

Implementing the Hybrid Lean-Agile Manufacturing System Strategically in Automotive Sector

Salah A. Elmoselhy

ABSTRACT

In order to strike a balance between cost and availability, the present study presents the strategic implementation of the hybrid lean-agile manufacturing system. The proposed implementation is based on literature review and statistical analysis. The study presents short term and long term proposed plans for implementing this newly developed system in a sustainable way. It shows how the strategic facet of the hybrid lean-agile manufacturing system addresses the key manufacturing competitive dimensions. The paper presents as well a cost-benefit analysis in comparison with the lean manufacturing system and agile manufacturing system based on the net present value. The study shows that the expectedly most efficient among the manufacturing systems is the Hybrid Lean-Agile Manufacturing System with normalized comparative improvement of about 58% and 42%, respectively. The study concludes through a statistical sample that about one third of the variation in successfully dealing with the sources of competitive advantage in automotive sector can be explained by adopting the strategic facet of the hybrid lean-agile manufacturing system. The study is limited to the automotive manufacturing sector. The paper would be of interest to the seekers for efficient manufacturing systems such as lean manufacturing practitioners and agile manufacturing practitioners.

CITATION: Elmoselhy, S., "Implementing the Hybrid Lean-Agile Manufacturing System Strategically in Automotive Sector," *SAE Int. J. Mater. Manf.* 8(2):2015, doi:10.4271/2015-01-9083.

INTRODUCTION

The challenge in balancing the automotive product portfolio is in building a global engineering network to support vehicle product development and manufacturing in multiple regions such as China and India [1, 2]. The hybrid lean-agile manufacturing system (HLAMS) has been hence proposed recently [3, 4, 5]. Some specialists called for what is called leagility or agilean, but what they proposed is to adopt leanness in the upstream of the value chain before the decoupling point and agility in the downstream of the value chain after the decoupling point [6]. What the HLAMS proposes is a manufacturing system that hybridizes both leanness and agility together in one manufacturing framework to be implemented throughout the value chain [3].

This study investigates the implementation of the strategic aspects of the proposed HLAMS. The research motivation will be presented first. The investigation of how the strategic facet of the HLAMS addresses the key manufacturing competitive dimensions will then be presented. The proposed implementation method of the strategic aspects of the HLAMS will then follow. Next, a cost-benefit analysis in comparison with the lean manufacturing system and agile manufacturing system based on the net present value (NPV) will be presented. Finally, the validation of the research will be presented.

RESEARCH MOTIVATION

This research stems from the changes in the manufacturing business environment in the automotive sector. The manufacturing systems become thus more and more complex in such ever-changing environment [7]. These changes have led to customers' requirements of both competitive cost and availability without compromising quality [8, 9]. Planners in the automotive sector have a difficult balancing act. On one hand, there are benefits from using common vehicle parts. On the other hand, there are more niche demands in the global market. The challenge that faces the entire automotive industry is to strike poise between these two extremes cost-effectively and without compromising quality. This challenge is evident in light of recent and frequent safety recalls of millions of vehicles in the automotive sector, even from the lean manufacturing pioneer, Toyota [10]. The current research aims to meet this balancing act by proposing an implementation method to implement the strategic facet of the HLAMS. The implementation of the strategic facet of the HLAMS aims at striking a balance between the main six competitive dimensions of manufacturing in the automotive sector, which are quality, delivery reliability, response time, low cost, customization and product life cycle, in addition to revenue [11]. The correlation between the implementation of the strategic facet of the HLAMS and the manufacturing enterprises' manufacturing business success in automotive sector is hence the core of investigation in this paper.

HOW THE STRATEGIC FACET OF THE HYBRID LEAN-AGILE MANUFACTURING SYSTEM ADDRESSES THE KEY MANUFACTURING COMPETITIVE DIMENSIONS

According to Skinner [12] a particular factory can excel on no more than two overall objectives. Achieving satisfactory performance for stakeholders on the low cost and product life cycle dimensions is a result of efficient customization. In addition, the quality and short response time dimensions that satisfy customers' needs are driven in a feedback context by delivery reliability. Customization and delivery reliability strategies are hence the core competitive manufacturing dimensions in the implementation of the strategic facet of the HLAMS. [Table 1](#) presents the classifications of these core competitive manufacturing dimensions.

[Table 1](#) shows that the customization and modularization core competitive manufacturing dimension is a lean aspect of the HLAMS. It shows as well that the delivery reliability core

competitive manufacturing dimension is an agile aspect of the HLAMS. The implementation of the lean characteristics should precede implementation of the agile characteristics in an HLAMS since efficient change require mapping of all the relevant business processes, which is a lean characteristic. The characteristics of the hybridization of lean and agile manufacturing systems are presented in [Table 2](#).

[Table 2](#) shows that the hybrid lean-agile value chain strikes a balance between lean and agile value-stream properties with respect to product, manufacturing, and suppliers in an endeavor to realize smoothness of work flow. Thus, Just-In-Time production, flexible changeover, and having at the end of every production stage except for the first production stage are implemented along with postponing the decoupling point to near the end of the value chain at the assemble-to-order. Showing how the strategic facet of the HLAMS addresses the key manufacturing competitive dimensions paves the way to elaborate on the implementation of the strategic facet of the HLAMS.

[Table 1. Classifications of the core competitive manufacturing dimensions](#)

	Hybrid Lean-Agile Manufacturing System Aspects	
	Lean Aspect	Agile Aspect
Key manufacturing competitive dimensions	Customization and Modularization	Delivery Reliability

[Table 2. Value-stream characteristics of the lean-agile value chain](#)

Grouping	Grouping Details	Lean-Agile Value Stream
Product	Development Stages	Tailored Customization, Assemble to Order
Manufacturing	Processes	Modularization-Based
	Procurement	Mixed-Pull
Suppliers	Supplier Base	Moderate

IMPLEMENTING THE STRATEGIC FACET OF THE HYBRID LEAN-AGILE MANUFACTURING SYSTEM

Since a manufacturing strategy refers to an approach that starts with corporate, business, and marketing strategies and then establishes a design of a manufacturing system to support them [13, 14], a change program is proposed in this section for the manufacturing strategy. The flowchart indicated in Figure 1 demonstrates the proposed plan for the implementation of the strategic facet of the HLAMS.

Minimizing risk is a key objective in the product design and manufacturing processes [15]. Before the beginning of the product design process, the SWOT analysis should be conducted and strategic partnership with key suppliers should be established. During the product design process, the value of design concept to customers at the end of each design phase should be proved through market research. The FMEA should be conducted before and throughout the manufacturing process.

For a firm that already has established its manufacturing business before, the following change plan is proposed for long term:

1. Implementing the following quality system: (i) instilling flexibility into the design and manufacturing processes for embracing change; (ii) adopting robust design of product using Quality Function Deployment (QFD) to satisfy customers and stakeholders and using Design for Manufacture in order to provide the manufacturing and transportation processes with what these processes need; (iii) adopting robust design of processes using Poka Yoke; (iv) adopting systematic procedures of doing things using ISO and QS standards; (v) detecting problems that can arise as early as possible using Statistical Process Control, Management By Walking Around, customer satisfaction surveys, staff surveys, quality standards audits, Kaizen continuous improvement events, product strip down, and inspection and testing; (vi) analyzing the root causes of those problems and removing these root causes using Pareto analysis, Ishikawa/fishbone diagrams, 5 Why's, value stream mapping, and FMEA.

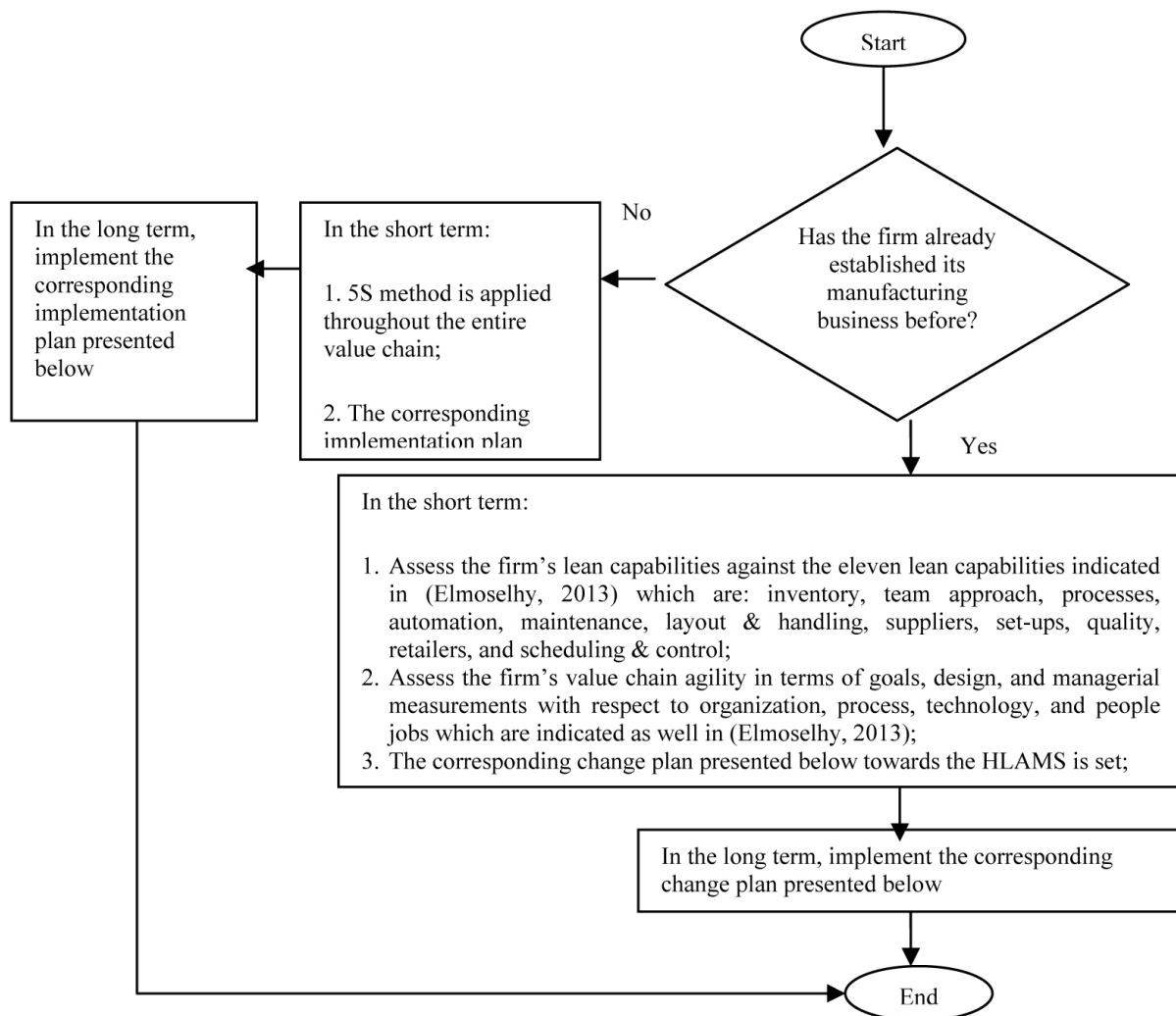


Figure 1. The proposed plan for the implementation of the strategic facet of the HLAMS