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Strategic Lean Management: Integration of operational Performance Indicators for strategic Lean management

Hector Cortes*, Joanna Daaboul*, Julien Le Duigou*, Benoît Eynard*

**Sorbonne Universités, Université de Technologie de Compiègne*
Department of Mechanical Systems Engineering, Roberval Laboratory - UMR CNRS 7337
France
{hector.cortes; joanna.daaboul; julien.le-duigou; benoit.eynard}@utc.fr

Abstract: Lean manufacturing has been widely used to increase operational excellence and performance in manufacturing systems. Nevertheless, this approach presents several limits, such as the lack of alignment between lean objectives and strategic management of a company, and the lack of justified measurements for futures Lean implementations. Nowadays, it remains difficult to evaluate the leanness of a manufacturing system due to the lack of relevant indicators and methods to evaluate them. This paper presents framework to overcome these limits: the Lean & Six-Sigma Framework (LSSF). It allows a company to evaluate, justify and enable future lean implementation in line with strategic missions and objectives of the company. This framework is based on real time information exchange with several information systems such as the Manufacturing Execution System and the Enterprise Resources Planning.

Keywords: Manufacturing System, Lean Management, Key Performance Indicators, Manufacturing Execution System, Information System.

1. Introduction

Nowadays, the enterprise environment is highly changing and uncertain due to many factors of which globalisation, shorter product lifecycle, increased product variety, etc. ; therefore the manufacturing systems have to be agile or flexible to face such changing environment while keeping high performance (Tyagi et al., 2015). For that end, the lean manufacturing approach was adapted by many enterprises to “do more with less” (Womack and Jones, 1996) meaning better utilise the system’s resources. It has become a necessity to create added value with an optimal resources utilisation (Cheng and Weng, 2009). Nowadays, it is implemented by several companies if all sectors, and has been proven to be an effective approach in seeking operational excellence (Slomp et al. 2009).

The word “Lean” first appeared in the 90s in order to share the Toyota Work Philosophy. The lean philosophy is based on two main principles: waste elimination and value creation (Murman et al., 2002). A waste is defined as an event that does not generate any added value, and for which the client is not ready to pay (Womack and Jones, 2009). There exist three types of wastes: Muda (task with no added value), Muri (surcharges), and Mura (irregularities) (Womack and Jones, 2009). Ohno (1998) has proposed seven different types of Mudas (overproduction, wait, transport, stock, unnecessary activity, defects, motion). An eighth Muda, unexploited creativity, was added by Liker (2004). The overproduction is considered as the most problematic waste by Ohno (1998). It generates all other types of wastes especially stocks that limit the continuous improvement aimed by the lean philosophy (Liker, 2004).

Many tools and methods were created to reduce/eliminate wastes, and implement the lean philosophy within a manufacturing system (Monden, 1998). Lean decision making is made in a deterministic and static value chain observation using VSM (Value Stream Mapping). The proposed improvements are neither always as expected before implementation, nor are they aligned with strategic enterprise goals. This failure is aggravated by: (1) nonsufficient number of observations (data collection); (2) non reliable data, sometimes lean experts collect production data by hand methods which generate variability sources; (3) a lack of continuous real time data collection; and (4) performance targets are not enough aligned in each manufacturing decision level. This paper proposes an improvement of the traditional lean approach in order to overcome these four limits. The proposed approach, Lean Six-Sigma framework (LSSF) is plugged in information systems to collect real time statistically sufficient and reliable data. The LSSF is based on an alignment between operational performance and strategic development axis of a company. Finally, the LSSF proposes a decision making support by comparing proposed improvements via simulating the manufacturing system. Both statistic-reliable-real-timed-structured data and simulation based analysis enhance traditional lean weakness. In terms of management, this framework offers a management support in lean implementation to lead tactical and operational decisions in order to improve and maintain manufacturing performance.

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In this paper, a literature review is presented to highlight the current limits of the lean implementation. Then the proposed framework is detailed with a focus on the operational/strategic alignment. Finally a conclusion with future works is presented.

2. Literature Review

More than 60% of the enterprises that implemented a lean approach in their manufacturing systems reported a reduction in lead time and costs, and an increase in their market share (Struebing, 1997). And yet, many enterprises and in different industries, are still reluctant to lean implementation due to the absence of tools/methods to quantify the estimated gain of such an implementation and to the resistance to change by operators (Prajogo and MCDermott, 2005). The success of other enterprises in lean implementation is not always sufficient to convince decision makers and managers to invest resources (time and money) hoping for a similar success. In addition, it is difficult and highly complex to manage and control a lean project without an accurate measurement of its performance (Behrouzi and Wong, 2011). Till today, and up to our knowledge, there is no existing tool allowing neither the measurement of all lean indicators nor the accurate estimation of expected gain from a lean implementation.

The different research works on lean indicators and their use to justify the implementation of a lean approach can be classified into 3 main categories: 1) Lean indicators definition (Diego and Rivera, 2007). 2) Leanness Measurement, which is the level of lean implementation and its associated performances (Elnadi and Shehab, 2014; Bayou and Korvin, 2008; Wan and Chen, 2008). 3) Decision aid systems and validation of future implementations (Al-Aomar, 2011; Marvel and Standridge, 2009; Abdulmalek and Rajgopal, 2007). Each of these categories will be discussed hereafter.

2.1 Lean Indicators Definition

The definition of lean indicators or any other indicator is to be realised in adequacy with a predefined objective. In the case of improving manufacturing systems performance, this objective should be in line with the company's strategic objectives and in adequacy with the competitive environment and the market nature and characteristics (Ahmad and Dhafr, 2002). For example, an enterprise offering products with short time to market, should concentrate its improvement strategy on reducing delays. The identified KPIs for the evaluation and implementation of lean approach should reflect the enterprise strategic objectives and facilitate the alignment between strategic, tactic and operational performances (Ahmad and Dhafr, 2002).

Strategic KPIs could be classified for any type of industry into five categories: Cost, Quality, Flexibility, Stock and lead time (Corbett, 1998).

Focusing only on indicators will not lead in most cases to significant performance improvement. An indicator analysed alone, is not sufficient to evaluate a system's performance. Decisions only based on numbers, percentages and ratios can lead to reduced performance at the long term. Often, enterprises use some indicators to measure and evaluate performance. These incomplete set of indicators could lead to inadequate actions for performance improvement. Hopp and Spearman (2000) propose to use three lean indicators for the evaluation of a production system's performance. These are: Cadence, cycle time, and Work-In-Process (WIP). These three indicators are not sufficient to evaluate a production system which can be evaluated with much more indicators that correlated. Nevertheless, it is very hard and even almost impossible to evaluate all these indicators using stochastic methods (Al-Aomar, 2011). This is why lean indicators are measured or estimated with approximate methods, which leads to unexpected results, waste of energy and highly costing change (Al-Aomar, 2011).

There are two sets of indicators used in a lean approach: indicators used to evaluate a system's performance and indicators used to evaluate the level of leanness of a manufacturing system. These are presented in the following section.

2.2 Leanness Measurement

The literature includes many works on methods and models for leanness evaluation. Leanness is defined as the degree of adoption and implementation of the lean philosophy in an organisation. The proposed methods and models for leanness evaluation can be classified into three types: 1) Interviews /surveys, 2) benchmarking, and 3) fuzzy models.

The approaches based on surveys are based on qualitative techniques (Fullerton et al., 2014; Bashin, 2012). The main limit of this approach is the subjectivity of the collected answers. Thus the resulting analysis depends on the interviewed individuals. Moreover the planed and prepared surveys are not adapted to all manufacturing systems (Wan and Chen, 2005).

Benchmarking is used for leanness measurement by several researchers (Wan and Chen, 2008). Its main limits are the difficulty to define an appropriate manufacturing system as a model and to access all needed information which is often confidential. This makes this approach of little use and benefit except for the self-benchmarking (Behrouzi and Wong, 2011).

The fuzzy approach is a mathematical theory for modeling qualitative and quantitative data using fuzzy numbers (Klir and Yuan, 1995). Behrouzi and Wong (2011) describe the implementation of fuzzy models in manufacturing systems. It was also used by Ko (2010) to eliminate risks in production monitoring, and inaccuracies in quantities produces. Fuzzy models allow measuring separately the performance of each lean indicator, which permits enterprises to efficiently analyze different production strategies and potential improvements (Behrouzi and Wong, 2011). Nevertheless, lean indicators have direct or indirect impact on many production parameters, and are not independent from each other. Thus this method doesn't allow the analysis of the impact of improving one indicator on the other indicators and thus the entire system. This is a main limit of this method, which lead us to conclude that taking into consideration the