IMPLEMENTATION OF LEAN BUSINESS STRATEGIES: EVIDENCE FROM MEXICO

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ABSTRACT

This research, identifies lean management practices and elements. Despite widespread interest and little empirical evidence to support its position in improving organization performance, there is little understanding of lean business strategy key organizational factors. This research identifies five elements of lean business practices. An instrument was developed to empirically analyze dimensions underlying the constructs of this study. To verify the results, cluster analysis was used to group organizations having different patterns of lean manufacturing practice implementation. The results confirm that lean organizations significantly differ from non-lean organizations with regard to manufacturing strategies having emphasis on cost and volume flexibility.

JEL: L6, L2, L1

KEYWORDS: Manufacturing, Organization, Firm Strategy

INTRODUCTION

In the globalized world of the XXI century, competitiveness has become necessary for companies of all sizes. In the quest to survive and thrive in today's dynamic and turbulent environment, organizations need to reconfigure their primary responsibilities (Hernandez, Rodriguez and Espinoza, 2010). To create and maintain a competitive manufacturing advantage, firms need skills to adapt production processes to the needs of their customers and a structure that supports a culture of continuous improvement. This is accomplished through the identification and reduction of waste in the organization.

Although it is generally accepted that SMEs are important to the national economy, few governments have taken measures to enhance their contribution or increase their competitiveness. Most countries do not have reliable statistics on SMEs (Saavedra and Hernandez, 2007). World class manufacturing companies focus on finding ways to improve their production processes and produce products or services with high levels of quality, productivity, reliability and lower cost.

Mexico has a large number of SME manufacturers trying to gain a competitive advantage. Some companies integrate their production and administrative processes. Despite widespread interest and some empirical evidence to support its role in improving organizational performance, there exists little research related to organizational characteristics of lean manufacturing companies.

One alternative to replace traditional manufacturing practices in SMEs is lean manufacturing and enterprise integration. This represents an opportunity to remain competitive in the market, in which the general rule seems to be fulfilling the goal of "reducing costs." Lean manufacturing has been used by many organizations to compete globally, which is considered revolutionary in the process of continuous improvement in manufacturing concepts (Womack and Jones 1996).

Lean manufacturing techniques can help SMEs meet the new paradigms in manufacturing (Maurer, 2005). Additionally, there is a growing consensus about the attributes of lean manufacturing. This tool has resulted in significant improvements in the performance of a large number of organizations. Despite the interest and agreement of its importance, current research has made very little progress in examining characteristics associated with lean manufacturing systems. Based on the state of the art, the current research contributes in two ways to fill this gap.

First, this study identifies lean practices elements of the current literature. Second, it explores patterns of implementation of lean manufacturing and enterprise integration. Despite widespread interest and some empirical evidence to support the improvement in performance, there is little theory regarding the concept of lean manufacturing in SME's. Identifying differences between companies that intensively implement these practices and their counterparts who do not implement them, this study provides insight to the development of a theory to explain lean manufacturing systems and present guidelines for managers of companies considering implementing lean manufacturing.

Since elements of lean manufacturing can be implemented individually or in combination, several patterns of implementation are feasible. The objective is to determine if companies that use lean manufacturing can adapt faster to changes in their external environment than non-users. We begin with a review and analysis of the subject matter literature and the configuration of lean manufacturing. Afterwards, the paper continues with a discussion of the methodology used in the research and presents the data and results of the study. Finally, concluding remarks and limitations are presented.

LITERATURE REVIEW

Traditional Manufacturing

Traditional manufacturing developed a framework for excellence in cities. The craft guilds exercised tight control of this urban industry, through complicated regulation preventing the development of free enterprise. Even when the traditional industry could support the requirements derived from the slow expansion of demand for manufactured goods, unions represented an anti-capitalist concept, representing a barrier to the emergence of technically more advanced forms of productive organization. The industrialized, increasingly globalized world of today, is experiencing a slow but gradual shift from traditional methods of production (Taylorism and Fordism) to new forms of work organization. Among these stands the Japanese model, also known as lean manufacturing, created by Womack (1996).

Emergence of Lean Manufacturing

The increase in global competitive challenges of the last two decades has led a number of companies to adopt new manufacturing practices (Meredith and McTavish, 2004). Particularly lean manufacturing (Womack and Jones 1996). Lean manufacturing is a multi-dimensional practice that includes a wide variety of management techniques, including just-in-time, quality control systems, employee involvement, supplier management, customer involvement, etc. in an integrated system.

Lean manufacturing comes from the Toyota system. This system represents a new way to do business worldwide (Ohno, 1988). Pioneers in tools development of the Toyota production system were: Toyoda, Ohno and Shingo (Kaufman, 2001). This system was introduced in 1945, when the president of Toyota Corporation decided to look beyond levels of United States manufacturing. One factor was the economic situation in Japan after the Second World War. This forced Japanese companies to seek a new strategy to optimize production processes. Therefore they developed the Toyota system which fits the lean manufacturing concept.

The main idea of lean manufacturing is that these practices can work synergistically to create a high quality system, which allows the creation of finished products according with the customer´s requirements with little or no waste. The existing evidence supports the association of lean manufacturing and improvement in performance. While most studies focus on the simple content of a specific area and their implications for performance (such as Hackman and Wageman, 1995; Samsom and Terziovski, 2003, MacDuffie, 2005), very few studies have focused on analyzing the two elements of this study and much less in SMEs.

Manufacturing programs, such as lean manufacturing, which evolve slowly over a long time period, are difficult to imitate and transfer. Lean manufacturing is valuable, rare and difficult to imitate (Barney, 1991). Lean manufacturing is valuable because it is associated with the highest performance of companies that have implemented it. It is rare because not all manufacturing companies, especially SMEs in Mexico, have this demanding program. The implementation of lean manufacturing requires distinctive practices and processes, as well as high-level administrative processes (Teece, Pisano and Shuen, 1997).

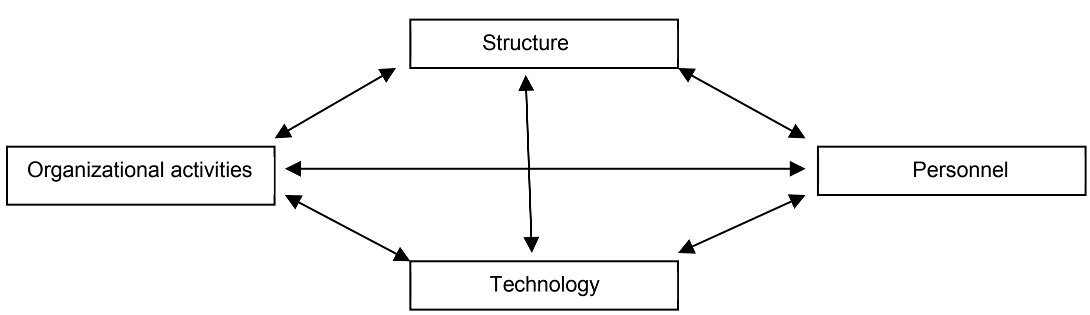
High administrative levels include coordination and communication processes with suppliers and customers. This suggests that lean manufacturing has high levels of interdependence and its replication may be difficult. Replication requires systemic change through the organization and between organizational links. Thus, identifying the appropriate process to implement appropriate strategies becomes a fundamental point.

The strategy can be defined as "the coordinated series of actions aimed to achieve a particular goal" (MacCrimmon, 1993). Strategies exist at every level of the organization and are hierarchical in nature (Hayes and Wheelwright, 1984). They are formulated at the corporate level as corporate strategies and at business unit level as business strategies. A definition of manufacturing strategy is seen as the effective use of the strengths of manufacturing as a competitive tool to achieve business and corporate goals (Swamidass and Newell, 1987).

The primary function of the manufacturing strategy is to put together the set of manufacturing capabilities that enable it to continue its chosen business strategy. Thus, the focus in manufacturing strategy research has been to describe options between key capabilities or competitive priorities (Ward and Duray, 2000). According to these authors, the literature on manufacturing strategies notes four competitive priorities: cost reduction, quality, delivery and flexibility.

According to Schroeder (2001), an organization can change by altering structure, technology or changing people. Structure change involves rearranging internal processes. Changing technology means to alter equipment, engineering processes, research techniques or production methods. In manufacturing companies the processes are interdependent as shown in Figure 1. The processes interact reciprocally under the influence of joint forces. Therefore, the question arises on how to integrate these processes.

Figure 1: Interdependent Organizational Elements



Source: Authors, based in Shah, 2002. This figure shows the processes of manufacturing firms, which explains how a change in its element would affect others.

Enterprise Integration

The use of computers and systems has enabled companies to face new challenges and opportunities through high speed information processing. Unfortunately, information flow has not been enough to interconnect the various internal processes of an organization. Therefore, integration models of companies aim to achieve an efficient and effective alignment of the elements of an enterprise through a simple modeling language (Chun, 2003).

The improvement of processes is an opposing relationship between cost-benefit that lightly tends to cost. Incomplete development and alignment in existing processes can lead to increased costs. Specialized systems and business lines diversification can generate an expensive processes. Changes in business requirements of unfinished projects can reduce benefits. Enterprise integration is a solution to these challenges. Enterprise integration drives assets and processes into a single adaptive infrastructure and is a more rational approach. When current and new tools are integrated smoothly within their preferred business methods, these can maintain and increase the value of investments in technology and training.

It is essential to select the important elements to be analyzed, ignoring irrelevant items. The main objective of integration is to provide necessary information on time. Companies must be able to integrate communication factors, cooperation and coordination between processes. The integration process is clearly important because many investigations focus on strategy.

To study the patterns of implementation of manufacturing practices in SMEs, it was essential to identify the key concepts often included and are commonly used to represent lean manufacturing systems in academic and anecdotal research. One is continuous implementation, where the limits represent each of the SMEs categories. At one end can be found those SMEs that implement lean manufacturing practices known as "lean archetypes" and at the other end SMEs that do not implement these practices in an extensive form, for the purpose of this study, called "non-lean archetypes". Once identified, it was important to develop valid and reliable scales to represent each of the key aspects. The literature review identified five key areas of lean manufacturing as noted in Table 1.

Thus, the overall objective of this study is to determine if companies that use lean manufacturing face faster the change phase of their external environment than companies that do not use it.

Table 1: The Two Configurations of Lean Manufacturing

	Intensity Level of Implementation	
Lean Manufacturing Practices	**Lean Archetype**	**Without Lean Archetype**
Just in time (JIT)	High	Low
Quality control tools (SPC)	High	Low
Employee involvement (INVEMP)	High	Low
Involvement of suppliers (INVPRO)	High	Low
Customer involvement (INVCLI)	High	Low

Source: Authors. This table shows the profiles of the two groups and suggests that key elements of lean manufacturing can be carefully matched in order for a company to achieve high performance.

Hence, our hypothesis is:

H1: Companies that use lean manufacturing do not face faster change phase in their external environment than those who do not use it.

The second objective was to determine the level of emphasis that SMEs that use the archetypes of lean manufacturing put on their business strategies of response, time and cost relative to those SMEs who do not use it. This study identifies the characteristics of the environment, strategy and performance of SMEs with and without archetypes of lean manufacturing as presented in Table 2.

Table 2: Characteristics of the Archetypes of SMEs with or without

Organizational variables	Slim Archetype	Without Slim Archetype
Business Strategy	High emphasis on response time and cost	Low emphasis on response time and cost

This table shows the emphasis about the archetypes of the SME´s according with the business strategy.

Hence, we present our next hypotheses:

H2: SMEs with slender archetypes do not establish a higher level of emphasis on the business strategies of response, time and cost of a statistically significant way those SMEs who do not have this archetype.

DATA AND METHODOLOGY

This work represents research based on analysis of information sources. From a theoretical standpoint, a basic primary documentary research on the issues and theories of lean manufacturing, traditional production methods, enterprise integration, basic statistics, research methodology, are most important. The quantitative research attempts to determine the strength of association between variables as well as generalization and objectivity of the results through a sample to make an inference to a population.

This is a cross-sectional study, to describe the population at a unique moment in time. The instrument used in this study measured the following constructs: change phase in the external environment, business strategy and manufacturing strategy. The developmental stages of the instrument were carried out in four phases: 1) the generation of factors, 2) pre-test phase, 3) pilot study and 4) validation of the instrument, collecting and analyzing information. The Pre-test phase was conducted with academics, workers and companies' experts. The pilot test was sent to manufacturing and operations managers of manufacturing companies with between 50 and 250 employees.

The objective of the instrument was to obtain reliability measures and validity for each construct. This study obtained a Cronbach alpha level of 0.78. The proper generation of the elements being measured was the key factor determining the validity and reliability of this empirical study. Elements of the external environment change phase were generated using two channels, the operational measures of dynamism (Miller, 1996) and clock speed (Mendelson and Pillai, 1999). The authors conceptualized clock speed as the rate of change in products: both existing products and the introduction of new products in the market.

The processing clock speed measures obsolescence of existing equipment and the rate of innovation of existing processes. Organizational restructuring and the formation of partnerships were considered indicators of organizational clock speed. Past empirical research has shown that specific measurements have a low response rate. For this reason, ten measurements were developed and scored on a Likert scale from strongly agree/disagree.

For the business strategy and manufacturing strategy constructs, there are well-developed instruments. For example, the business strategy is a well-developed topic in the literature on organizational strategy and management theory. This study adapted elements proposed by Porter (1980), and Kotha and Vadlamani (1995) to construct the scale. Similarly, the elements of manufacturing strategy were adapted from Leong, Snyder and Ward (1989). Since these constructs have been found reliable and valid in other studies, there was no further validation.

This study used manufacturing SMEs registered with the state of Chihuahua, in the Mexican Business Information System (SIEM) in January of 2012. Companies were examined during the first six months of same year. Enterprises of different sizes and different processes were selected. Respondents had titles in the positions of general managers, plant managers, manufacturing managers and operations managers. They used email as a primary method to collect data on the first phase. The reason for using e-mail was the low cost for data collection and the time required.

The Dillman Total Design was used as a technique for electronic mailings. Dillman (2000) suggests the customization of each e-mail instead of sending emails to all reviewers at once. Using this method allows the responses of 4 to 5 weeks as opposed to the traditional method requiring 8 to 10 weeks. Cluster analysis was performed to classify them into groups. Cluster analysis categorizes individuals or objects into clusters making the clusters of each group to be similar and different from other clusters. It had 2,553 e-mail addresses, from the Business directories and the Association of Maquiladoras directory.

During the first week responses were received from 185 respondents. Some 423 emails were returned by the system, because they could not be delivered. Another 48 “out of office” automatic responses were received. Some 479 asked to be removed from the list of respondents by company policy. There were 15 incomplete responses by respondents. The final sample includes 271 completed and returned surveys as shown in Table 3.

Table 3: Administration of Questionnaires Sent

		Calculation
Initial sample size	2,553	
Not Sent Notifications	423	
Participation Declined	479	
Incomplete Responses	15	
Actual sample size	2,114	2,553-(423+15)
Complete Responses	271	
Response rate	12.8%	271/2114

Source: Authors. This table shows results by response category of the questionnaires sent.

RESULTS AND DISCUSSION

In this section, we present detailed results obtained from the implementation pattern of lean manufacturing practices to justify manufacturing archetypes profile. A cluster analysis was used to classify them into groups. The aim is to find statistical assumptions maximizing the homogeneity of objects within the clusters, in the same way that also maximizes the heterogeneity between clusters. A variation in the cluster, represents the set of variables used to rank companies within the cluster. Hence, we hypothesize:

H1: Companies that use lean manufacture do not face change phase faster statistically significant in its external environment than companies do not use it.

To test the above hypothesis, cluster analysis study was used as a confirmatory tool to verify the archetypes presented. The archetypes represent extremes of the categorization in manufacturing companies. A cluster option was also developed from literature review and its relationship between cluster variables and pre-specified archetypes. An analysis of clusters of two stages was carried out.

The first stage in this study was to select an appropriate number of clusters. The Ward method was used to minimize differences within the clusters. In the second stage, Lehman's guidance was followed such that an appropriate number should contain between 30 and 60 cases. So we expect to get two to four clusters with 129 cases. To this end we used SPSS 20.0 program for clustering coefficients of each stage.

Table 4: Analysis of Clustering Coefficient with the Ward Method

Number of Clusters	Clustering Coefficient	Incremental Change in the Coefficient	Percentage Change of the Coefficient
10	230.03	11.9	5.2%
9	241.93	13.71	5.7%
8	255.64	17.18	6.7%
7	272.82	17.63	6.5%
6	290.45	23.04	7.9%
5	313.49	29.97	9.6%
4	343.46	31.24	9.1%
3	374.7	53.77	14.4%
2	428.47	139.49	32.6%
1	567.96	-------	-------

Source: Authors. This table presents the coefficients of agglomeration, the incremental change and the incremental percentage change in agglomeration coefficients obtained.

Additionally, an ANOVA statistical test was performed to examine the statistical differences among the five clusters of variables between groups. An ANOVA test was developed to find significant differences in means. The results of the ANOVA test, indicate that the two clusters differ significantly based on each of the five variables considered. The level of significance of four of these variables was $p < 0.000$. This supports claims of Swamidass and Newell (1987), who established that manufacturing forces positively influence proper implementation of lean manufacturing tools in business. Table 5, shows the results of the ANOVA examining statistical differences between the clusters.

Table 5: Results of the ANOVA Testing the Significance between the Clusters

Variables	Cluster Mean Square	Df	Error Mean Square	Df	F Value	Significance
JIT	25.44	1	0.39	127	65.37	0.000***
SPC	13.82	1	0.41	127	33.83	0.000***
INVEMP	29.34	1	0.33	127	89.41	0.000***
INVPRO	34.10	1	0.41	127	83.37	0.000***
INVCLI	4.92	1	0.47	127	10.41	0.002**

*Source: Authors. This table shows results of Anova test. *p<0.10 ** p<0.05 ***p<0.01. Significant difference between clusters of JIT, SPC, INVEMP, INVPRO, INVCLI.*

Additionally, a discriminate analysis was performed to achieve a cross-validation of cluster analysis. In contrast to the ANOVA analysis, discriminate analysis is a multivariate statistical tool. A multivariate test allows us to simultaneously analyze multiple variables and at the same time. The discriminate function was derived by combining the five cluster variables in a linear function. Discrimination is achieved by adjusting the weight of each variable to maximize the relative variance between groups and within group variation. Table 6 presents the results for cross validation.

Table 6: Results of Cross Validation of the Discriminate Function

Function	Characteristic Root (Eigenvalue)	Canonical Correlation	Significance Of Correlation	Squared Canonical Correlation
1	2.04	0.82	0.000***	0.67

*Source: Authors.. This table shows the discriminative function, the value of the characteristic root (Eigenvalue), the canonical correlation and its statistical significance. *p<0.10 ** p<0.05 ***p<0.01.*

The ratio of 0.82 associated with canonical discriminative function was significant at a p<.000 value. The canonical relationship measures the relative strength of the relationship between the variables of lean manufacturing and group membership.

The second hypothesis is:

HO2: SMEs with slender archetypes do not establish a higher level of emphasis on the business strategies of response, time and cost of a statistically significant way that SMEs do not have the archetype.

Since lean manufacturing practices have been implemented in certain industries, especially in the automotive industry, studies have suggested these companies' business strategies include a stable environment and a predictable rate of change as prerequisites for the implementation of lean manufacturing as shown in Table 7.

Table 7: Groups of Manufacturing and Business Strategy

Variables		Lean Manufacturing N = 69	Without Lean Manufacturing N = 60	T Test (Significance)
Business Strategy				
Cost	Average of Cluster	0.20	0.02	-1.46 (0.15)
	Standard Error	0.08	0.09	
Time	Average of Cluster	0.18	0.08	-0.92 (0.36)
	Standard Error	0.07	0.09	
Response	Average of Cluster	0.22	-0.08	-2.48 (0.02**)
	Standard Error	0.08	0.09	

Source: Authors. This table shows the average manufacturing groups and the standard error of each of the three dimensions of business strategy. **p<0.10 ** p<0.05 ***p<0.01.*

While the two archetypes differ in all three dimensions of business strategy, there is only one statistically significant difference which was the response p <0.02. We found no statistically significant difference in business strategies in time and cost. This result seems to support the arguments of Schroeder (2001), who claims that a company can achieve changes for its culture or by changing their structure.

CONCLUDING COMMENTS

This research proposed and tested a configurational model of lean manufacturing. The research proposed that the pattern of implementation of five key elements of lean practices was cohesive and internally consistent. It presented conceptual archetypes depicting patterns of implementation of the elements of lean manufacturing at two extreme polar ends. One group was composed of companies that implemented practices from all elements extensively, lean archetype, and the other group was composed of companies that do not use lean practices extensively, non-lean archetypes.

Subsequent to derivation of profiles, two hypotheses were posited to evaluate differences between the two groups for organization level characteristics. Data collection and scale development were described in the methodology. Data were collected using a survey administered via e-mail. The data were divided into two parts for exploratory and confirmatory purposes. Exploratory factor analysis with CF-Varimax rotation was used to purify the measurement model for the constructs, which were subsequently examined with the validation sample using confirmatory factor analysis.

Lean manufacturing scales were used to classify the organizations into mutually exclusive groups using a two-stage cluster analysis. The cluster analysis resulted in a two-cluster solution. The two clusters were well separated on the five clustering variables, and the univariate ANOVA results indicated a clear distinction in the pattern of values for the clustering variables. The two-cluster solution was validated using discriminate analysis and the jack-knifing procedure.

The findings of this study is that ongoing changes in the global market, the evolvement of manufacturing technology and emerging management practices, offer manufacturing companies unparalleled strategic opportunities, as well as provides various administrative challenges. One of the biggest challenges is how to optimize manufacturing capabilities of enterprises. Manufacturing capabilities are difficult to develop and once these skills are developed, they are difficult to change.

The two-stage cluster analysis categorized manufacturing organization in two groups. The first group had high positive values on all five variables, indicating a high level of implementation of lean practices. The second group was characterized by high negative values on all five variables, implying relatively low implementation levels. The cluster analysis suggested that there were clear distinctions in the pattern of implementation of lean practices across organizations in Chihuahua, Mexico. Further, the archetypes suggest that manufacturing organizations in Mexico differ in the way they implement manufacturing practices and they have realized the systemic nature of lean manufacturing.

This research provides a theoretical perspective of the lean manufacturing concept and provides greater clarity to its elements. Additionally, this study provides a theoretical justification on the link of lean manufacturing with operational performance. One objective of this study was to determine if companies using lean manufacturing face faster phase changes of their external environment than nonuser companies.

A second objective was to determine the level of emphasis that SMEs that use the archetypes of lean manufacturing put on their business strategies of response, time and cost compared to SMEs that do not use it. To prove the first objective, lean manufacturing practices were grouped into five key variables that frame lean manufacturing systems and considered the deployment pattern of the five variables proposed. The research suggests the pattern of implementation of the five variables is internally consistent and can be derived empirically.

To test the second research objective, manufacturing profiles were compared among the companies selected with the characteristics selected in this study. The results link the manufacturing groups with the indicated manufacturing strategies, comparing companies with lean manufacturing with companies that do not have it.

The knowledge gained suggests that manufacturing companies differ in intensity of implementation of various manufacturing practices. However, the pattern of implementation of different practices was not sufficiently clear. The results obtained from this study provide a snapshot of the companies with lean manufacturing and shows how they differ from companies that do not have it. This study considers the empirical data collected from different theoretical perspectives and makes inferences that suggest administrative intervention. In particular, we emphasize the following contributions: The research represents the first systematic empirical effort to investigate and characterize the implementation of lean manufacturing. Five key variables were used to represent the land of lean manufacturing. This provides a set of valid and reliable measures that can be replicated in future research on lean manufacturing systems. The multidimensional nature of lean manufacturing has been frequently addressed in academic literature, unfortunately, the absence of theory that could explain the systemic nature of lean manufacturing has impeded its progress. The results obtained in this research help fill this space.

This study also shows one effort to link implementation and non-implementation of lean manufacturing practices with different manufacturing and business strategies. Contrary to conventional knowledge, the results of this study suggest business strategies that involve companies using lean manufacturing to give the highest priority to customer response and market needs.

This study provides an opportunity for improvement and ideas for future research. In this sense, limitations and future research are presented together. This investigation is a first step in developing SMEs within a profile of lean manufacturing practices, by comparing and contrasting the relationship between companies with and without lean archetypes. We provide a framework to better adapt their practices. The current research does not suggest a causal link or a causal model. Because the data collected here was cross-sectional, it cannot directly address the question of whether implementing lean business practices leads to high performance.

Further, because there is a significant overlap in lean manufacturing and high performing companies, the direction of causality can be argued. This limitation suggests two directions for future research. First, collecting data from the respondents of this study to test for longitudinal performance effects for implementing lean manufacturing. This process will provide an answer to the question of causality posed above. Second, it would be of utmost interest to examine how high performing organizations differ from the rest of the companies in their pattern of lean implementation and in their strategic and behavioral characteristics. Future research can design a model that includes multiple relationships simultaneously with the relations of several constructs of the present investigation. Future research should also be conducted to replicate the results of this study.

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