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Analysis of Agile Manufacturing Enablers: A Case Study

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Abstract

The purpose of this paper is to strategically select and focus the right Agile Manufacturing Enablers (AMEs) for agility enhancement. A methodology is proposed using Interpretive Structural Modeling - Fuzzy Matriced Impacts Croises Multiplication Appliqueaun Classement analysis to analyze the AMEs considering their driving and dependence power. The proposed methodology was applied to an Indian electrical hardware manufacturing company. It was concluded that the effort and focus should be streamlined towards information visibility and transparency, devolution of authority, and adaptability for enhancing its agility.

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1. Introduction

Agile Manufacturing (AM) has gained tremendous recognition and acceptability among the manufacturing engineers since the last decade. AM has evolved as a revolutionary way of manufacturing and assembling the products based on rapidly changing market and customer demands [1]. AM includes both management and technological enablers. The focus on management based AM enablers are given more importance by the researchers in comparison to technology based AM enablers [2]. Although alignment among competitive drivers, agility capabilities and providers are all very critical in making an enterprise agile, it is difficult for an enterprise to achieve...
agility because of the lack of an efficient approach for agile development planning [3]. There exists a need to comprehensively model the agile system with key enablers as well as to find the interdependency that exists between the agile enablers in an unpredictable environment [4]. Therefore, it is essential that the right AMEs should be selected to enhance the agility level of manufacturing system in general and of AM in specific. Their current status should be assessed and gap should be identified so that efforts would be streamlined to reach the desired level of performance along these selected AMEs. This selection of AMEs is manufacturing environment specific as priority of competitive strategies, internal and external business environment, and nature of the product are the basic and relevant input for the analysis. It is complicated in nature as all the interactions in terms of their driving and dependence power have to be captured considering the manufacturing environment. The proposed methodology using ISM-FMICMAC analysis is the systematic analysis of AMEs to select the right AMEs where the company must focus and put effort. The benchmarking approach should be developed for right AMEs for successful implementation of AM and its agility. This is an approach that has not been attempted before. A case study has been carried out to explain the salient features of the proposed methodology. Thus, the research gap has been filled.

This paper is organized as follows: the literature review on agile manufacturing and agile manufacturing enablers are in section 2 and section 2.1 respectively. The proposed methodology for successful implementation of AM is presented in Section 3. The ISM and Fuzzy MICMAC analysis for analyzing AMEs are discussed in section 3.1 and section 3.2 respectively. The application of proposed methodology in an Indian manufacturing company is presented in section 4. The results and managerial implications of the case company are discussed in section 5 and section 6 presents conclusions.

2. Agile Manufacturing Enablers

The purpose of this paper is to identify the agile manufacturing enablers (AMEs) and then define the domain of each enabler so that right AMEs can be selected in a specific manufacturing environment. Many researchers had carried out various studies related to AMEs, agile enablers and agility which may be specific or generic in nature. They also carried out various analysis using different tools and techniques. Avazpour et al [5] developed a framework based on the fuzzy multiple criteria decision making approach to identify the most appropriate agility enablers to be implemented by companies. They applied it in a subsidiary company of the National Iranian Gas Company and concluded that team building is the best agility enablers. Aravindraj and Vinodh [6] developed a 40-criteria agility assessment model and was applied to an Indian relays manufacturing organization. The present agility level of the case organization was determined which was used for the gap analysis and agility improvement proposals. Mishra et al [7] developed a fuzzy based integrated agility appraisement module, incorporated the variations in the Decision Makers’ (DMs) risk bearing attitudes and analyzed the effects of variations in DMs’ attitudes toward agility estimation. Gurd and Ifandoudas [8] used an action research approach in a single organization to investigate the practicality and usefulness of an agility-focused balanced scorecard (BSC) system. Vinodh and Aravindraj [9] identified AMEs and used multi grade fuzzy and fuzzy logic approaches for the agility assessment and the results were benchmarked. Based on the literature survey in AM [10] and discussion held with experts in Indian manufacturing environment, various enablers have been identified those promote AM and have been grouped (i.e. Adaptability (ADP); Product and Process Automation (PPA); Supply Chain Integration (SCI); Core Competency (CCT); Supply Chain Key Partner's Alacrity (SCP); Devolution of Authority (DOA); Information Visibility and Transparency (IVT); Manufacturing Management (MFM); Customer Relationship Management (CRM); Supplier Relationship Management (SRM); Human Resource Management (HRM)).

**Adaptability (ADP):** It is the capability of a system to respond to both predictable and unpredictable changes. The changes are not restricted to technology (i.e. new and better technologies), business environment, customer requirements, socio-economic, products and services, risk etc.

**Product and Process Automation (PPA):** It is the capability of a system to design, produce parts and develop processes with the aim to reduce the lead-times. Use of automated and computer-aided-technologies like Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Computer Aided Process Planning (CAPP), automated material handling, packaging etc. lead to reduced design-to-manufacture time.

**Supply Chain Integration (SCI):** It refers to the ability of integrating the operations/activities along the supply chain through respective core-competencies or specializations of various stakeholders. It is achieved through mutual trust, management of inter-relations and intra-relations, integrated procurement, logistics and distribution systems.
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