

Proposal of a Lean Index Development in Organizational Contexts

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Abstract— The purpose of this paper is to suggest the development of a Lean index to assess the proximity of any organization management system to the Lean system. Based on predefined criteria, intended to evaluate if the Lean Philosophy is the more appropriate for a particular organization achieve its strategic objectives. It was concluded that the Lean index, carried out in this work, can be used by any organization and allows evaluate the number and implementation level of a wide variety of principles, practices and Lean indicators. It is found that the organizational culture, continuous improvement processes and relationship with customers are the three areas in which the assessed organizations are closer to Lean thinking. It is verified the existence of a direct relationship between the Lean index and the performance indicators area index, demonstrating the importance of this area for Lean indices development in order to attest its effectiveness. It is based that the Lean index can be an important support tool in the decision making process concerning the adoption of Lean as a program to obtain competitive and sustainable advantages.

Index Terms— Lean index, Lean thinking, Organizational culture.

I. INTRODUCTION

In the end of World War II, Toyota was far behind in organizational terms when compared with the American car manufacturers. Nevertheless the company managed to grow and become the world's largest car manufacturer and also the most profitable. This has led many researchers to study their production system to learn how he managed to reach its current position in the market (Jimmerson, 2010). This production system was "baptized" Lean in 1988 by Krafcik investigator MVPI (International Motor Vehicle Program) and later popularized in 1990 by the researchers Womack, Jones and Roos through the the book intituled The machine that changed the world (Shetty et al. 2010)

Toyota's success also inspired thousands of industrial organizations, services and governments organizations to adopt Lean thinking in order to acquire the necessary flexibility to meet new competitive challenges. The focus of

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Lean is on the customer and the value chain. It is characterized by the pursuit of perfection through constant elimination of waste, continuous improvement and promote innovation (Shetty et al., 2010). However, many managers, hoping to solve their problems of competitiveness, try to adhere to the Lean philosophy impulsively, often without the knowledge of the reality of their own companies.

The implementation of a lean culture isn't the mere implementation of a set of operating tools. It is a cultural change in complex process that requires the full commitment of leadership and a consistent long-term vision. Lean culture has to be internalized by all levels of the organization (Flush et al., 2009).

The vast majority of research available in the literature deals with the development of methods and indicators to measure the level of Lean implementation. This methods and indicators were developed to assess the progress of the implementation process, assessing whether the principles and Lean practices are being implemented properly. Do not respond to the organizations that have other management systems and want to assess whether, taking into account their specific features, plunge into the Lean is the right strategic choice. In this context, this paper aims to propose the development of a lean index, consisting of a list of indicators that can be used by any organization wishing to evaluate how your management system approaches the management philosophy Lean. Thus, the organisation can check both the number and the level of implementation of a set of principles and Lean practices and use them as support in the decision making process to ensure the desired sustainable progress and competitiveness.

II. ORIGIN OF LEAN THINKING

The term Lean Production was first used in 1988 by John Krafcik's MVPI (International Motor Vehicle Program) from MIT (Massachusetts Institute of Technology) to describe the system of production of Toyota (TPS). He called it Lean considering that used smaller amounts of everything compared to mass production (Lorenzo and Martins, 2006). Subsequently Wolmack et al. (1990), used the term Lean Production in the book "The Machine That Changed the World" to contrast the Toyota production system with the Western system of mass production and the artisanal production.

Thinking Lean is a philosophy of leadership and management whose objective is the development of people, processes and systems, with a view to identifying and systematic reduction of waste throughout the organization and the creation value for all stakeholders (Pinto, 2009).

That is, to be able to deliver to the customer a product or service with more and more added value and don't constitute a loss for any other direct interested entity or indirectly in its activity. Always give more, spending less and less. No entity loses because the value that is added is the result of gradual elimination of any waste.

A. Principles Lean

Womack and Jones (2003) defined five Lean principles to eliminate waste in an organization:

Set value - The value is set by the end customer. It is only significant when expressed as a product and / or service that meets the customer's requirements at a specific price at a specific time (Womack and Jones, 2003). We need to know what are the goals of each stakeholder and know in detail what is valued. Only this way its possible identified what is value and what is waste to the organization.

Identify the value chain - Define for each product and / or service and to each interested party the respective value chain. The value chain is the set of all the specific actions required to conduct a product and / or service through the critical tasks of any business from raw material until the finished product in the customer's hands (Womack and Jones, 2003). Often the analysis of value chain allows identify a big number of waste. (Womack and Jones, 2003).

Optimize the flow - Optimize the flow passes try to synchronize the means involved in the creation of value for all parties. Flow of materials, people, information and capital.

Be able to apply a flow to the whole range of human activities is not an easy or automatic task, because it is difficult for most managers see the value stream and therefore understand its importance. However, the principles of flow can be applied to any activity and the results are always surprising. In fact, the amount of human effort, time, space, equipment and inventory required to develop and provide a product and / or service can typically be halved by the application and optimization of the flow (Womack and Jones, 2003).

Implement the pull system - Only customer orders shall trigger all processes. Organizations can't produce what they think the customer will need (just in case) but what is request and the amount and at the right time (just-in-time). The flow is pulled and not pushed along the value chain.

Pursue the perfection - Encourage continuous improvement of all levels of the organization, constantly listening customer's and trying to be fast, will enable organizations to improve continuously (Pinto, 2009).

The Community Lean Thinking (CLT, 2010) proposed The revision of the principles of Lean thinking identified by Womack and Jones (2003), was done with the addition of two new principles ("know the Stakeholders" and "Always Innovating"). This principles seek to place the organization on the right path towards excellence and outstanding performance (Pinto, 2009).

The success of quality improvement systems of Toyota doesn't mean that you can automatically transform any organization with a different culture and environment. Toyota can provide inspiration, demonstrate the importance of stability in leadership and values that go beyond short-

term profits, and suggest how the right combination of philosophy, process, people and solving problems can create a learning organization. All production companies or services who want long-term success must become a learning company.

B. Lean Practices

Lean Thinking is a management philosophy geared towards maximizing value through consistent reduction of waste. To this goal, serves up a set of methods, techniques and tools geared to simplifying and optimizing processes, remove activities and resources that add no value. Lean Thinking includes involvement of all (people and processes) in the constant improvement of the performance of organizations (Pinto, 2009).

Many of these solutions are known to those already familiar with the issues of quality management and continuous improvement processes. The most referenced are: i) One-piece-flow; ii) Takt-time; iii) Heijunka; iv) Pull-system; v) Value-stream-mapping; vi) Poka-yoke; vii) Jidoka; viii) Kaizen; ix) Visual management.

The application of these tools does not guarantee the successful implementation of Lean thinking, since the essence of this management philosophy is not the solutions advocated but less tangible aspects such as corporate culture, leadership of people and process management (Pinto, 2009).

The overall focus is the development of lean flow in the production environment. Flow production is the movement of materials through the production system without interruption and with the pace of customer requests, takt time. The raw materials flow quickly and in small batches to the finished product . The flow is achieved through the development of flexible production systems that balance the use of people and equipment with customer orders. Flow means that information and appropriate materials are delivered to the production system at the right time in the right quantity and in the right place. It means that the equipment and processes are reliable, capable and available. Thus, all elements of the organization have both the knowledge and skill as a commitment to improving the performance of the organization through continuous improvement. The flow of information and products in the production environment is developed and improved through effort on waste disposal. This waste is often manifested through large production batches and associated stocks. Consequently, the focus of effort must be specific in identifying the root cause of the flow disruption deletes them and consequently reduce the size of the batch and stock.

III. ASSESSMENT OF LEAN INDICES OF ORGANIZATIONS

Is countless the number of people that in the last 20 years studied and wrote about the success of the management system and practices of Toyota. Paradoxically, despite the volume of knowledge presented in the literature, no outside organization of Toyota ever approached his level of performance (Rother, 2010).

The focus on tools and techniques should be led by a deep

understanding of key concepts and guiding principles around which the instruments were developed. The guiding principles become the basis of the entrepreneurial mindset and design systems that reinforce these principles in all actions of all its members (The Shingo Prize, 2010).

The visible elements, techniques, tools, and even the principles of TPS have been shown and described several times in great detail, but only copy those visible elements does not seem work. (Rother, 2010). However, evaluation of the performance of practices tends to be more viable than a direct assessment of principles and may indirectly give clues on the extent of implementation and dissemination of the principles and Lean practices in organizations (Nogueira, 2007). Lean implementation level is not directly related to the number of Lean tools implemented, but with the level of maturity compared to the day-to-day problems and how it has an impact on performance indicators.

According to Nogueira and Casalinho (2008), authors that make an assessment of the degree of implementation of Lean in organizations, some of the most cited in the literature are the methods of Karlsson and Ahlstrom (1996), Sánchez and Pérez (2001) and Fernandes et al. (2005). Among the evaluation methods are the methods Shingo Prize (1998), the Lean Enterprise Model (LEM, 1998), SAE (Society of Automotive Engineers, 1990) J4000 (Identification and measurement of best practices for implementing Lean operations), J4001 (Implementation of Lean operations - user manual) and RR003 (Example better conversion practices for Lean concept in the automotive industry). All authors, proposed a set of indicators to evaluate performance.

The methods Karlsson and Ahlstrom (1996) and Perez Sanchez (2001) and Fernandes et al. (2005), they are very similar. Have weaknesses as the failure to consider the alignment between the organization's strategies and goals of Lean and the lack of assessment of the adequacy of the organizational culture of the company to a Lean culture. These methods do not consider the perception of persons performing activities related to Lean, and not directly assess the performance of operational Lean practices (Nogueira and Casalinho, 2008).

The Shingo Prize methods (1998), Lean Enterprise Model (1998) and SAE J400 and J4001 have in common that the origin of its development. All are derived from professional associations initiatives or those in partnership with research institutes. The weaknesses common to all, is the lack of clarity about how the proposed indicators should be collected and interpreted, as well as the absence of direct evaluation of a comprehensive set of typical Lean practices. The Shingo Prize (1998) Methods, Lean Enterprise Model (1998) do not assess operational practices of Lean, but more related practices in terms of management, such as leadership culture and infrastructure, production strategies and integrated systems and functions that support the production. SAE J4000 and J4001 standards have difficult assessment requirements to be applied due to its subjectivity (Nogueira and Casalinho, 2008).

IV. PERFORMANCE INDICATORS

Performance evaluations have become one of the most important strategic tools at the organizational level (Nogueira and Casalinho, 2008).

According to Kennedy et al. (2007), performance indicators serve multiple purposes. Communicate, clarify, evaluate and provide specific direction for decisions showing the trajectory of the progress of an organization toward its goals and objectives. Basically, the performance indicators provide information and support feedback to decision-making needed to achieve the strategic objectives of the organization. Therefore, it is essential to align them with the strategy chosen by the company. Many traditional performance indicators are anti-Lean. If for example a company uses the rate of use of the machines as an indicator, managers will be interested in keeping the machines to work even if it leads to the creation of excess inventory. This attitude is completely opposite to the lean principles of flow and pull triggered by customer orders. To achieve the full potential of Lean, companies have to replace the traditional performance indicators for those who reflect the Lean strategies and to motivate employees to reach them. For this reason, it is necessary that the indicators are applied as a system, as the over emphasis on a single indicator can address the wrong effort and compromise to improve capacity

According to Pinto (2010), performance indicators, fundamental to Lean are: i) overall efficiency; ii) Availability; iii) occupation; iv) lead-time; v) cycle time and takttime; vi) Rotation of stocks; vii) build to order; viii) FTQ (first team quality).

In the opinion of James Womack, quoted by Marchwinski (2011) for the commitment of middle managers in the Lean transformation process, organizations must transform the metrics and the evaluation behaviour of their performances.

V. DEVELOPMENT OF AN INDEX LEAN

The method developed in this work is a global structure that integrates and synthesizes the multiple dimensions of an organization. Within this framework, it was defined eight areas of impact that are used as the basis for developing questions for research on the adoption of certain principles, practices and Lean indicators. The eight areas are incorporated: i) organizational culture; ii) management of human resources; iii) processes and production control; iv) continuous improvement processes; v) development of new products; vi) relationship with suppliers; vii) customer relationship; viii) performance indicators.

The choice of these eight areas was made from models such as the Lean Thinking Management wheel (Shetty et al., 2010).

The wheel Thinking Lean Management was designed by the first researchers to visually illustrate the Lean Lean thinking and is the first concrete prototype in the development of this type of research (Shetty et al., 2010).

The Shingo model is based on the management approach Lean taught by Shigeo Shingo as the shared thinking with Toyota and other organizations that have achieved operational excellence levels (Shingo Prize, 2010).

To determine the level of implementation of the principles and Lean practices in every organization, it is made raising their level of implementation. Utilizing the five-point Likert scale (never, rarely, sometimes, most of the times, forever). For the analysis of results, weights were assigned as follows: N (ever) = 1; R (rarely) = 2; AV (sometimes) = 3; MPV (most of the times) = 4; S (always) = 5.

The following index to determine the level of implementation of the principles and Lean practices in each area and for each organization:

$$ILA_i = \frac{N^\circ Ni \times 1 + N^\circ Ri \times 2 + N^\circ AVi \times 3 + N^\circ MPVi \times 4 + N^\circ Si \times 5}{N^\circ PAi \times 5} \quad (1)$$

where:

$ILai$ - Is the Lean index of the organization in area i ($i = 1..8$, where 1 = organizational culture; 2 = human resource management; 3 = processes and production control; 4 = continuous process improvement; 5 = development of new products; 6 = relationship with suppliers; 7 = relationship with customers; 8 = performance indicators).

$N^\circ PAi$ - represents the number of the area i practices.

$N^\circ Ni$ - is the number of i area practices evaluated N (never).

$N^\circ Ri$ - is the number of i area practices evaluated with R (rarely).

$N^\circ AVi$ - represents the number i of the evaluated area practice AV (sometimes).

$N^\circ MPVi$ - represents the number of the area i practices evaluated MPV (most often).

$N^\circ Si$ - is the number of i area practices evaluated with S (always).

Lean organization index is calculated using the following formula:

$$IL = \sum_{j=1}^8 \frac{ILA_j}{8} \quad (2)$$

where:

IL - is the Lean index of the organization.

$ILai$ - is the Lean index of the organization in the area i ($i = 1..8$, where 1 = organizational culture; 2 = human resource management; 3 = processes and production control; 4 = continuous process improvement; 5 = development of new products; 6 = relationship with suppliers; 7 = relationship with customers; 8 = performance indicators).

This method of determining the level of implementation of the principles and Lean practices, will check: i) the number and percentage of Lean principles and practices implemented in each organization; ii) the level of implementation of each principle and practice Lean; iii) the deployment rate of the lean principles and practices of each area and each organization; iv) Lean content of each organization; v) the relationship between the characteristics of organizations and their Lean index.

VI. CONCLUSION

Thinking Lean is a management philosophy that requires a cultural transformation in organizations. For this paradigm

shift is reached companies need understand that this is a process of learning and constant endless. This way of thinking requires a synergistic relationship between all branches of the organization.

The author believes that managers held by the Lean index, developed in this work, would be to know not only how far the organization they lead is the philosophy of leadership and Lean management but also which areas and, more specifically, what practical and organizational principles would have to change and / or implement in case they decide to start the Lean journey. Lean index developed thus complies with the objective to provide managers with data that allows them to more accurately assess the size and depth of the transformation necessary and so better support decision-making for the implementation or not of the Lean philosophy. As philosophy itself Lean advocates, you should always look for aspects to improve in a continuous learning process in pursuit of perfection.

This work covers the way for more research within a more consistent validation Lean index developed, require a greater number of applications in different scenarios, especially in different sectors organizations.

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