

Assessment of Lean Manufacturing and Six Sigma operation with Decision Making Based on the Analytic Hierarchy Process

Alhuraish, I. Robledo, C. Kobi, A

*University of Angers, LARIS systems engineering research
Laboratory, ISTIA engineering school, Angers 49000, France
(Ibrahim.alhuraish, Christian.robledo, Abdessamad.kobi)@univ-angers.fr*

Abstract: In this paper, an AHP model was used for determining the optimal method and the most efficient methodologies of lean manufacturing and six sigma in various industries based on three criteria. These criteria are financial performance, operational performance, and innovation performance. Study results show the impact of three categories that are based on the implementation of a specific method. Findings show that companies implementing lean and six sigma were more effective than companies that implemented either lean manufacturing only or used limited tools of lean six sigma across operational and financial performance. Meanwhile companies that used limited tools of lean six sigma gained minimal performance improvements. Additionally, the results illustrated that automobile industries followed by service and electronics industries have the most effectiveness in innovation, operational and financial performance. Moreover, this study shows struggle of lean manufacturing and/or six sigma implementation with transportation and health industries. Bibliographic investigation showed there is limited scientific research focusing on lean manufacturing and six sigma implementation within French industries.

© 2016, IFAC (International Federation of Automatic Control) Hosting by Elsevier Ltd. All rights reserved.

Keywords: Multi Criteria Decision, Analytic Hierarchy Process, Lean manufacturing, Six Sigma, Type of Industry

1. INTRODUCTION

Many companies apply quality approaches such as lean manufacturing and six sigma methodologies to minimize defects and waste and to improve performance output. Lean manufacturing refers to a methodology designed to lower the costs involved in production with a view to minimizing waste (Womak, 1990; Meda, 2010; Wilson 2010). Research has shown that companies that implement and practice lean manufacturing or lean production see a significant improvement in operational performance (Shah and Ward, 2003). Montgomery and Woodall (2008) state that six sigma is a statistical technique that permits a scientific evaluation of processes and transactions for the reduction of variability and the removal of defects. However, this paper investigates the status of performance outcomes of companies based on the methodology that have been implemented within the organizations. Results reveal applications in three different categories. Firstly, companies that implemented lean manufacturing only. Secondly, companies that use a combination of lean manufacturing and six sigma. Thirdly, particulars of limited tools of lean six sigma implemented, where they didn't refer as either lean manufacturing or six sigma with their organization. Through the use of Analytic Hierarchy Process, we statically investigated these different categories to determine the effectiveness of an implemented method on a company's performance. The AHP was used in order to identify the status of performance payback from the implementation methodology. The AHP is one of the multi criteria decision making methods and was developed by

Saaty in 1980. It is comprised of a technique for decomposing decision-making in complex problems via the compilation of hierarchal goals, criteria and options or alternative solutions (Saaty, 2008). However, the goals of this paper is to identify the powerful application that is helpful on increasing companies' performance and the effective industry that perform these lean manufacturing and six sigma practices across financial, operational and innovation performance. This paper investigates not only the impact of lean manufacturing and six sigma implementation, but also the influence of the implementation method based on the type of industry.

This paper organized as follow: the second section presents the literature review on lean manufacturing, six sigma and AHP with discussion. The third section, presents the procedure to evaluate the performance. The fourth section shows AHP results and the discussion of the study's finding for selecting the best methodology. The fifth section presents AHP results concerning various industries that implement lean manufacturing and six sigma. Finally, the conclusion is presented as well.

2. OVERVIEW OF LEAN AND SIX SIGMA AND ANALYTIC HIERARCHY PROCESS

Many companies gain performance advantage through implementing lean manufacturing and six sigma. Lean and six sigma implementation show strong support for increasing in a company's performance in terms of improved quality and

productivity (Delgado et al., 2010; George, 2002). Some organizations have integrated lean and six sigma as a means of compensating for the limitations in each method and this technique is referred to as lean six sigma (Amheiter and Maleyeff, 2005). Literature review reveals that the successful implementation of lean six sigma yields better improvement in performance outcomes than the implementation of lean or six sigma alone. The implementation of both methods achieved significant impact on performance outcomes compared to companies that use lean only (George, 2002, Näslund, 2008). Thus, this study seeks to verify that French companies regarding implementing both methods create better improvements compared to companies that either use lean manufacturing only or use specific limited tools of lean six sigma against financial, operational and innovation performance. However, many industries utilize AHP as it is valuable for making decisions for selecting or prioritizing the alternative (Triantaphyllou and Mann, 1995). Also, AHP has been expended with lean six sigma implementation. For example, AHP is used to recognize the factors causing waste (Hassan, 2013). Su and Chou (2008) investigated the benefits and risk criteria for the six sigma project selection. AHP is also applied in a framework of six sigma (DMAIC) for improving quality (Azzabi et al., 2009). Therefore, AHP provides the advantage of determining a good decision based on the objective.

3. EVALUATE THE PERFORMANCE

In order to evaluate performance results for French companies that implemented lean manufacturing and/or six sigma, empirical data was collected via two surveys. Thus, two phases were performed. Firstly, a survey was designed to measure outcomes of the implementation and practice of lean manufacturing and/or six sigma in 33 French companies. 12 items were included such as customer satisfaction, improve quality, reduce variation, improve productivity, reduce costs, increase profit, suggestion and employees involvement and reduce turnover rate. Each of these items was measured within an ordinal scale to indicate the effectiveness based on implementation methodology. From 1=strongly disagree to 5=strongly agree. Based on the results, it was discovered that there are three different categories. These categories (A) characterizes companies that have implemented lean manufacturing and six sigma; (B) characterizes companies that have implemented lean manufacturing only, and (C) characterizes companies that use limited of lean six sigma tools. Next step, the analytic hierarch process (AHP/ANP) is used by super decision software (www.superdecisions.com). AHP was used to weigh 3 criteria. These criteria are financial, operational and innovation, as well it was used to weight sub criteria. These twelve sub criteria are customer satisfaction, improve quality, reduce variation, improve productivity, reduce costs, increase profit, suggestion and employees involvement and reduce turnover rate. The main advantage of AHP in terms of other decision-making technique is its priority rates. In the final step of AHP, priority ratings are subjected to numerical calculations along all of the decision-making alternatives. The priority rates reveal each alternative decision value for achieving each decision goals (Dezert et al., 2010).

4. ANALYTIC HIERARCHY PROCESS USED FOR SELECTING OPTIMAL METHOD (S)

Step 1: Defining the criteria and sub criteria

The hierarchy was constructed through discussions with experts in quality for suitability and clarity. Therefore, 2 items or sub criteria such as increase profit and reduce cost were grouped under financial criteria, 7 criteria such as improve quality, improve productivity etc, were grouped under operational criteria, and 3 sub criteria such as reduce turnover rate, suggestion and employees involvement were grouped under innovation criteria.

Step 2: Developing hierarchy

The hierarchical structure decision for selecting the best method and best industry are established. However, the hierarchical structure decision is shown in figure 1. The first level contains identifying the basic objective. In this study, we have two objectives. Therefore, there are two selections. First is selecting the optimal method, second is selecting the best industry. The second level and third level are similar for both objectives. Therefore, it covers three vital criteria: financial, operational and innovation. The third level covers 12 sub criteria. These sub criteria are increase profit, reduce cost, improve quality, decrease inventory, improve productivity, reduce time, reduce variation, customer satisfied, create safety environment, involve employees, reduce turnover rate and suggestion by the employees. The final level contains two alternatives for evaluating the performance based on methodology and industry:

1. Three alternatives that these different methods (A, B, C) have implemented within French industries. These categories A, B and C were weighed in order to select the best effective method
2. Six alternatives including various industries such as electronics, automobile, service, health and other industries were evaluated

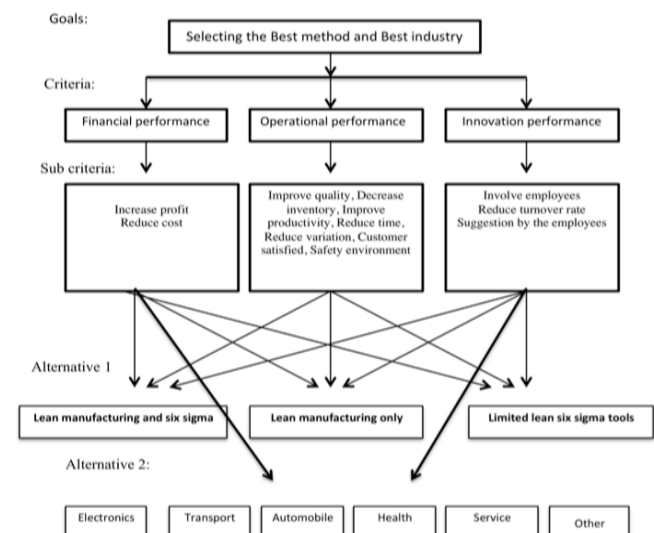


Fig. 1. Hierarchical Structure decision

Download English Version:

<https://daneshyari.com/en/article/710054>

Download Persian Version:

<https://daneshyari.com/article/710054>

[Daneshyari.com](https://daneshyari.com)