent variables, the three dimensions of leadership, organizational learning, and knowledge management obtained through factor analysis with varimax rotation were used, as shown in Tables 2 and 3.

Table 6

Linear regression analysis. Measurement of innovation as a dependent variable. Standardized coefficients.

	Y Innovation	Z
R	.81	
Adjusted R2	.65	
F	66.19*	
X1 Leadership	.39*	.07
X2 Organizational learning	.31*	.11*
X3 Knowledge management	.22*	.06

*Significant at .05
Z: Kolgomorov-Smirnov normality test. Null H: The distribution is normal
Source: Own elaboration.

The results of the regression analysis can be seen in Table 6. The three independent variables were significant. Table 6 also shows indicators of normality for the independent variables used in the linear regression model. These indicators show that not all independent variables meet the normality criterion.

Results of the structural analysis

Two structural models (structural equation models) were made using EQS V6.2 software. The initial model of direct effects considered the hypotheses proposed in which the three latent variables—organizational learning, knowledge management, and leadership—are related to

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the latent variable of innovation (See Figure 1). The data obtained from the application of the questionnaires were used as observed variables. These observed variables were related to each of their respective three latent variables according to the factor analysis shown in Table 1. Subsequently, the independent latent variables with the greatest significant impact on innovation were identified and the second structural model was generated, which was called the direct and indirect effects model.

The normality test of all observed variables used showed that they did not meet the normality criterion. Although the normality criterion is a required assumption for structural analysis, there is evidence to suggest that when large samples (n=100 or greater) are available, as in this case, the non-normality of observed variables tends to not affect the accuracy of the structural model (Jannoo *et al*., 2014).

Table 7 shows that the structural models comply satisfactorily with the adjustment indicators required to be considered acceptable models. Reality adjustment factors (NFI, IFI, and CFI) above 0.90 are considered acceptable, and above 0.95 as good (Bentler and Bonett, 1980). Values of 0.08 in the RMSEA are considered reasonable (acceptable) error approximations and values of 0.05 or less indicate a good fit with respect to degrees of freedom, and it is suggested that values greater than 0.10 should not be accepted (Browne and Cudeck, 1993; MacCallum *et al*., 1996). For the CMIN/DF indicator (chi-square divided by degrees of freedom) values below 5.0 can be considered acceptable (Wheaton *et al*., 1977; Marsh and Hocevar, 1985). The RMSEA and the WCC/DF are alternative adjustment measures for accepting the model when the chi-square is too large as in this case (Browne and Cudeck, 1993; MacCallum *et al*., 1996; Kenny, 2011).

Table 7
Structural models. Adjustment indicators.

	Initial Model (Direct effects)	Final Model (Direct and indirect effects)
Chi2	511.85	411.51
CMIN/DF	1.72	1.39
BBNNFI	.83	.91
IFI	.85	.92
CFI	.85	.92
RMSEA	.08	.06

Source: Own elaboration

Table 8 shows the results of the regression weights among the latent variables in the structural models. In the first model, independent latent variables with direct effects were introduced to determine if there is an effect on the innovation latent variable. Here the three independent latent variables showed statistically significant regression weights towards innovation. Leadership had the highest regression weight value.

Table 8
Structural analysis. Standardized regression weights and R^2 coefficients of determination for the dependent variable (Innovation)

Parameters	Initial model (Direct effects)	Final model (direct and indirect effects)
Learning ---> Innovation	.48	.55
Knowledge---> Innovation	.27	--
Leadership---> Innovation	.52	.36
Leadership--->Learning	--	.41
Leadership--->Knowledge	--	.66
Knowledge--->Learning	--	.51
R2 for Innovation	.58	.74

* Significant at .05. R^2 = square of the multiple correlation for the dependent variable
Source: Own elaboration.

Table 9 shows a comparison between the coefficients of determination and the regression coefficients of the analyses carried out.

Table 9
Coefficients of determination and regression coefficients

		Innovation	Innovation (latent)
Linear regression	R2	.65	
	X1 Leadership	.39*	
	X2 Organizational learning	.31*	
	X3 Knowledge management	.22*	
Structural analysis	R2		.74
(final model)	X1 Leadership---> Y Innovation		.55*
	X2 Knowledge---> X1 Learning		.51*
	X3 Leadership---> Y Innovation		.36*
	X3 Leadership---> X1 Learning		.41*
	X3 Leadership---> X2 Knowledge		.66*

* Significant at .05. Note: The R^2 coefficients of determination have no associated significance test.
Source: Own elaboration.

Conclusions

Unlike previous studies on innovation in companies, this study identifies factors that influence innovation in order for it to take place (leadership, organizational learning, and knowledge management). The present study was based on an exploratory investigation where a detailed attribute detection was carried out. Thus, this study worked with 26 specific attributes of

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organizational learning, knowledge management, leadership, and innovation in manufacturing and services companies (see Table 2).

Having detected very specific attributes based on the analysis of the innovation process allows to offer a more detailed explanation of the innovation generators of the operational personnel in the companies. The instrument developed makes it possible to approach the measurement of the effect of the concepts detected as antecedents in the innovation of companies.

Previous studies have focused on measuring innovation in other countries from the point of view of the manager or executive of companies. In the review of the literature, no innovation studies were found considering the perspective of operational personnel in the context of Mexican companies, at least not in academic research literature. Thus, the present study could constitute a first approximation, at the level of academic publication, of the antecedents of innovation in Mexican manufacturing and service companies.

Taking into account that there are no previous studies on innovation in the Mexican context, the aim is for the article to support the development of new work that will deepen the study of innovation in the Mexican context. The main contribution of the study lies in the in-depth analysis of the drivers of innovation, and the techniques and methodologies used for the empirical study will be useful in addressing subsequent studies in the Mexican case.

It is important to address the perception of operational personnel in Mexico given that operational personnel are the basis in the execution of innovation and are responsible for generating the products and services that will be offered to the consumer.

Tables 10, 11, 12, 13 and Figures 2 and 3 show the results and validation of the hypotheses of this study.

Table 10
Validation of the hypotheses of the direct effects model.

Model	Hypothesis	Path	Result	R-Squared
Direct Effects	H1	Towards Leadership Innovation	Supported	.58
	H2	Towards Innovation in Organizational Learning	Supported	
	H3	Towards Innovation in Knowledge Management	Supported	

Source: Own elaboration.

Table 11

Results of the model of direct effects in EQS.

Maximum Likelihood Solution	
Standardized Solution:	R-Squared
F1 =F1 = .489*F2 + .522*F3 + .276*F4 + .642 D1	.588
(5.764@ (5.391@ (2.030@	
INN = .489*AORG + .522*LID + .276*ACON + .642 D1	.588

Standardized coefficients (β): high, @ = t-student >1.96 (α = 0.05), INN=Innovation, AORG=Organizational Learning, LID=Leadership, ACON=Knowledge Management.
Source: Own elaboration.

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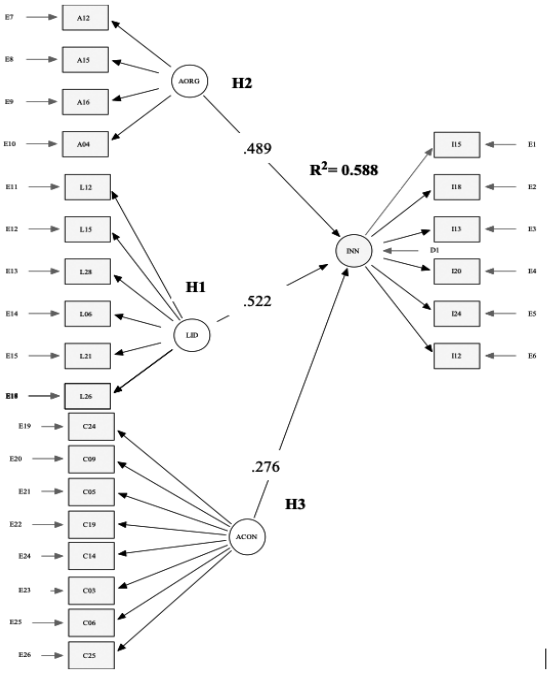

Figure 2. Results of the direct effects model.
Source: Own elaboration.

Table 12
Validation of the hypotheses of the direct and indirect effects model.

Model	Hypothesis	Path	Result	R-Squared
Direct and Indirect Effects	H4	Towards Leadership Innovation	Supported	.74
	H5	Towards Leadership Organizational Learning	Supported	
	H6	Towards Leadership Knowledge Management	Supported	
	H7	Towards Organizational Learning for Leadership through Knowledge Management	Supported	
	H8	Towards Leadership Innovation through Knowledge Management and Organizational Learning.	Supported	

Source: Own elaboration.

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Table 13

Results of the direct and indirect effects model in EQS.

Maximum Likelihood Solution	
Standardized Solution:	R-Squared
F1 =F1 = .555*F2 + .362*F3 + .508 D1	.742
(4.664@ (4.184@	
F2 =F2 = .514*F4 + .415*F3 + .530 D2	.719
(3.919@ (3.501@	
F4 =F4 = .661*F3 + .750 D4	.437
(4.886@	
INN = .555*AORG + .362*LID + .508 D1	.742
AORG = .514*ACON + .415*LID + .530 D2	.719
ACON = .661*LID + .750 D4	.437

Standardized coefficients (β): high, @ = t-student >1.96 (α = 0.05), INN=Innovation, AORG=Organizational Learning, LID=Leadership, ACON=Knowledge Management.
Source: Own elaboration.

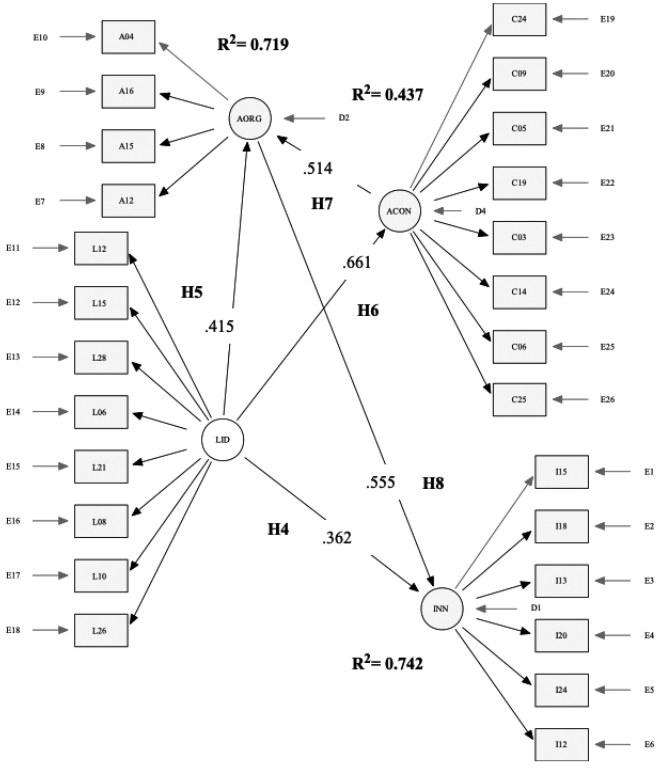

Figure 3. Results of the direct and indirect effects model (final).
Source: Own elaboration.

Based on the results obtained, it can be argued that there is evidence to support the hypotheses put forth in this study for both the direct effects model and the direct and indirect effects model (final). Therefore, it can be said that the factors of organizational learning, knowledge management, and leadership are probably the most important ones for generating a perception of innovation on the part of operational personnel (see Table 9). Of these, leadership apparently plays a more prominent role than the others. The leadership factor obtained the highest statistical weights in the regression model and in the structural models (see Table 9).

Considering that the analysis of structural equations in general is a much more robust multivariate statistical method than regression analysis, it was determined for the present study to accept primarily the results of the first study. However, it is always interesting to see the results of two different statistical methods.

Limitation

This study offers a first approach to the direct relation between the dimensions of organizational learning, knowledge management and leadership, and the perception of innovation by operational personnel in Mexican companies. However, despite the efforts made, the study has several limitations. One limitation is of a geographical nature, since it was carried out with the operational personnel of companies located in the metropolitan area of Mexico City. Subsequent research could include innovation studies in companies in other regions of the country to evaluate the results by geographical area.

The work developed is an effort to determine the impact on innovation considering the three constructs involved, so it is beneficial to replicate this type of studies in more companies and institutions in order to strengthen the instrument developed and obtain more empirical evidence to generalize the behavior of the phenomenon.

In addition, there are some other factors mentioned in the literature on the subject which may have an effect on innovation in companies, but which deserve to be addressed in additional studies to deepen the relationships observed and their effects.

Lines of continuity and delving in innovation research

Future research may focus on factors such as organizational climate, knowledge generation and creativity, among others. These factors can promote a favorable environment for innovation and the formation of so-called innovative ecosystems that impact the organizations and participants that are close to their operation.

Likewise, business models that promote innovation and new business ventures can be studied to determine the factors that promote innovative behavior and derive policies that encourage innovation in small and medium-sized enterprises.

The study focused on the precursors of innovation, however, the relationship between innovation and performance can also be studied, which is an aspect that can be addressed in subsequent research to understand more fully the phenomenon of innovation and its effects on organizations.

The most recent studies in the literature relate to the concepts addressed in this research. In the case of leadership, the political uncertainty present in countries with national elections

is identified as a factor that causes a fall in technological innovation activities, while political commitment is an incentive for innovation (Bhattacharya *et al*., 2017). An analysis of manufacturing companies in an emerging economy (China) shows that the ownership structure with minimal state participation is the optimal structure for achieving the best results in the development of innovation (Kevin Zheng *et al*., 2017). In the case of family-owned businesses, there has been an increase in the rate of conversion of inputs to innovation results compared to nonfamily-owned businesses, taking into account factors present in each nation such as shareholder protection and the level of education of the labor force (Duran *et al*., 2016). Transformative leadership is seen to have a positive effect on the innovative performance of the work team through integrative and knowledge-centered mechanisms such as cooperative standards and external knowledge acquisition (Jiang and Chen, 2016). Motivation for innovation is based on creating an organizational culture that tolerates early failure and rewards long-term performance through incentives for the personnel (Manso, 2017).

In the case of organizational learning, an analysis of intergovernmental bodies shows a positive effect on national innovation through the connectivity of learning units and leveraging external knowledge (Jandhyala and Phene, 2015). The importance of social networks in influencing individual creativity and innovation is highlighted, identifying the phases so that an idea with a novel concept can have a tangible result (Perry-Smith and Mannucci, 2017). The tacit knowledge that can be extracted from the subsidiaries of multinational companies and the mediating elements such as the efficiency of the task, the organizational structure, and the affective trust, are studied (Sheng *et al*., 2015).

In the case of knowledge management, the effect of information technologies is studied through access to data systems and connectivity networks for the absorption of external knowledge and the generation of strategies to increase innovative performance (Trantopoulos *et al*., 2017). It is also noted that firms face four concerns in fully assimilating digital innovation: existing and required capabilities, product or process focus, internal or external collaboration, and governance, i.e., control or flexibility (Svahn *et al*., 2017). In addition, it is observed that the management and processing of consumer information flows, through information absorption capabilities, can increase the levels of innovation in the firm (Saldanha *et al*., 2017).

Considering recent studies, we can observe additional lines of continuity and deepening of innovation research aimed at factors such as government policy decisions, ownership structures of companies, operation of family-owned businesses, transformational leadership, and generation of a culture for innovation. Learning, connectivity, external knowledge, and social networks are also important for individual creativity, innovation, and the extraction of tacit knowledge in companies. Similarly, the effect of information technologies on the absorption of external knowledge, the assimilation of digital innovation, and the information absorption capacities and their effects on the innovation of companies are also relevant.

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