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Modelling of Prime Agile Enablers: People, Virtual Integration and Information Technology

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Abstract

Agile manufacturing has successfully established its importance in dealing with dynamic demand of customer and market. A survey based study has been conducted with an aim to identify main predictors of agile manufacturing enablers and to develop a model for agile manufacturing enablers. The framed hypotheses for the four sections of agility enablers were tested by ANOVA. Four sections of enabler were organization's people, organization's virtual integration & collaboration, organization's information technology & communication, and organization's tools & technology. Principal component analysis was applied to identify main components of agile enablers. Stepwise linear regression analysis was used to generate model for agile manufacturing enablers. Analytical hierarchy process has been used to rank the variables of components pictured in linear regression model. Afterward, a complete regression model has been prepared with the help of priority vectors generated by AHP. The variables information system interface with customers, employee's empowerment, sharing of concepts and CAD/CAM found as the most important agile enablers. Therefore, these agile enables need high attention to make an organization agile. The status of agile enablers in Indian manufacturing industries has been calculated and it is found that the level of agile enablers in Indian manufacturing industries is quite low.

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Keywords: Agile manufacturing; agility enabler; hypothesis ANOVA testing; principal component analysis; linear regression model; Analytical hierarchy process .

1. Introduction

The concept of agile manufacturing was introduced in 1991. Since then it is growing all around the world. The agile manufacturing is the combination of speed, flexibility, quality, innovation, profitability and relationship. Agile

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manufacturing is the ability to cope up with unexpected changes [1]. Agile manufacturing have four pillars that are flexible people, flexible technology, strategic planning and market focus [2]. Flexibility is the one of the main component of agile manufacturing. The simulation model for the optimum flexible manufacturing system is very important for high accuracy and efficiency [3]. The main agile manufacturing enablers are rapid prototyping, robots, internet, AGV's, CAPP, CAD/CAE, CIM and flexible manufacturing system [4]. Maximum use of information technology and software may increase the value of any organization [5]. The use of digital options such as internets, data bases, advanced knowledge technology, virtual conference systems, and cooperation based tools for sharing the knowledge are very important for agile firms [6]. CAD and CAE have been proved as the main enablers of agility [7]. Workforce and autonomy have been argued as the key enabler for the agile manufacturing [8].

2. Research methodology and data collection

The survey based research approach has been employed in the study. The hypotheses were developed on the basis of research questions. Five point Likert scale was used to gauge the variables. The questionnaire was designed on the basis of agile driver, agile providers, agile capabilities and agile enablers. Main variables and sub variables have been selected on the basis of literature review and expert opinion. The final questionnaire was then distributed through web and post. The questionnaire was email to 600 Indian manufacturing companies out of which 113 respondents filled it completely and submitted it online. 50 responses were collected through posts and directly contacting the company's representatives. Thirteen responses were found incomplete, so the analysis was performed on 150 complete responses. Empirical investigation of agility factors provided two sections of agile manufacturing that were agile developer (providers and capability) and agile enablers. The agile enabler consisted of four sections that were virtual integration, people, information technology and communication, and tools and technology. In the present study, first of all, the reliability and validity of agile enablers have been checked. Then the framed hypotheses for all four sections of agile enablers have been tested by ANOVA test. After testing the hypothesis principal component analysis was undertaken to identify main components of agile enablers. Eight components generated by principal component analysis have been labeled in the Table no. 1. Stepwise linear regression analysis has been used to generate model for agile manufacturing enablers and to identify the main predictors of agile manufacturing enablers. Thereafter, the variables of components, identified in linear regression analysis have been ranked by Analytical hierarchy process (AHP) and status of agile enablers in Indian manufacturing industries has been calculated.

3. Results and analysis

The data analysis approach was quantitative type. The normality of data has been judged by the absolute values of the skewness and kurtosis indices. In this study the gathered data were normal, since the values of skewness index was below 1.0 and kurtosis index was found between 3.0 and 4.0 for all variables. To check the reliability of data reliability test was performed. It measures the Cronbach alpha index that varies from 0 to 1. The minimum value has been argued by many authors. Cronbach alpha 0.7 generally considered as good and assumed that data are well consistent and stable. The value of alpha was found 0.890 for organization's people, 0.911 for organization's virtual integration & collaboration, 0.843 for organization's information technology and communication and 0.927 for tools & technology. In other words, data were 11%, 8.9%, 15.7 % and 7.3% inconsistent for people, virtual integration & collaboration, information technology & communication, and tools and technology respectively.

3.1 ANOVA analysis

The hypotheses for four sections have been framed on the basis of research questions. The hypotheses of these sections have been tested by ANOVA test. It compares the mean of one parameter (response variable) between two or more groups. High value of F is evidence against null hypothesis H_0, since it indicates that there is more difference between groups than within groups. The F-value and the p-value are practically meaningless without the degrees of freedom [9].

The results for the ANOVA test for variables of organization's People revealed that the role of organization's