PROJECT, DESIGN AND MANAGEMENT

https://www.mlsjournals.com/Project-Design-Management

ISSN: 2683-1597

How to cite this article:
Hernández Ramos, J. M., Castro Coronado, L. G., & Solís Peña, C. (2023). Factores influyentes para mejorar el desempeño de fabricantes de autopartes de Nueva León. *Project, Design and Management*, *5*(2), 151-172. doi: 10.35992/pdm.5vi2.1770.

INFLUENTIAL FACTORS TO IMPROVE THE PERFORMANCE OF AUTO PARTS MANUFACTURERS IN NUEVO LEÓN

Juan Manuel Hernández Ramos
Autonomous University of Nuevo Leon (Mexico)
jmanuelhdz10@live.com.mx - https://orcid.org/0000-0003-0359-912X
Luis Gerardo Castro Coronado
Sistemas Automotrices de Mexico SA de CV (Mexico)
luisgerardocastroc@gmail.com - https://orcid.org/0000-0002-2330-9639
Carolina Solís Peña
Autonomous University of Nuevo Leon (Mexico)
carolina.solispa@uanl.edu.mx - https://orcid.org/0000-0002-0918-1034

Abstract. Increasing performance towards a highly efficient operation in the manufacture of parts is one of the approaches that companies adopt in their production systems. Given the growing globalization, due to trade agreements between countries and geographical areas, the need to integrate the automotive industry into the value chain arises. The objective of this research is to determine which factors influence the improvement of the performance of auto parts manufacturers in Nuevo León. The method used to determine these factors was the collection of information, through a literature review, to form a survey as the main measurement instrument. This survey was first tested by experts in the area to validate it and later it was applied to a pilot sample to check its reliability. It is necessary to indicate that the study subjects are the managers of the productive area in auto parts companies. According to the established model, multiple linear regression was applied to evaluate the four variables that impact the Improvement of Organizational Performance. The established variables were Lean Manufacturing Tools, Process Measurement, Organizational Practices and Process Innovation. The results obtained from statistical analyzes in SPSS, indicate that Organizational Practices and Process Innovation have a significant impact on the Improvement of Organizational Performance.

Keywords: Organizational performance, lean manufacturing, innovation, process measurement, organizational practices.

FACTORES INFLUYENTES PARA MEJORAR EL DESEMPEÑO DE FABRICANTES DE AUTOPARTES DE NUEVO LEÓN

Resumen. Incrementar el desempeño hacia una operación altamente eficiente en la fabricación de piezas es uno de los enfoques que las empresas adoptan en sus sistemas de producción. Ante la creciente globalización, por acuerdos comerciales entre países y áreas geográficas, surge la necesidad de integrar la industria automotriz a la cadena de valor. La presente investigación tiene como objetivo determinar qué factores influyen en la mejora del desempeño de los fabricantes de autopartes de Nuevo León. El método usado para determinar dichos factores fue la recopilación de información, mediante revisión de literatura, para conformar una encuesta como principal instrumento de medición. Esta encuesta fue primeramente probada por expertos en el área con el objetivo de validarla y posteriormente se aplicó a una muestra piloto para revisar su fiabilidad. Es necesario indicar que los sujetos de estudio son los gerentes del área productiva en empresas de autopartes. De acuerdo con el modelo establecido, se aplicó la regresión lineal múltiple con el objetivo de evaluar las cuatro variables que impactan en la Mejora del Desempeño Organizacional. Las variables establecidas fueron las Herramientas Lean Manufacturing, Medición de los Procesos, Prácticas Organizacionales e Innovación de los Procesos. Los resultados obtenidos, a partir de análisis estadísticos en SPSS, indican que las Prácticas Organizacionales y la Innovación de los Procesos tienen un impacto significativo en la Mejora del Desempeño Organizacional.

Palabras clave: Desempeño organizacional, lean manufacturing, innovación, medición de los procesos, prácticas organizacionales.

Introduction

The objective of this research is to analyze a proposal on the factors that influence organizational performance in the auto parts industry in Nuevo Leon performance in the auto parts industry in Nuevo Leon. The importance of studying this topic lies in the need for companies in this sector to increase their competitiveness due to the dynamic, uncertain environment and increasingly intense competition as a result of globalization, technological innovation and short product life cycles, among other factors.

Initially, the background of the problem to be studied is presented, analyzing information regarding statistics related to the subject of study, at local, national and international level, as well as the classification of the auto parts manufacturing industry according to the National Institute of Statistics and Geography (INEGI) (INEGI, 2018).

Based on the type of industry, the variables that have an impact on the problems and industrial sector presented were determined. Based on the literature, a measurement instrument was developed, which consisted of a survey with a Likert scale from 1 to 5, which was applied to a portion of the sample in order to measure the reliability of the measurement instrument.

Once the measurement instrument was validated, it was applied in its entirety to the established sample and the data collected were analyzed descriptively to establish the characteristics of the selected sample. The analysis of the impact of the independent variables on the dependent variable was carried out using inferential statistics and a model obtained by multiple linear regression.

Significant factors in Lean Manufacturing implementation

The automotive industry is one of the most important not only in Mexico but in the world. It is one of the industries that generates the largest number of jobs and improves the economy of the countries that host it, so one of the main objectives is to strengthen and develop its growth (Rugel & Pineda, 2019).

In 2012, global automotive production hovered around 84 million vehicles including pickup trucks and buses, employing approximately 9 million workers and generating 50 million jobs, including indirect jobs (OICA, 2013).

Considering the above data and coupled with the effect of the COVID-19 pandemic, it is possible to identify the relevance of this industry as a "multiplier effect" (UNESCO, 2021). This effect refers to the impact of the automotive industry on other industries and their capacity to generate employment, attract investment and technological development. The automotive sector stood out for its highest employment generation with 57% of vacancies, followed by the food industry with 11%, textile and footwear with 6%, chemicals with 5% and aerospace with

5% (MexicoIndustry, 2017). The good performance of the automotive industry benefits the rest of the sectors, such as metal-mechanics, plastics and pneumatics, as a whole. This is due to the fact that this industry requires a large number of suppliers of different parts, raw materials and/or materials, as well as services (heat treatments, coatings, welding, calibration of measuring equipment, transportation and logistics).

The automotive industry, in search of organizational development, relies on the *Lean Manufacturing* methodology, which in recent years has spread in the manufacturing industry, as well as in companies dedicated to commercial distribution, telecommunications, health, aeronautics, pharmaceuticals, among others.

According to González et al. (2012) *Lean Manufacturing* is an integrated management system, whose main objective is to achieve maximum efficiency of the company, developing operations with minimum cost and zero waste. The aim is to act on the cause of variability or losses and above all inflexibility in order to achieve improvements in costs, deadlines, times and quality, in this way the companies adopt a management philosophy based on continuous improvement.

González (2007)defines *Lean Manufacturing* as a set of tools that support the identification and elimination of waste that could improve quality, as well as production times and costs. Waste are activities that do not generate value and can be found both tangibly in materials, parts and equipment and non-tangibly in time and money (Nor, Rahman, Sharif, & Esa, 2013). Complementing *Lean Manufacturing* is *Lean Thinking*, which is a process that is characterized by identifying activities that add value for the customer with the minimum of waste (Anthony, 2011).

According to León (2017)who analyzed the factors that determine the success of *Lean Manufacturing* implementation in organizations, indicated that there are four key factors, among which top management commitment, continuous monitoring, leadership and the training program stand out.

Möldner (2020)in his research determined that *Lean Manufacturing* application techniques (Just in Time, Total Productive Maintenance, *Jidoka*, *Value Stream Mapping* and continuous improvement) have a direct relationship with the development of the organization's operations.

On the other hand, Arango (2015) indicated the use of *Kanban* as a methodology that has an impact on organizational performance due to the decrease of inventories and synchronization of the stages for the assortment of materials, Figure 1.

Figure 1

Kanban Hypothesis Model and Organizational Performance

Peralta (2020)reported as an independent variable the application of the Kanban tool in cedis, depending on cost reduction, that is, to obtain improvements that allow the success of the tool. The author concludes that the human factor is key for the tool to work in the best way; however, it was proven that the implementation of the tool brings improvements and leads to a successful application.

Santos (2013)santos, states that the 5's technique provides solutions to make processes more agile, since this technique is defined as a work philosophy that allows the development of a systematic behavior to continuously maintain classification, order and cleanliness, resulting in higher productivity, improved safety, work environment, personal motivation, quality, efficiency and consequently the performance of the organization. The name of the 5's tool is derived from the techniques in Japanese: Seiri, Seiton, Seiso, Seiketsu and Shitsuke.

Author Lefcovich (2012)mentions some of the benefits of Kaizen: reduced accidents, reduced inventories, process-oriented thinking, emphasis on the planning stage, reduced equipment and tool failures, reduced machine setup times, customer satisfaction, increased inventory turnover levels, significant drop in failure and error levels, improved staff self-esteem and motivation, increased productivity, cost reduction, improved product design, reduced waste and spoilage, reduced design and operating cycles, improved cash flow, reduced customer and employee turnover, economic and financial balance, improved attitude and aptitude of management and staff for continuous change implementation, ability to compete in globalized markets and finally a better adaptation to abrupt changes in the market.

Monge (2013)monge, establishes that the independent variables lean manufacturing, sustainable processes and continuous improvement have a direct, relevant, positive and statistically significant impact on the dependent construct of operational efficiency and environmental responsibility, with lean manufacturing having the greatest impact.

Wilches (2013)indicates that there is a strong relationship to increase the performance of organizations through *Lean Manufacturing* tools, highlighting that important factors for this increase are the commitment of employees and the continuity of management in the planning, follow-up and action-taking stages.

In the research conducted by Prasanta (2019)presented the analysis of the independent variables, development of lean and sustainable practices, process innovation in small and medium-sized companies, on the dependent variable organizational performance, concluding that *Lean* practices are more effective for SMEs compared to process innovation.

Greenan (2003)states that there is a relationship between process innovation and improved organizational performance. Achanga (2006)indicates that globalization and emerging technologies have had an impact on manufacturing industries around the world. He identified that 50% corresponds to leadership, 30% financial investments, 10% organizational culture and 10% skill.

Process innovation is the implementation of a new or significantly improved production or delivery method, including significant changes in techniques, equipment and/or software (Klewitz & Hansen, 2014). Innovation is a process of change, currently the industry 4.0 revolutionized production processes by creating smart factories through the use of robotics, the internet of things, advanced interface and virtual reality (Ivanov, Dolgui, & Sokolov, 2019).

Indicators and organizational practices

Alvarado (2001) describes indicators as numerical values that allow measuring the behavior and evolution of a process, activity, area or department. They should be simple or direct, and should consist of a direct measure of the characteristics to be measured, and their purpose is to evaluate specific activities or tasks of a process in order to improve the performance of the organization. Ray (2007) indicates that a business metric should quantify, monitor and evaluate the success or failure of the organization's performance.

Related to the indicators are organizational practices, which are mechanisms used in an organization to communicate its values, norms and goals to its employees; they are instrumental and shape perceptions about the emphasis that the organization places on its principles. They also serve the function of pointing out, communicating and reinforcing those aspects that the organization expects from its employees. In the context of quality, the practices emphasize attitudes and behaviors within the organization (Riordan C, Gatewood, & Bill, 1997).

Mudhafar (2017), states that leadership impacts the implementation of lean manufacturing and determined that it has been highlighted as a key success factor especially in SMEs. In addition to the above, it indicates that through the use of lean tools and methods it is possible to implement lean manufacturing; the reality is that they do not ensure success unless top management and leadership adapt to the needs of *Lean Manufacturing*.

Sarhan (2013) analyzes the success of *Lean Manufacturing* implementation in the construction industry by analyzing the organizational practices that serve as determinants for its implementation. The author concluded that *outsourcing,* social responsibility, financial problems, lack of management commitment, lack of Lean education, lack of customer focus and lack of establishing performance metrics can all affect the success of *Lean Manufacturing*.

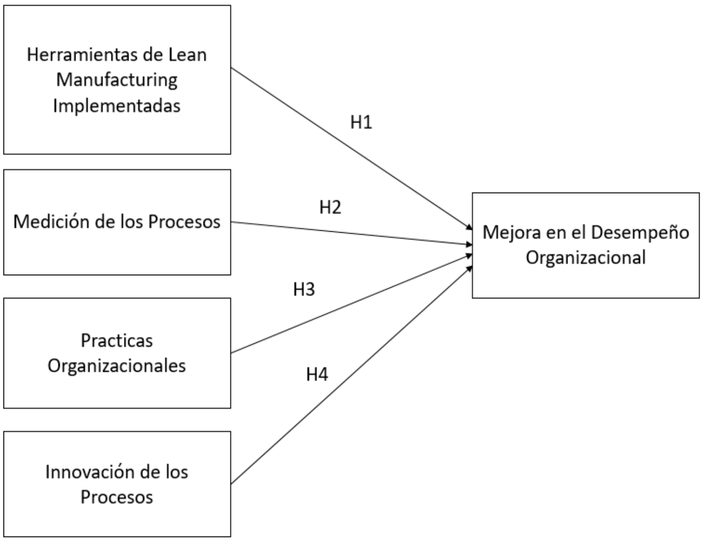
Among the main practices is management's commitment to quality. There is a consensus in accepting management leadership or commitment as a necessary condition for a quality culture. Deming includes it in his fourteen principles of application, Crosby refers to it as the first step to quality and Juran holds top management accountable for operational compliance. There is positive evidence between leadership and organizational performance (Tejada & Arias, 2005).

Gopalakrisghnan (2000)considers that organizational performance has several synonyms, among which are efficiency, effectiveness, financial results and employee satisfaction. Empirical studies related to organizational performance have been carried out in which the innovation process stands out (Yamakawa & Ostos, 2011).

In accordance with the literature reviewed, the improvement in the performance of organizations and the relationships found between variables in different research studies, Figure 2 is presented.

Figure 2

Graphical model of the hypotheses



The hypotheses presented for the research are described below:

H1: *Lean Manufacturing* tools have an impact on improving organizational performance.

H2: Process Measurement has an impact on improving organizational performance.

H3: Organizational Best Practices have an impact on improving organizational performance.

H4: Process innovation has an impact on improving organizational performance.

The research approach is quantitative in nature because it measures phenomena and uses statistics to test hypotheses and theory (Hernandez S. , 2014).

Method

The present study is of the cross-sectional type because the data collection was carried out at a single time point. It is quantitative in nature since it considers the measurement of variables related to the dependent variable. In addition, it is correlational and explanatory since it evaluates the impact of the independent variables on the dependent variable, through the application of the survey and subsequent analysis by means of multiple linear regression with the use of SPSS software. On the other hand, this research is non-experimental since the phenomenon was observed without any type of manipulation of the model variables (Hernandez R. , 2018).

The sample was determined using the non-probabilistic sampling technique with an unknown finite inventory, at a 90% confidence level and an error of 10%, obtaining a sample of 28 large auto parts manufacturing companies for motor vehicles distributed in the state of

Nuevo Leon (Hernandez R. , 2018). It is important to note that the measurement instrument was sent to selected companies with their prior authorization.

In order to collect the information, a survey with a Likert scale evaluation was applied: 1) Strongly disagree, 2) Disagree, 3) Neither agree nor disagree, 4) Agree, 5) Strongly agree. In order to carry out the content validity, the measurement instrument was reviewed with a group of experts in the field, resulting in the restructuring of the wording of some items (IP1, IP2, HLM19, and HLM20), and the recommendation to use the 5-point Likert scale (Soriano, 2014).

On the other hand, in order to test the reliability of the measurement instrument, a pilot test was carried out with 15 surveys addressed to companies dedicated to the manufacture of auto parts. To test reliability, Cronbach's Alpha index was applied per variable. Table 1 shows the results for the variables Process Measurement, Organizational Practices and Organizational Performance, which indicate that there is a correlation and it is not necessary to eliminate any item. For the variables Innovation in the Organization and Lean Tools, it is necessary to eliminate three and one item, respectively, in order to achieve internal consistency of the instrument. Consequently, the survey consists of 41 questions for the next stage.

Table 1

Cronbach's Alpha values pilot test

Variable	Variable Name	Final Cronbach's Alpha	Items eliminated from the total	Items considered
X1	Lean Manufacturing Tools	0.824	HL16	HL17, HL18, HL19, HL20, HL21, HL22, HL23, HL24, HL25
X2	Process Measurement	0.910	-	MP9, MP10, MP11, MP11, MP12, MP13, MP14, MP15
X3	Organizational Practices	0.805	-	PO30, PO31, PO32, PO33, PO34, PO35, PO36
X4	Innovation in the Organization	0.799	IP5, IP6, IP8	IP1, IP2, IP3, IP4, IP7
Y1	Organizational Performance	0.909	-	DO37, DO38, DO39, DO40, DO41, DO42, DO43

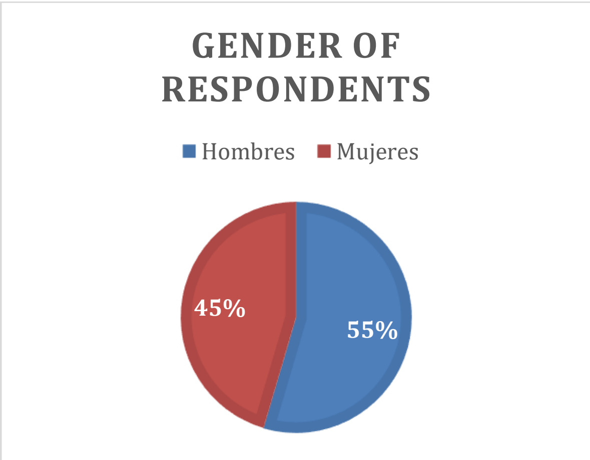
Results

Results of descriptive statistics

The results of the respondents' gender and the descriptive statistics to obtain the values of the measure of each of the variables are presented below. Regarding the gender of the respondents, it is important to note that 55% are men and 45% are women. The number of surveys applied was 45, however, there were *outliers*, which resulted in 33 surveys being considered valid. This information can be seen in Figure 3.

Figure 3

Gender of Respondents



From the data collected during the application of the 33 surveys, the mean and standard deviation of each of the variables were calculated. The results of the descriptive statistical observation on the behavior of each variable item are shown in the following tables.

The descriptive statistics of the items that make up the variable X1, *Lean Manufacturing* Tools, are shown in Table 2. The mean of the responses tends to a value of 5, which being the maximum value indicates that the respondents fully agree with the question asked. On the other hand, the standard deviation for item HL17 is 0.36411 which indicates that the data are stable, similar and close to each other. Data for items HL16, HL19, HL20 indicate variability, but not significant. The items that show this variability correspond to the use of *Value Stream Mapping*, SMED and JIDOKA, which are *Lean Manufacturing* tools that take more time to develop and companies choose to select "other" tools for the improvement of their processes, such as the 5's. Furthermore, considering that the question is focused on the frequency of tool use, it is possible to conclude that these are second-level tools, which are not applied on a daily basis.

Table 2

Descriptive Statistics Variable Lean Manufacturing Tools Implemented.

	N	Minimum	Maximum	Media	Standard Deviation
HL16	33	1	5	4.3030	1.35750
HL17	33	4	5	4.8485	0.36411
HL18	33	3	5	4.7879	0.48461
HL19	33	1	5	4.3636	1.02525
HL20	33	1	5	4.0303	1.15879
HL21	33	1	5	4.2121	0.99240
HL22	33	3	5	4.2424	0.70844
HL23	33	4	5	4.7879	0.41515
HL24	33	2	5	4.7576	0.66287
HL25	33	3	5	4.7576	0.56071

For variable X2, Process Measurement, the information is presented in Table 3. The mean value shows an inclination to strongly agree. The standard deviation of item MP12 is 0.39167, indicating that the variability is low. In the case of item MP8 the variability is 0.90558, which corresponds to the analysis of the productivity of human resources in the different processes of the organization. It is considered that this deviation was generated due to the fact that not only productive processes but also other areas of the organization were asked about.

Table 3

Descriptive Statistics Variable Process Measurement

	N	Minimum	Maximum	Media	Standard Deviation
MP8	33	2	5	4.4848	0.90558
MP9	33	2	5	4.6061	0.78817
MP10	33	2	5	4.5455	0.79415
MP11	33	3	5	4.5152	0.75503
MP12	33	4	5	4.8182	0.39167
MP13	33	3	5	4.3636	0.74239
MP14	33	3	5	4.8182	0.46466
MP15	33	2	5	4.5758	0.75126

In the case of the Organizational Practices variable, the information is presented in Table 4, which shows that the mean of each of the items is oriented towards the highest score. On the other hand, the standard deviation indicates that item PO30 has a low variability of 0.17408, the opposite is true for item PO34 with 0.96236. The latter corresponds to the empowerment of workers. Mexico, being a country undergoing change, still has organizations that consider excluding the empowerment of its workers, concentrating the power of decision only in the managers (Blanco & Moros , 2020).

Table 4

Descriptive Statistics Variable Organizational Practices

	N	Minimum	Maximum	Media	Standard Deviation
PO30	33	4	5	4.9697	0.17408
PO31	33	4	5	4.8788	0.33143
PO32	33	3	5	4.6061	0.55562
PO33	33	3	5	4.5455	0.61699
PO34	33	1	5	4.3636	0.96236
PO35	33	3	5	4.8485	0.44167
PO36	33	2	5	4.9788	0.54530

For the last independent variable, Process Innovation, the results are shown in Table 5 whose mean is above a value of 4.

Table 5

Descriptive Statistics Variable Process Innovation

	N	Minimum	Maximum	Media	Standard Deviation
IP1	33	3	5	4.4848	0.79535
IP2	33	3	5	4.4545	0.79415
IP3	33	2	5	4.0909	0.91391
IP4	33	2	5	4.3030	0.91804
IP5	33	2	5	4.2727	1.09752
IP6	33	2	5	4.6061	0.82687
IP7	33	3	5	4.8182	0.52764

The statistical data associated with the dependent variable, Organizational Performance, show that the means of the items tend to a value close to 5, which represents the highest score in the measurement instrument. On the other hand, the standard deviation for this construct is minimal as shown in Table 6.

Table 6

Descriptive Statistics Variable Organizational Performance

	N	Minimum	Maximum	Media	Standard Deviation
DO37	33	4	5	4.8182	0.39167
DO38	33	4	5	4.7273	0.45227
DO39	33	4	5	4.6364	0.48850
DO40	33	3	5	4.4848	0.66714
DO41	33	4	5	4.7273	0.45227
DO42	33	4	5	4.5455	0.50565
DO43	33	3	5	4.5454	0.61169

Final results obtained using multiple linear regression

In this research, multiple linear regression was used to test the significance of the hypotheses, according to the model described above (Hair , Black , Babin , & Anderson , 2014). The principles of linear regression for data analysis are presented below.

Normality

Considering that the information collected is ordinal and the responses were coded with a Likert scale applied to a sample, a Kolmogorov-Smirnov test was performed to verify the fit of the data to a normal distribution. To check the significance level, if it is less than 0.05, the distribution is not normal; if it is greater than 0.05, the distribution is normal. Table 7 shows that the significance level obtained was 0.608, so the hypothesis of normality of the residuals is not rejected.

Table 7

Kolmogorov-Smirnov test

One-Sample Kolmogorov-Smirnov Test		
		Standardized Residual
N		33
Normal Parameters a,b	Mean	0
	Std. Deviation	0.96824584
Most Extreme Differences	Absolute	0.133
	Positive	0.087
	Negative	-0.133
Kolmogorov-Smirnov Z		0.761
Asymp. Sig. (2-tailed)		0.608

Note. a Test distribution is Normal. b Calculated from data.

Linearity

Linearity is another quality statistic of a linear regression. The "Pearson" correlation coefficient was used, which has a series of parameters mentioned below: coefficient of 1 indicates that the correlation is perfect and positive, between $0.90<r<1$ is very high, $0.70<r<0.90$ is high, $0.40<r<0.70$ is moderate, $0.20<r<0.40$ is low, $r=0$ is null, $r = -1$ is perfect and negative. Table 8 shows that the Innovation variable is highly correlated, Process Measurement is low, Lean Tools and Organizational Practices are moderately correlated; however, the method used "by successive steps" did not consider the Lean Tools variable in the proposed model.

Table 8

Pearson correlation

Type of Variable	Variable Name	Correlation
V.I	Innovation	0.701
V.I	Process Measurement	0.125
V.I	Lean Tools	0.564
V.I	Organizational Practices	0.580

Multicollinearity

Multicollinearity describes the relationship between variables when we create an econometric model. It is usually considered a problem of degree because its relationship can be of greater or lesser degree. To test this statistic we used the variance inflation factor which indicates the degree to which the variance of the least squares estimator is raised by collinearity between variables.

In practice, multicollinearity is considered to exist as from 5. Multicollinearity is calculated using variance inflation factors (VIF) as shown in Equation 1:

Equation 1. Multicollinearity calculation

$$VIF = \frac{1}{1 - R^2}$$

Source: Lopez, 1998

Table 9 shows the statistical results of collinearity and confirms that they are in the range mentioned in the literature.

Table 9

Collinearity table

	Collinearity		
Model	**Tolerance**	**VIF**	
1	Constant		
	Innovation	0.784	1.276
	Organizational Practices	0.784	1.276
	A. Dependent Variable		

Measure of goodness of fit: Linear correlation coefficient

In this research the $R^2$was used, this statistical measure indicates numerically how close the data are to the fitted regression line. The R^2 is the percentage of variation in the response variable. According to the authors, a correlation coefficient with a value of 0 means that there is no linear correlation, therefore, it can be said that it shows linear independence, if it is between 0 and 0.2 there is a very weak linear correlation, between 0.2 and 0.5 is a weak linear correlation, between 0.5 and 0.7 is a medium linear correlation, between 0.7 and 0.9 is a strong linear correlation and between 0.9 and 1 is a very strong correlation (López & Fachelli, 2015).

IBM SPSS software was used in this research to test this assumption. The system generated two models, which are shown in Table 10. The model that best represents the research problem is presented, in this case model 2, which obtained an R^2 of 0.532.

Table 10

Models developed by the method of successive steps

Model	R	R square	R-square adjustment	Standard error of the estimate	*Durbin Watson*
1	0.701	0.491	0.475	0.38606364	
2	0.749	0.561	0.532	0.36453846	*1.511*

Model 1	Independent Variables: Innovation
Model 2	Independent Variables: Innovation, Organizational Practices
	Dependent variable: Organizational Performance

According to the results obtained, the result of the second model 0.532 is valid for the research, since, according to the authors, a coefficient between 0.5 and 0.7 shows a medium linear correlation. The variables included in the model were Innovation and Organizational Practices; those excluded in this case were Process Measurement and *Lean Manufacturing* Tools. The latter two were the ones that presented items with significant standard deviations, which were described above.

Analysis of VARIANCE

The analysis of variance "ANOVA" tests the hypothesis where the means of two or more populations are equal. ANOVAs assess the significance of one or more factors by comparing the means of the response variable at different factor levels (Minitab , 2021).

According to the analysis of variance (ANOVA), presented in Table 11, the null hypothesis, which indicates that there are no effects or interactions between the dependent and independent variables, is rejected. Therefore, the alternative hypothesis is accepted, which mentions that there is an interaction between the independent and dependent variables, confirming that the model is significant.

Table 11

ANOVA

Model		Sum of Squares	DF	Quadratic Mean	F	Sig.
2	Regression	5.091	2	2.545	19.155	0.000
	Waste	3.987	30	0.133		
Model 2	Independent Variables: Innovation, Organizational Practices					
	Dependent variable: Organizational Performance					

Significance of t-Student variables

Table 12 shows the results of the *t*-Student statistic, a test that aims to show which variables have an impact on the study conducted. In this case, the stepwise method considered that of the 4 variables that were entered into the system, only 2 were significant. These variables are Process Innovation and Organizational Practices, both with a positive impact and lower standard deviations.

Table 12

t-Student and Standardized Coefficients

Model Variable	Coefficients not Standardized		Standardized coefficients t	Coefficients	
	Beta	Standard error	Beta	t	Sig
Constant	0.325	0.065		4.969	0
Innovation	3.180	0.077	0.5562	4.110	0
Organizational Practices	0.169	0.077	0.298	2.184	0

Durbin Watson

The next test of quality is the independence of the residues. The Durbin Watson (DW) statistic is a test used to detect the presence of autocorrelation. The value of this statistic ranges from 0 to 4. A value close to 2 indicates that there is independence of the residuals (so values between 1.5 and 2 are acceptable). In this study the DW value is 1.511, shown in Table 13.

Table 13

Value of Durbin Watson

Model	**R**	**R square**	**R-square adjustment**	**Standard error of the estimate**	**Durbin Watson**
1	0.701	0.491	0.475	0.38606364	
2	0.701	0.561	0.532	0.36453846	1.511
Model 1	Independent Variables: Innovation				
Model 2	Independent Variables: Innovation, Organizational Practices				
	Dependent variable: Organizational Performance				

Testing of Hypotheses

Table 14 shows the consolidated acceptance or rejection of the hypotheses for the dependent variable Organizational Development. With the results presented, the hypothesis of the variables Innovation and Organizational Practices is accepted, while for the variables *Lean Manufacturing* Tools and Process Measurement the hypothesis is rejected.

Table 14

Consolidated Information of the Independent Variables

Variable	Hypothesis	Beta	P value	Accept or Reject
Lean Manufacturing Tools	Lean Manufacturing Tools have an impact on improving organizational performance.	-	-	Rejects
Process Measurement	Process Measurement has an impact on organizational improvement.	-	-	Rejects
Organizational Practices	Organizational Practices have an impact on improving organizational performance.	0.298	0.00	Accept
Process Innovation	Process Innovation has an impact on improving organizational performance	0.562	0.00	Accept

With the above, it is possible to obtain Equation 2, which indicates that the coefficients of the betas represent 86% of the phenomenon studied.

Equation 2. Proposed linear regression model.

$$\hat{y} = 0.325 + 0.298\ X3 + 0.562\ X4 + \in$$

Where:

$\hat{y}$: Improved performance

X3: Organizational Practices

X4: Process Innovation.

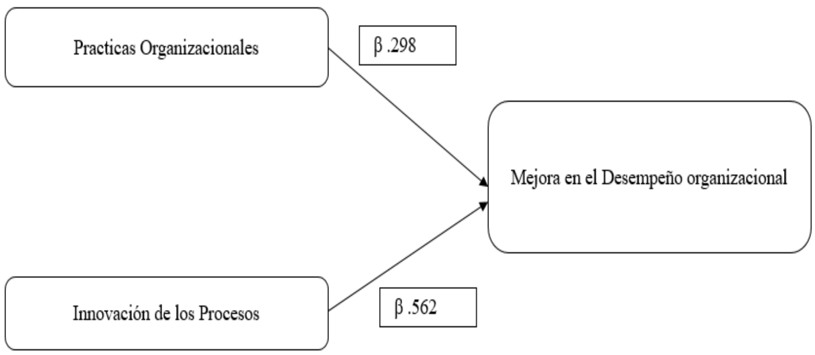
$\in$: Error

Discussion and conclusions

This research contributes to knowledge, as it establishes that Organizational Practices are necessary to achieve process improvement and Process Innovation will allow to be competitive. In accordance with the above, Figure 4 shows the final graphic model, where it is indicated that the statistically significant independent variables are Organizational Practices and Process Innovation, as well as the Beta coefficients, $\beta$for each of them.

Figure 4

Graphical model of final variables



The results of this research indicate that the organizations in the study do not consider *Lean Manufacturing* tools and Process Measurement as variables that impact the improvement of their process performance.

Despite this, it is recommended to analyze the *Lean Manufacturing* tools variable separately, as it contains several tools that may bias the opinion of the study subject, and harm the result generated by the item in the construct (Nor, Rahman, Sharif, & Esa, 2013). Next, authors are cited who analyzed some tools as the dependent variable and focused on narrowing down which variables have an impact on that tool only.

Authors such as Balram (2003), Arango (2015)Peralta (2020)analyzed the variables that directly influence Kanban, this being its dependent variable.

Santos (2013) also analyzed the 5's methodology. Lefcovich (2012)independently analyzed the Kaizen methodology. The aforementioned authors concluded that these variables have an impact on the improvement of the processes individually; however, in this research it is concluded that there is no impact on the improvement of the grouped processes.

On the other hand, when taking the results of the surveys applied to this construct, at least three items were identified as having a higher standard deviation than the rest, which affects the final result. The study subject's response is due to the fact that the question asks about the frequency of use of the tool, and since the tools are not easy to apply or do not require prior knowledge, this generates the affectation. In this case, it is recommended for future research to change the question "How often do you use...?" to "Do you consider that the tool _______ contributes to the improvement of the organization's performance?", in this way, the fact that the tool is not used in your current job does not affect the result, since the subject of the study can determine if it really has an impact based on his or her experience.

The Process Measurement variable was not statistically significant. This result was affected by item MP8, which was left "open" when it is known beforehand that human resources are generally measured in organizations in a very particular way in production departments and not in office departments. In the question, marketing was mentioned as an example, when the latter could be said to have an indicator to review the products obtained from human resources, not their productivity.

The Likert scale measurement instrument encourages the subject of the study to indicate what he/she considers to be happening in his/her organization. It should be mentioned that the measurement instrument for this independent variable was based on questions that had been considered in other research studies (Monge C. , 2015) (Ray, Zuo, & Wiedenbeck, 2007), (Mulugeta, 2021). In addition to the above (change in the item) it is recommended to assign a numerical scale in each Likert level so that the study subject can really locate the results obtained in the organization and not leave a totally disagree or agree.

In the case of Organizational Practices, this study is supported by the results obtained by Mudhafar (2017) who talks about the impact of leadership on process improvement through lean manufacturing implementation. Similarly, Sarham (2013) indicates that the values of the organization's employees affect the improvement of processes through the use of lean manufacturing. The main practices considered were training, employee competencies, idea generation, motivation (Padilla, 2019), worker empowerment (Saumyaranjan, 2017), supplier development, as well as contracting a quality management system. According to the aforementioned, it can be indicated that in order to improve processes, a fundamental part is the practices adopted by the organization mentioned above.

Finally, the independent variable Innovation was statistically significant. This variable obtained a β of 0.562, which indicates that it has a greater impact than the Organizational Practices variable 0.298. Klewitz (2014), supports the results of this research by mentioning in his definition that innovation is the implementation of a new or significantly improved production or delivery method. Prasanta (2019), posed as independent variable the development of lean and sustainable practices, as well as process innovation and as dependent variable organizational performance, having as a result that the latter has a noticeable impact on organizational performance. Therefore, innovation implemented with a specific objective will guarantee better results in the organization.

Recommendations

In order to obtain a broader vision of the improvement of the organizations' performance, it is recommended to apply the measurement instrument at the different levels of the supply chain, as well as to expand its application in the states of the Mexican Republic where the automotive area is developed.

As future lines of research, it is mainly recommended to change the question of the variable *Lean Manufacturing* Tools from How often do you use...? to Do you consider that the tool _______ contributes to the improvement of the organization's performance?, with the objective of including the previous knowledge that the subject of the study has and not to bias it by limitation of resources or considerations of superiors that lead to declaring it as an independent variable. In the case of Innovation and Organizational Practices they can remain the same in the current model as independent variables and in the case of Process Measurement it is recommended that it be a mediating variable, since it is in charge of the organization's indicators.

References

Achanga, P., Shehab, E., Roy, R., & Nelder, G. (2006). Critical success factors for lean implementation within SMEs. *Journal of Manufacturing Technology Management, 17*(4), 460-471. http://dx.doi.org/10.1108/17410380610662889

Alvarado, J. (2001). *Sistemas de Indicadores para la mejora y el control integrado de calidad de los procesos*. Publicaciones de la Universitat Jaume I.

Anthony, J. (2011). Sigma vs Lean: Some perspectives from Leading Academics and Practitioners. *International Journal of Productivity and Performance Management, 60*(2) https://doi.org/10.1108/17410401111101494

Arango, M., Campuzano , L., & Julian , Z. (2015). Mejoramiento de los procesos de manufactura utilizando Kanban. *Revista Ingenierías Universidad de Medellín, 14*(27), 222-232. https://doi.org/10.22395/rium.v14n27a13

Balram, B. (2003). *Kanban systems: The Stirling Engine Manufacturing Cell*. University of Manitoba.

Blanco, Y., & Moros , H. (2020). Empoderamiento Organizacional: Factor del Bienestar Laboral. *Revista Cubana de Salud y Trabajo,21*(2), 60-65.

Celina, H., & Campo, A. (2005). Aproximación al uso del coeficiente alfa de Cronbach. *Revista Colombiana Psiquiatria, XXXIV*(4), 575-580.

González, F. (2007). Lean Manufacturing. Main Tools. *Revista Panorama Administrativo*, 85-112.

Gonzalez, M., Campos , J., Gonzalez , L., Hidalgo, M., & Sanchez , S. (2012). Design of a model for successful Lean implementation. In *6th International Conference on Industrial Engineering and Industrial Management*, (pp. 1518-1525).

Gopalakrishnan, s. (2000). Unraveling the links between dimensions of innovation and organization perfomance. *Journal of High Techology Management Research, 24*(9), 137-153. https://doi.org/10.1016/S1047-8310(00)00024-9

Greenan, N. (2003). Organizational change, technology, employment and skills: An empirical study of French manufacturing. *Cambridge Journal of Economics, 27*(2), 287-316.

Hair , J., Black , W., Babin , B., & Anderson , R. (2014). *Multivariate Data Analysis.* Pearson.

Hernandez , R. (2018). *Metodología de la investigación: las rutas cuantitativa, cualitativa y mixta.* McGraw Hill.

Hernandez , S. (2014). *Metodología de la Investigación*. McGraw Hill.

INEGI. (2018). Sistema de Clasificación Industrial de América del Norte 2018. https://www.inegi.org.mx/app/scian/

Ivanov, D., Dolgui, A., & Sokolov, B. (2019). The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics. *International Journal of Production Research*, *57*(3), 829-846. https://doi.org/10.1080/00207543.2018.1488086

Klewitz, J., & Hansen, E. (2014). Sustainability-oriented innovation of smes: A systematic review. Journal of Cleaner Production, *65* 57-75. https://doi.org/10.1016/j.jclepro.2013.07.017

Lefcovich, M. (2012). *Gestión de la Productividad.* Administracion de las Operaciones.

Leon, G., Marulanda, N., & Gonzalez, H. (2017). Factores claves de éxito en la implementación de Lean Manufacturing en algunas empresas con sede en Colombia. Tendencias Revista de la Facultad de Ciencias Económicas y Administrativas, 18(1), 85-100. https://doi.org/10.22267/rtend.171801.66

López , P., & Fachelli, S. (2015). *Metodología de la Investigación Social Cuantitativa*. Autonomous University of Barcelona.

MexicoIndustry. (2017). Mexico Industry. El medio de la industria manufacturera. https://mexicoindustry.com/noticia/bajo-crece-ms-del-20-en-la-generacin-de-empleo

Minitab. (2021). Soporte Minitab 18. https://support.minitab.com/es-mx/minitab/18/help-and-how-to/modeling-statistics/anova/supporting-topics/basics/what-is-anova/

Möldner, A., Garza , J., & Kumar, V. (2020). Exploring lean manufacturing practices' influence on process innovation performance. *Journal of Business Research*, 233-249. https://doi.org/10.1016/j.jbusres.2018.09.002

Monge, C. (2015). Nivel de desempeño en manufactura esbelta, manufactura sustentable y mejora continua. *Mercados y Negocios, 31*. http://doi.org/10.4067/S0718-07642013000400003

Monge, J., & Lopez, F. (2013). Impacto de la Manufactura Esbelta, Manufactura Sustentable y Mejora Continua en la Eficiencia Operacional y Responsabilidad Ambiental en Mexico. *Información Tecnologica, 24*(4), 15-32. http://dx.doi.org/10.4067/S0718-07642013000400003

Mudhafar, A., Konstatinos, S., & Yuchum, X. (2017). *The role of leadership in implementing lean manufacturing. Procedia*, 756-761.

Mulugeta, L. (2021). Productivity improvement through lean manufacturing tools in Ethiopian garment manufacturing company. *Materials Today Proceedings, 37*(2), 1432-1436. https://doi.org/10.1016/j.matpr.2020.06.599

Nor, A., Rahman, A., Sharif, S., & Esa, M. (2013). Lean Manufacturing Case Study with Kanban System Implementation. *Procedia Economics and Finance, 13* 174-180. https://doi.org/10.1016/S2212-5671(13)00232-3

OICA. (2013). Organizacion Internacional e Constructores de Automoviles. https://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1665-952X2013000300005

Peralta, J. (2020). Reducción de costos de distribución de productos farmacéuticos aplicando el Sistema Kanban: Estudio de caso. Asociación Mexicana de Logistica y Cadena de Suministro.

Prasanta, K. C. (2019). Could lean practices and process innovation enhance supply chain sustainability of small and medium-sized entreprises? *Bussines Strategy and the Environment*, *28*(4), 1-17. https://doi.org/10.1002/bse.2266

Ray, C., Zuo, X., & Wiedenbeck, J. (2007). The lean index: Operational lean metrics for the wood products industry. *Wood and fiber science, 38*(2), 238-255.

Riordan C, Gatewood, R., & Bill, J. (1997). Corporate image: Employee reactions and implications for managing corporate social performance. *Journal of Business ethics, 16*, 401-412.

Rositas, J. (2014). *Los tamaños de las muestras en encuestas de las cienciassociales y su repercusión en la generación del conocimiento.* Innovaciones de Negocios. https://doi.org/10.29105/rinn11.22-4

Rugel, C., & Pineda, I. (2019). Medición de los inventarios y su efecto en los estados financieros del taller automotriz Masterservi S.A. *Revista Observatorio de la Economía Latinoamericana*, *9*(2). https://doi.org/10.15332/s1794-9998.2013.0002.09

Santos, F., Murguia D, Lopez , A., & Santoyo, E. (2013). Comportamiento y organización. Implementación del sistema de gestión de la calidad 5S'S. *Diversitas*, *9*(2), 361-371.

Sarhan, S., & Fox, A. (2013). *Barriers to Implementing Lean Construction in the UK Construction Industry.* The Built & Human Environment Review.

Soriano, A. (2014). *Diseño y validación de instrumentos de medición.* Repositorio Digital de Ciencias y Cultura de El Salvador.

Tejada, J., & Arias, F. (2005). Practicas organizacionales y el compromiso de los trabajadores hacia la organizacion. *Enseñanza e investigacion en psicologia*, *10*(2), 295-309.

UNESCO. (2021). Evaluación del impacto del COVID-19 en las industrias culturales y creativas. https://unesdoc.unesco.org/ark:/48223/pf0000380185?1=null&queryId=N-a3e3a6bd-cf60-40da-b09d-c604a0430750

Wilches, M., Cabarcas, J., Lucuara, J., & Gonzalez , R. (2013). Aplicación de herramientas de manufactura esbelta para el mejoramiento de la cadena de valor de una línea de producción de sillas para oficina. *Dimensión Empresarial*, *11*(1), 126-136.

Yamakawa, P., & Ostos, J. (2011). Relación entre innovación organizacional y desempeño organizacional. *Universidad y Empresa*, *13*(21), 93-115.

Date received: 09/01/2023
Revision date: 07/03/2023
Date of acceptance: 18/04/2023