Available online at www.sciencedirect.com

ScienceDirect

Procedia CIRP 50 (2016) 198 – 203

www.elsevier.com/locate/procedia

26th CIRP Design Conference

Lean Rules Identification and Classification for Manufacturing Industry

D. Mourtzis*, P. Papathanasiou, S. Fotia

[a]*Laboratory for Manufacturing Systems and Automation(LMS), Department of Mechanical Engineering and Aeronautics, University of Patras, Rio Patras, Greece, 26504*

* Corresponding author. Tel.: +30 2610 997262; fax: +30 2610 997744. *E-mail address*: mourtzis@lms.mech.upatras.gr

Abstract

Lean theory, principles and tools, are intended to highlight the value within the company and eliminate waste entirely. Despite the large amount of literature work on lean, there is a lack of in-depth analysis for collection and categorization of specific lean rules for the manufacturing industry. Therefore, the present work proposes a classification, formalization and identification of lean rules, in order to create a comprehensive and applicable library of lean rules, after the investigation of academic literature and a mould-making industry. Finally, the "drawer" idea is introduced aiming to motivate employees of different hierarchical levels in the lean rules development.

Peer-review under responsibility of the organizing committee of the 26th CIRP Design Conference

Keywords: Lean rules; Lean thinking; Manufacturing industry; Product-Service Systems (PSS)

1 Introduction

For more than two decades, lean philosophy has been the business strategy which guarantees competitiveness and eco-friendliness by concentrating on the elimination of non-value-added activities. Since the resources and energy are finite, new sustainable ways of producing more with less ought to be established [1][2]. Lean thinking consists of the lean theory that Toyota presented at the beginning of the 20th century, five key-principles, and a number of applicable tools [3]. The concept of lean manufacturing has demonstrated noteworthy effects on the productivity, in several industries. Pioneers of lean manufacturing developed a large amount of tools and techniques which allow practitioners to handle various problems and eliminate waste. A recent study on lean implementation in National Textiles, with the collaboration of NC State University, has given remarkable results. The number of unnecessary set ups decreased by 50%, the set up time diminished from 15 minutes to 5 minutes, and a 30% efficiency change in productivity as well as a 40% cost reduction in that production area were reported [4].

In spite the fact that lean has received enormous attention over the years, which is reflected in the amount of the literature work, research so far has neglected to monitor the ongoing progress of the philosophy [5]. Lean has been under the research focus throughout the years, however, despite the wide recognisability, expansive use, and level of general familiarity among senior executives, lean has not achieved its full potential [6]. As Duncan and Ritter stated: "We believe that as senior executives gain more exposure to lean and deepen their understanding of its principles and disciplines, they will seek to drive even more value from it" [6]. In 2011, Hodge et al. stated that "Lean principles must advance research and the practice" [4]. Also, Mirdad mentioned that "A suggested solution is to create web-based tool that support the practitioners by providing a systematic implementation process" [7].

Taking into consideration the previous statements, it is believed that people from high hierarchical levels of an organization, gain deeper knowledge about lean theory and its principles, aiming at deriving more value from it, resulting to greater lean results for the company. However, the lean philosophy and knowledge should not concern only people from high hierarchical levels, but also people from any hierarchical level within an organization. The present work, in order to accomplish these objectives, presents the "drawer" idea, which introduces a new methodology for gathering the raw and unstructured information regarding waste elimination and added-value activities of employees from all the hierarchy levels within an organization, in order to develop a repository of lean rules.

Peer-review under responsibility of the organizing committee of the 26th CIRP Design Conference
doi:10.1016/j.procir.2016.04.097

Moreover, another main issue that is identified is the lack of collection and categorization of specific lean rules that provide guidance and assistance in the business environment. To this end, the present work identifies, gathers, classifies, and formalizes initial lean rules based on the literature review and on the industrial practice. The lean rules could be used as a guideline, for individual persons or enterprises that aim to become leaner, and to create a lean process guideline for managers, workforce, suppliers and customers. The lean rules classification methodology relies on an initial classification which consists of categories and subcategories that represent a company's structure.

2 Background and Literature Review

2.1 Lean Theory

Lean theory is a production practice which intends to minimize waste along entire value streams and create more value for customers. According to lean, any utilization of resources that does not ascribe value for the customer is an objective for change or elimination. This management philosophy has mainly been applied to manufacturing, notably in Toyota and the Toyota Production System, from where lean theory originates [8]. Nevertheless, lean has also been connected in non-manufacturing areas as well [9]. In essence, the goals behind the lean manufacturing system, which has been practiced for a long time in Japan, are waste elimination, cost reduction and employee empowerment. The Japanese approach supports that customers are the generator of the selling price. The more quality someone incorporates into the product and the more service the company provides, the more the customer is willing to pay for a product or service. The contrast between the expense of the product and its price is what determines the profit [8].

The lean manufacturing discipline is to dispose of waste obtain capital, acquire more sales and stay competitive in a growing global market. The Toyota production system has long been hailed as the source of Toyota's astounding performance as a manufacturer. The systems' distinctive practices - Kanban quality circles, for instance - have been generally introduced in manufacturing companies. Indeed, GM, Ford, and Chrysler have taken major initiatives to develop production systems such as Toyota's. Organizations that have attempted to adopt the system can be found in fields as diverse as aerospace, consumer products, metals processing, and industrial products [10].

2.2 Lean Principles

Womack and Jones [9] outlined lean thinking in five key-principles, which lean enterprises need to follow. The first principle, *Identify value*, implies that the stakeholders define value in a lean thinking system. The objectives of product design are identified through the definition of value. Value may include reliability, maintainability, availability, multiple functions, and attractive styling for a product/service. "Value is expressed in terms of how the specific product addresses the customer's needs, at a specific price, at a particular time". The second principle, *Map the value stream,* consists of activities that include value satisfaction. The sequence of these activities is known as the value stream. In this process, the product is required to go through three critical management tasks: problem solving, information management, and physical information. The third principle, *Create flow*, clarifies that flow is the continuous movement of product or service through the system to the customer. Principle four, *Establish pull* has been characterized by Womack and Jones as a manufacturing philosophy that ought to provide the product or service just when the customer needs it – not earlier or later. Last, principle five, *Seek perfection,* is a constant effort striving to: (i) uproot non-value-adding activities, (ii) enhance flow, and (iii) fulfil customer delivery needs. Womack and Jones, also stated that lean thinking has no boundaries concerning the procedure of decreasing effort, time, space, cost, and mistakes, while offering products that persistently approach precisely what customer needs.

2.3 Lean Tools

Once enterprises pinpoint the major sources of waste, lean tools, for instance "6S", just-in-time production, Gemba, etc., will guide organizations through corrective activities to eliminate waste and continuous improvement [11][12]. Tools are dependent on lean theory and principles, and can be applied to every enterprise worldwide with appropriate modifications.

3 Definition and Formalization of Lean Rules

In order to start identifying and categorizing lean rules it is essential to define: (i) what lean rule is, (ii) how the style of formalization will be, (iii) and what technique will be used to address the level of importance of each rule. According to our approach, lean rules should follow lean theory, they are based on at least one lean principle and may use or improve the implementation of lean tools.

After an intensive literature review, no definition of lean rule has been explicitly stated so far, thus for the purposes of the present work term of lean rules is defined below:

Definition: *Lean rules are a set of explicit rules based on the lean theory, principles and practices (lean tools), concerning the entire product/service lifecycle, aiming to waste elimination, profit amplification, and stakeholders' satisfaction.*

Continuing, the formalization of rules will be based on the MoSCoW method [13], which is a prioritization technique used in management, business analysis, project management and software development. This method aims to achieve a typical comprehension among stakeholders about the importance they set at a process. Rules labelled as *Must*, are critical and have to be done promptly. Rules labelled as S*hould*, are important but not every time and are used to provide or request guidance or recommendations. Rules labelled as *Could*, are desirable but not necessary. These rules will regularly be incorporated, if time and resources permit. Rules labelled with *Won't Have/Would,* have the lowest effect