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Artículos Científicos

Relación de la innovación organizacional y la manufactura avanzada en industrias manufactureras

Relationship of Organizational Innovation and Advanced Manufacturing in Manufacturing Industries

Relação entre inovação organizacional e fabricação avançada nas indústrias de transformação

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Resumen

Las actividades relacionadas al comercio exterior y de forma específica al sector manufactura representan una fortaleza de la economía mexicana. En 2018, las exportaciones e importaciones sumaron 914 986.9 millones de dólares, el valor de las exportaciones totales alcanzó 450 684.5 millones de dólares y el valor de las importaciones totales ascendió a 464 302.4 millones de dólares de acuerdo al Instituto Nacional de Estadística Geografía e Informática (INEGI, 2019). Por lo que resulta importante realizar estudios que permitan un mejor posicionamiento del sector en cuestión. En este artículo se exploró a la innovación organizacional como una estrategia para que las empresas de este rubro de la Industria Manufacturera, Maquiladora y de Servicios de Exportación (Immex) de Tijuana, Baja California, logren incorporar prácticas de manufactura avanzada; se planteó una hipótesis, objetivo y preguntas de investigación, los cuales se comprobaron y respondieron mediante la aplicación de la estadística de análisis de regresión lineal.

Palabras clave: análisis de regresión, innovación organizacional, manufactura.

Abstract

Activities related to foreign trade and specifically to the manufacturing sector represent a strength of the Mexican economy. In 2018, exports and imports totaled 914 986.9 million dollars, the value of total exports reached 450 684.5 million dollars and the value of total imports amounted to 464 302.4 million dollars (INEGI, 2019). Therefore, it is important to carry out studies that allow a better positioning of the manufacturing sector. In this article, organizational innovation was explored as a strategy to achieve that the companies of the Manufacturing, Maquiladora and Export Services Industry (known in Spanish as IMMEX) of Tijuana, Baja California, manage to incorporate advanced manufacturing practices; a hypothesis, objective and research questions were proposed, which were tested and answered by applying the statistical tool linear analysis of regression.

Keywords: regression analysis, organizational innovation, manufacturing.

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Resumo

As atividades relacionadas ao comércio exterior e, especificamente, ao setor manufatureiro representam um ponto forte da economia mexicana. Em 2018, as exportações e importações totalizaram 914.986,9 milhões de dólares, o valor total exportado atingiu 450.684,5 milhões e o valor total importado totalizou 464.302,4 milhões (Instituto Nacional de Estatística, Geografia e Informática INEGI , 2019). Portanto, é importante a realização de estudos que permitam um melhor posicionamento do setor em questão. Neste artigo, a inovação organizacional foi explorada como uma estratégia para empresas nessa área da Indústria de Manufatura, Maquiladora e Serviços de Exportação (Immex) em Tijuana, Baja California, para incorporar práticas avançadas de fabricação; Uma hipótese, objetivo e questões de pesquisa foram propostas, as quais foram verificadas e respondidas pela aplicação da estatística de análise de regressão linear.

Palavras-chave: análise de regressão, inovação organizacional, manufatura.

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Introduction

Mexico has access to a network of free trade agreements and preferential tariff access to markets in North America, Europe, Asia and Latin America, which has promoted the country as an export platform. Organizations manufacture goods from raw materials that come from all over the world, which has allowed opening the doors of the most important consumer markets in the world (Government of Mexico, 2017).

This context has consolidated foreign trade as an essential force in the Mexican economy. In 2018, exports and imports totaled $ 914,986.9 million, the value of total exports reached $ 450,684.5 million, and the value of total imports amounted to $ 464,302.4 million (INEGI, 2019).

With a population of 129.2 million, Mexico is the second largest country in Latin America, and number eleven in the world. Its gross domestic product (GDP) in 2018 was 18,584,926 pesos (INEGI, 2019). During the 2004-2014 decade, economic growth in GDP averaged 2.5% per year, equivalent to 0.9% in per capita terms. Excluding the agricultural and government services sectors, the manufacturing sector is the largest, with a contribution

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to GDP of 29%, followed by mining (16.8%) and financial and insurance services (9.5%) (Government of Mexico, 2017).

In 2014, approximately 49.4 million people were employed in formal jobs, with a slight increase over the previous year (49.2 million). The National Occupation and Employment Survey (ENOE) indicates that manufacturing and construction is the most productive Mexican sector, generating 4.3 million jobs and 1.2 billion pesos on the payroll (Government of Mexico, 2017).

Mexico exported 384 billion in 2014. The main export destinations were the United States, Canada, Spain, and China. Transport vehicles represented 24.2% of total goods exports; electronic products 20.2%, and machinery products 18.6% (Government of Mexico, 2017).

Based on information from INEGI (2017a), there are 489 530 manufacturing companies in Mexico, of which 7320 correspond to the state of Baja California, and of that total 3351 are located in Tijuana. On the other hand, according to information compiled from the transparency report of companies in the Manufacturing, Maquiladora and Export Services (Immex) companies of the Ministry of Economy (2017), in Mexico 6596 manufacturing companies have the Immex program for the sector industrial and services; Of this total, 3835 are located in Tijuana, of which 578 are classified within the industrial sector, and in turn, of that total, 307 companies are medium-sized, that is, they have a range of workers from 51 to 250 (Secretaría de Economía, 2017a).

Likewise, at the national level there is a workforce of 5,073,432 workers in manufacturing companies; 322 643 work in the state of Baja California, and 202 114 in Tijuana (INEGI, 2017a).

With the above information it is possible to appreciate the importance of the manufacturing sector in Mexico, both for its contribution to GDP and for the jobs and wages it generates, the amount of exports and the number of companies in the manufacturing sector of Immex, which shows the relevance of conducting research that provides proposals to organizations in this area.

Specifically, the manufacturing sector that has the program called Immex allows to temporarily import the goods necessary to be used in an industrial or service process destined to the elaboration, transformation or repair of merchandise of foreign origin temporarily imported for export or to provide services. of export, without covering the payment of the

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general import tax, the value added tax and, where appropriate, the compensatory quotas (Ministry of Economy, 2017a).

Now, to raise the relevance of the relationship between organizational innovation and advanced manufacturing, it is important to highlight that the use of innovative advanced manufacturing tools in manufacturing operations can help improve the performance and competitiveness of the Immex sector (Jayaram, Oke and Prajogo, 2014). Advanced manufacturing is identified with the incorporation of activities focused on production, logistics, services, design and development, research and marketing (ProMéxico, 2017).

The term advanced manufacturing (Dutrénit, 2015) encompasses many of the developments in the field of manufacturing that have been implemented since the end of the 20th century and that have been aimed at carrying out increasingly knowledge-intensive processes and products, relying on information technology, modeling and simulation in design. It is the result of the advancement of traditional manufacturing into businesses that use a high level of design or engineering skills.

When comparing the position between Mexico and the two countries that head the top places in the Global Manufacturing Competitiveness Index (Deloitte, 2018), it is observed that, in manufacturing GDP, China earns an income of 8.6%, Mexico 3.2% and United States United of 0.8%; The percentage of manufacturing GDP as a total of GDP for China corresponds to 29.9%, for Mexico 17.6% and for the United States 12.3%. Regarding labor costs in dollars, Mexico has a cost of 6.2 per work day, while the United States 8.0 and China 3.3 dollars. In the heading of manufacturing exports as a percentage of total merchandise shipments, China leads the number one position with 93.8%, followed by Mexico with 77.7% and then the United States with 63.7% (Deloitte, 2016).

Taking into account the indicators of the classification prepared by the Organization for Economic Cooperation and Development (OECD, 2005), which is governed by the innovation model of the Oslo Manual, it is observed that in technological innovation, in the category of introduction of product innovation (good or service), in Mexico only 8.72% of companies meet this requirement, while the minimum, according to the OECD (2005), is held by Japan (17.30%) and the highest by Switzerland (47.60%). In the introduction of a process innovation, in Mexico 5.33% of the companies have reached this goal; the minimum is once again held by Japan (11.70%) and the highest by Austria (44.40%). In Mexico, 1.57%

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of companies developed internal technological innovation; the minimum is held by Japan (18.10%) and the maximum by Sweden (44.2%).

Now, regarding the non-technological innovation indicators, specifically in the introduction of marketing innovation, in Mexico only 2.62% of companies came out on a positive note; the minimum is held by Japan (8.30%) and the maximum by Luxembourg (30.2%). In the introduction of organizational innovation, for its part, Mexico registers 4.43% of companies that have developed this aspect; the minimum is for Norway (24.10%) and the maximum for Luxembourg (59.1%) (Moyeda and Arteaga, 2016).

Non-technological innovation is the antecedent for the development of technological innovation, so the fact that companies lack strategies for the implementation of organizational innovations is an impediment to achieving technological innovation (Arraut, 2008) .

Based on the foregoing, a problem is identified for Mexico, specifically within the manufacturing sector: there is a need to improve innovation indicators, so this study aimed to analyze organizational innovation in the workplace, jobs and in the external relations of the Immex sector of Tijuana, Baja California, Mexico, and through the statistical linear regression analysis, to identify its relationship with advanced manufacturing activities. Organizational innovation can represent the link that is required for Immex companies to move from simple to advanced manufacturing and thereby take a step towards technological innovation from non-technological (organizational) innovation.

Methodology

The objective of the study was to verify the following research hypothesis: Organizational innovation in the workplace, jobs and external relations allows companies in the Immex sector to carry out activities related to advanced manufacturing.

To achieve the objective, an exploratory, non-experimental, transectional, descriptive and correlational research was designed; since variables are not deliberately manipulated and data is collected in a single time. The purpose was to describe variables and analyze their incidence and interrelation at a given moment. Inferences about the relationships between the variables are made without intervention or direct influence and these relationships are observed as they have occurred in their natural context (Hernández and Mendoza, 2018).

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The research focus was quantitative; Statistics were used for the quantitative analysis, applying the multivariate analysis technique called multiple regression. Multiple regression is the extension of bivariate regression by incorporating more than one independent variable (Briones, 2002). The target population was the manufacturing sector with the Immex program in the city of Tijuana, Baja California.

The sampling frame corresponded to the economic manufacturing units of the industrial sector with the Immex program in the city of Tijuana, Baja California. The sampling technique used was non-probability sampling; more specifically, the exponential non-discriminatory snowball technique was used: each of the individuals recommended more than one contact and of these none is discarded to be part of the sample (Espinosa, Hernández, López y Lozano, 2018).

The information gathering instrument used was adapted from the 2015 National Survey of Manufacturing Industry Innovation applied in Lima, Peru (Pichilingue, 2017) and from the Manufacturing Company Innovation Survey. Fiscal Year 2015 applied in Puerto Rico (Lobato, Romero and Hernández, 2017); Both documents are based on the Bogotá Manual (Jaramillo, Lugones and Salazar, 2001). Finally, questions on the subject of innovation in manufacturing are also incorporated, specifically those related to the topic of advanced manufacturing.

Table 1 presents the results of Cronbach's alpha. As is known, values between 0.6 and 0.7 are acceptable for items that must form the same construct (Hernández and Mendoza, 2018). The results obtained indicate that there is a high internal consistency between the items of the information collection questionnaire.

Tabla 1. Análisis de fiabilidad. Alfa de Cronbach

Variables	Dimensión	Alfa de Cronbach
Innovación Organizacional (independiente)	Lugar de Trabajo	0.721
	Puestos de Trabajo	0.683
	Relaciones Externas	0.913
Manufactura Avanzada (dependiente)	Investigación	0.729
	Diseño y Desarrollo	0.802
	Producción	0.855
	Servicios	0.694
	Logística	0.813
	Mercadotecnia	0.84

Fuente: Elaboración propia

The variables used in Table 1. They are Organizational innovation as an independent variable, with the dimensions of Workplace, jobs and external relations; while Advanced Manufacturing is the dependent variable with dimensions of research, design and development, production, services, logistics and marketing.

In order to process the results of the questionnaire, it was necessary to create composite variables from the items that make up each dimension of the variable matrix. From this it is possible to perform statistical correlation tests and multiple linear regression analysis to obtain an equation of the straight line and predict the behavior of the model variables.

Results

Statistical analysis to check the research hypothesis

A correlation analysis was performed between the dependent variable (Advanced Manufacturing) and the dimensions of the independent variable (Jobs, Workplace and External Relations). Table 2 presents the summary of correlations obtained. Advanced Manufacturing has a high correlation with Jobs at the 0.670 level, which is equivalent to 67%

correlation with a significance of 0.01%. Advanced Manufacturing has a high correlation with External Relations at the 0.809 level, equivalent to 80.9% correlation with a significance of 0.01%. Advanced Manufacturing has a high correlation with Work Place at the level of 0.767, equivalent to 76.7% correlation with a significance of 0.01%.

Tabla 2.Resumen de correlaciones

		Manufactura Avanzada	**Puestos de Trabajo**	**Relaciones Externas**	**Lugar de Trabajo**
Manufactura Avanzada	Correlación de Pearson	1			
Puestos de Trabajo	Correlación de Pearson	.670**	1		
Relaciones Externas	Correlación de Pearson	.809**	.677**	1	
Lugar de Trabajo	Correlación de Pearson	.767**	.444**	.675**	1

** La correlación es significante al nivel 0.01 (*2-tailed*)

Fuente: Elaboración propia

Once the correlation analysis was completed, we sought to generate a predictive model that would show the relationship between the variables using an equation. For this, the statistical tool called multiple linear regression analysis was used.

Assumptions for Multiple Linear Regression Analysis

Frequency distribution calculation

A frequency distribution or frequency table is a table arrangement of the statistical data, assigning each data its corresponding frequency. That is, a summary of tabular data is produced that presents the number of elements (frequency) in each of the classes (Anderson, Sweeney and Williams, 2008). Table 3 presents the statistics by variable according to the frequency distribution obtained.

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Tabla 3. Estadística por variable

		Puestos de Trabajo	**Relaciones Externas**	**Lugar de Trabajo**	**Manufactura Avanzada**
N	*Valid*	33	33	33	31
	Missing	0	0	0	2
Mean		1.4949	2.8042	1.3636	1.7583
Median		1.5	2.7692	1.25	1.7338
Mode		1	2.46	1	2.18
Std. Deviation		0.45925	1.24675	0.38574	0.43795
Variance		0.211	1.554	0.149	0.192
Range		1.83	3.77	1.25	1.62
Sum		49.33	92.54	45	54.51

Fuente: Elaboración propia

Dispersion diagram

The scatter diagram is a useful graphical technique to show the relationship between variables. Two variables are necessary to draw a scatter diagram. One of the variables is scaled on the horizontal axis (X axis) of a graph and the other variable along the vertical axis (Y axis) (Lind, Marchal and Wathen, 2008). Figure 1 presents the relationship between the variables Advanced Manufacturing and Organizational Innovation with a value for R^2 = 0.762.

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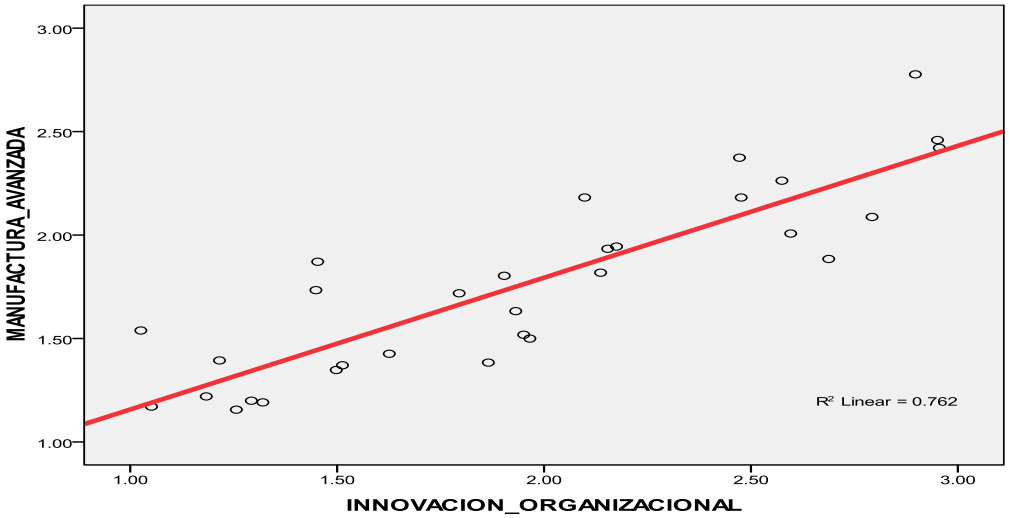
Figura 1. Diagrama de dispersión de las variables Innovación Organizacional y Manufactura Avanzada



Fuente: Elaboración propia

Likewise, the scatter diagram in Figure 1 shows some of the assumptions that are directly related to the validity of the research results, including:

a) The two variables are intervals or ratios (they are continuous).

b) Only relevant variables are included.

c) There is a linear relationship between the two variables.

d) There are no Significant extreme measures (outliers).

e) We can observe the result of $R^2 = 0.762$, which means that there is a very strong positive correlation between the two variables (Hernández y Mendoza, 2018)

Multiple linear regression analysis by the successive steps method (*stepwise*)

Once the variables have been verified to comply with the assumptions required for the multiple linear regression analysis, the linear regression model is created. For this, the method of successive steps is chosen. The results are the following.

Table 4 shows that there is a mean of 1.7583 for the Advanced Manufacturing variable and 1.5269 for Jobs, 2.9181 for External Relations and 1.3871 for Workplace, while the standard deviation obtains values of 0.43795 for Advanced Manufacturing and 0.45562 for Jobs, 1,19861 for External Relations and 0.38643 for Workplace. We can also see that the total sample corresponds to 31 elements.

Tabla 4. Estadística descriptiva por variable

Variables	***Mean***	***Std. Deviation***	***N***
Manufactura Avanzada	1.7583	0.43795	31
Puestos de Trabajo	1.5269	0.45562	31
Relaciones Externas	2.9181	1.19861	31
Lugar de Trabajo	1.3871	0.38643	31

Fuente: Elaboración propia

Table 5 presents the results of the successive steps method. The order in which the independent variables are related to the dependent variable is shown, that is, they have a statistically significant relationship. According to the results, we can see that the variable that has the highest relationship with Advanced Manufacturing is External Relations, followed by Workplace and, finally, Jobs.

Tabla 5. Método *stepwise*

Modelo	**Variables**	**Variables removidas**	**Método**
1	Relaciones externas	.	Stepwise (Criteria: Probability-of-F-to-enter <= 0.050, Probability-of-F-to-remove >= 0.100)
2	Lugar de trabajo	.	Stepwise (Criteria: Probability-of-F-to-enter <= 0.050, Probability-of-F-to-remove >= 0.100)
3	Puestos de trabajo	.	Stepwise (Criteria: Probability-of-F-to-enter <= 0.050, Probability-of-F-to-remove >= 0.100)

a) Variable dependiente: Manufactura Avanzada

Fuente: Elaboración propia

Table 6 presents the summary of the model and the value of R, that is, the simple correlation for each variable. Here we obtain a value of R = .809 and R^2 = 0.655 for the correlation between Advanced Manufacturing and External Relations, which means a high positive linear correlation and that the External Relations variable can predict 65% of the

linear equation. Likewise, a value of R = 0.869 and R^2 = 0.755 is obtained for the correlation between the External Relations and Advanced Manufacturing Workplace variables, which also indicates a high positive linear correlation, both variables can predict 75% of the final equation. While for the correlation between the predictor variables External Relations, Workplace and Advanced Manufacturing Jobs, the correlation coefficient is R = 0.892 and R^2 = 0.796, which also indicates a high positive linear correlation between the predictor variables and the dependent variable, with a 79% prediction of the independent variables that determine the linear equation.

Tabla 6. Resumen del modelo

Model o	***R***	***R²***	***Adjusted R²***	***Std. Error of the Estimate***	***Change Statistics***				
					R^2 Change	*F Change*	*df 1*	*df 2*	*Sig. F Change*
1	0.809a	0.655	0.643	0.26179	0.655	54.957	1	29	0
2	0.869b	0.755	0.738	0.22421	0.101	11.536	1	28	0.002
3	0.892c	0.796	0.774	0.20843	0.041	5.403	1	27	0.028

a) Predictors: (*Constant*), Relaciones Externas

b) Predictors: (*Constant*), Relaciones Externas, Lugar de Trabajo

c) Predictors: (*Constant*), Relaciones Externas, Lugar de Trabajo, Puestos de Trabajo

d) Variable dependiente: Manufactura Avanzada

Fuente: Elaboración propia

Likewise, Table 7 shows the results of the analysis of variance test (Anova). The three models obtained are statistically significant, that is, they allow a correct prediction to be made. The Anova is of great importance in the analysis of the results of regression studies if the variability between the sample means is "small", this favors the null hypothesis (Anderson *et al.*, 2008).

Tabla 7. Anova

Modelo		***Sum of Squares***	***df***	***Mean Square***	***F***	**Sig.**
1	*Regression*	3.767	1	3.767	54.957	.000a
	Residual	1.988	29	0.069		
	Total	5.754	30			
2	*Regression*	4.346	2	2.173	43.229	.000b
	Residual	1.408	28	0.05		
	Total	5.754	30			
3	*Regression*	4.581	3	1.527	35.152	.000c
	Residual	1.173	27	0.043		
	Total	5.754	30			

a) Predictors: (*Constant*), Relaciones Externas

b) Predictors: (*Constant*), Relaciones Externas, Lugar de Trabajo

c) Predictors: (*Constant*), Relaciones Externas, Lugar de Trabajo, Puestos de Trabajo

d) Variable dependiente: Manufactura Avanzada

Fuente: Elaboración propia

The Anova indicates that there is a Significant linear relationship (Sig. <0.05) between the Advanced Manufacturing dependent variable and the three independent variables: Jobs, Workplace and External Relations.

Table 8 shows the results obtained that show the value of the constant for each model. In the case of model one, the value of the constant is 0.896; model two gets 0.528, and model three 0.317. The value of the beta standardized coefficients allows us to observe that the variable that has the greatest significance for predicting the hypothesis is External Relations for models one and two, however, in the case of model three it is observed that the variable with the greatest weight is Place of Work, with a value of 0.424.

Table 8 of coefficients also shows the diagnosis of collinearity. In SPSS statistics, it is established that a model can have problems when there is collinearity between the predictor variables, that is, that a predictor variable can be predicted from other predictor variables (IBM SPSS Statistics, 2008).

According to the data obtained in the collinearity statistic, the values generated in the three predictor variable models are above 0.10, which means that there is no collinearity problem between the predictor variables. The generated models are valid.

Tabla 8. Coeficientes

Modelo		***Unstandardized Coefficients***		***Standardized Coefficients***	***t***	**Sig.**	**95.0 % *Confidence Interval for B***		***Collinearity Statistics***	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(*Constant*)	0.896	0.126		7.136	0	0.639	1.152		
	Relaciones Externas	0.296	0.04	0.809	7.413	0	0.214	0.377	1	1
2	(*Constant*)	0.528	0.152		3.466	0.002	0.216	0.841		
	Relaciones Externas	0.197	0.045	0.538	4.379	0	0.105	0.289	0.579	1.729
	Lugar de Trabajo	0.473	0.139	0.417	3.396	0.002	0.188	0.758	0.579	1.729
3	(*Constant*)	0.317	0.168		1.88	0.071	-0.029	0.662		
	Relaciones Externas	0.133	0.05	0.364	2.668	0.013	0.031	0.235	0.405	2.469
	Lugar de trabajo	0.48	0.13	0.424	3.706	0.001	0.214	0.746	0.578	1.729

	Puestos de Trabajo	0.254	0.109	0.264	2.324	0.028	0.03	0.478	0.586	1.708

Fuente: Elaboración propia

Table 9 shows the eigenvalues (eigenvalue). If they are close to 0 and the value of the condition index is greater than 30, it implies a collinearity problem between variables (Morales, 2011). Here all three models do not present a problem with the index condition and the result of the eigenvalues, therefore all three models are valid.

Tabla 9. Diagnóstico de colinealidad

Modelo	**Dimensión**	***Eigenvalue***	***Condition Index***	***Variance Proportions***			
				(*Constant*)	Relaciones Externas	Lugar de Trabajo	Puestos de Trabajo
1	1	1.927	1	0.04	0.04		
	2	0.073	5.144	0.96	0.96		
2	1	2.9	1	0.01	0.01	0	
	2	0.073	6.299	0.43	0.6	0	
	3	0.027	10.41	0.56	0.39	0.99	
3	1	3.861	1	0	0	0	0
	2	0.073	7.268	0.31	0.42	0	0
	3	0.045	9.306	0	0.01	0.39	0.59
	4	0.021	13.58	0.69	0.57	0.61	0.41

a) Variable dependiente: Manufactura Avanzada

Fuente: Elaboración propia

Calculation of the regression line equation

The results of the coefficients allow obtaining the data for the calculation of the regression line equation. According to the values obtained in the summary of the model, the equation is calculated from the results obtained from model three, which includes the total of the predictor variables. Multiple regression analysis (Lind et al., 2008) extends the concept of simple linear regression analysis by including two or more interrelated predictive variables

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(X), known as independent variables, with their corresponding slopes in the calculation of the linear equation (b).

$$Y = a + (b1 * X1) + (b2 * X2) + (b3 * X3) + \ldots (b_n * X_n)$$

After having individually analyzed the independent variables where the correlation coefficients are obtained, a model is prepared using the statistical technique of multiple linear regression analysis. This is to analyze the (independent) predictor variables and obtain the equation that best helps predict the dependent variable Advanced Manufacturing.

The calculation of the equation is obtained by generating a new variable in which the value of the constant of model three is included, to which is added the value of the standardized coefficient of the independent variables, which are multiplied by the value of each independent variable. With the result, it is possible to obtain a new value that allows predicting Advanced Manufacturing from External Relations, Jobs and Workplace.

The equation of the regression line obtained when executing the statistical calculation in the SPSS program is as follows:

Manufactura Avanzada = 0.317 + (0.133 * Relaciones_Externas) + (0.480 * Lugar_de_Trabajo) + (0.254 * Puestos_de_Trabajo)

Figure 2 shows the dispersion diagram with the regression line equation, which is made from the dependent variable Advanced Manufacturing and the adjusted values of the three dimensions of the independent variable Organizational Innovation: Jobs, Place of Work and External Relations, with a confidence interval of 95%.

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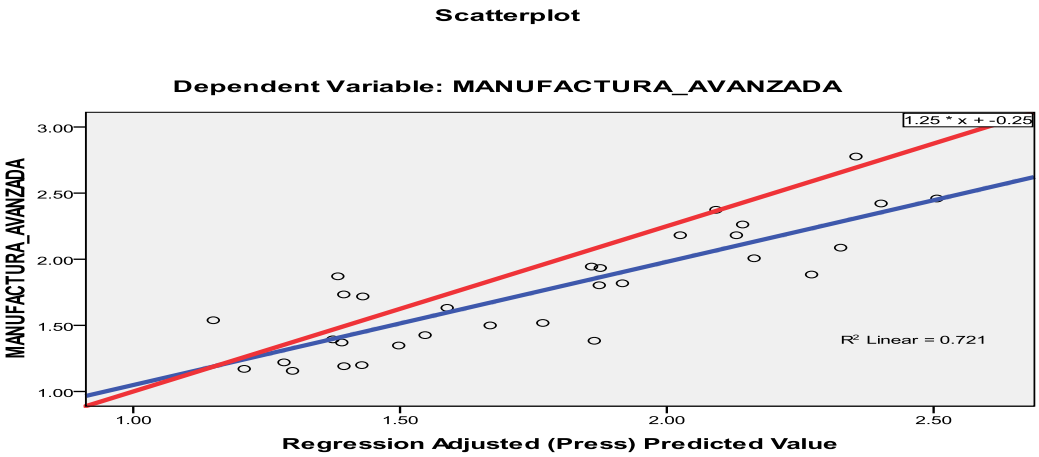
Figura 2. Diagrama de dispersión con la ecuación de la línea de regresión



Fuente: Elaboración propia

Fitted regression line equation

$$y = 1.25 * x + -0.25$$

To determine the certainty in the calculation of the equation, we proceed to compare the Advanced Manufacturing variable with the predictor variable created for the calculation of the Advanced_Manufacturing equation, using the statistical tool t, comparison of related samples.

Test t

Table 10 shows that the value obtained for the mean of the Advanced Manufacturing variable is 1.7583, while the value of the mean for the Advanced Manufacturing prediction variable is 1.7587. The difference in the value of both means is minimal.

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Tabla 10. Estadísticas de par de muestras

Par de muestras		***Mean***	***N***	***Std. Deviation***	***Std. Error Mean***
Par 1	Manufactura Avanzada	1.7583	31	0.43795	0.07866
	Manufactura Avanzada Predicción	1.7587	31	0.39078	0.07019

Fuente: Elaboración propia

Table 11 presents the calculation of the t statistic, which shows the Pearson correlation between the two variables with a value of 0.892, which means a high correlation with a significance level of 0.05 %.

Tabla 11. Correlaciones del par muestras

		N	**Correlación**	**Sig.**
Par 1	Manufactura_Avanzada & Manufactura_Avanzada_Predicción	31	0.892	0

Fuente: Elaboración propia

Table 12 shows that the difference between the two means is 0.00046, which represents a minimum amount, making it possible to check the validity of the generated model and thereby check the research hypothesis.

Tabla 12. Prueba *t* del par de muestras

		Paired Differences					***t***	**df**	**Sig. (2-tailed)**
		Mean	*Std. Deviation*	*Std. Error Mean*	95 % *Confidence Interval*				
					Lower	Upper			
Par 1	Manufactura Avanzad - Manufactura Avanzado Predicción	-0.00046	0.19773	0.03551	-0.07299	0.07207	-0.013	30	0.99

Fuente: Elaboración propia

Discussion

According to the literary review carried out, it is possible to affirm that the implementation of organizational innovation in companies is a link for the development of activities related to advanced manufacturing within the Immex sector of Tijuana.

The results obtained allow testing the hypothesis when answering the questions derived from the research objectives. Therefore, it is possible to affirm that the organizational innovation in the workplace, the jobs and the external relations allows to move towards advanced manufacturing activities.

Based on the assumptions for the linear regression analysis, a multiple linear regression model was generated in which the relationship of the dependent variable Advanced Manufacturing was analyzed to explore and quantify its relationship with the independent or predictive variables. Work and External Relations, which are dimensions of the Organizational Innovation variable.

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When executing the statistical analysis of multiple linear regression, the dependent variable Advanced Manufacturing and the predictor variables are introduced to measure the degree of correlation with the variable Organizational Innovation. The regression coefficient statistic is calculated, with a confidence interval of 95%, the change in R^2, the descriptive analysis and diagnosis of collinearity.

The variable that has the highest relationship with Advanced Manufacturing is External Relations, followed by Workplace and, finally, Jobs, which was verified by analyzing the results of the coefficient table and in the correlation analysis and the successive steps.

The main limitations of the study are found in the target population, since it is difficult to access, which led to the collection of information being obtained very slowly, so a weakness lies precisely in the fact that, due to this fact, it is difficult the questionnaire could be reapplied to the population at another time in the future to verify or measure the degree of progress or decline in their organizational innovation practices, or a longitudinal study could be carried out.

In this sense, taking into account that the growth of an economy is related to the generation of new knowledge, development of technology and innovation, which are linked by a common territory and are generated from the local space, taking into account all this. As it was said, analyzing the interaction of these factors with each other makes it possible to present proposals that favor and promote regional development from an innovative perspective, so that within the strengths of this work is obtaining data to advance understanding of the patterns of adoption of organizational innovations followed by companies in the manufacturing sector Immex and the opportunity opens for a future line of research that allows this study to be applied to another economic sector with similar characteristics in terms of composition.

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Conclusion

In Mexico, an important area of opportunity is identified to improve innovation indicators, specifically within the manufacturing sector, since they are in a position far removed from the leading countries in the field; therefore, within the results of this research, the activities related to the advanced manufacturing of the Immex companies in Tijuana were identified. And it was proven that organizational innovation can represent the link that is required for Immex companies to move from simple manufacturing to advanced manufacturing, and thus move towards technological innovation from non-technological (organizational) innovation.

To check the hypothesis, the general and specific research objectives, a statistical analysis was performed using the tool called linear regression; To do this, composite variables were created from the items that make up each dimension of the variable matrix. In this way it was possible to perform statistical correlation tests and multiple linear regression analysis, and thus obtain an equation of the straight line and predict the behavior of the variables.

According to the results, the hypothesis is tested, namely: Organizational innovation in the workplace, jobs and in external relations allows companies in the Immex sector to carry out activities related to advanced manufacturing.

Therefore, the research questions are answered and it can be affirmed that organizational innovation in the workplace, jobs and external relations allows to move towards advanced manufacturing activities in the Immex sector of Tijuana.

Once the correlation analysis was completed, a predictive model was generated that showed the relationship between the variables by means of an equation, for which the tool called multiple linear regression analysis was used.

Likewise, according to the Anova results, the three models obtained are statistically significant, that is, they allow a correct prediction to be made.

Thanks to the results obtained, it is possible to affirm that organizational innovation is the antecedent for the implementation of advanced manufacturing processes. Specifically, external relations represent a key element for the implementation of strategies linked to innovation in the organization by obtaining an improvement in the availability of data regarding the measurement of non-technological or sociotechnological innovations.

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