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A review of Agile Manufacturing in the Industry

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ABSTRACT

Businesses that engage in production or servicing must reform or reorganize themselves to meet the challenges of the twenty-first century and ensure that their customers are not only satisfied but thrilled. Businesses should use an agile, responsive, and flexible paradigm in this competitive environment, which may go by the moniker "agile manufacturing" (AM). An AM system can be used to rapidly and inexpensively develop a variety of items. It can do this because of some useful enabling technologies and concrete tools. Among these is concurrent engineering (CE), which is a systematic approach to the integrated, concurrent design of goods and the related processes, like manufacturing and support.

1.1 INTRODUCTION

Companies in either production or servicing need to be reformed or re-organized in order to overcome with obstacles of the 21st century in which clients are not only happy but also delighted. In this competitive context, enterprises should utilize a flexible, adaptive and responsive paradigm that may be entitled by a unique term: agile manufacturing (AM). A range of products can be developed quickly and at a minimal cost using an AM system. It has certain practical enabling technologies and tangible tools for this. Concurrent engineering (CE) is one of these; it is a methodical approach to the integrated, concurrent design of products and the processes associated with them, such as manufacturing and support. In order to better meet customer expectations, it is therefore a useful and advantageous strategy to shorten the time it takes to develop a product and lower the cost of manufacturing it at the same time. This study's objectives are to highlight the benefits of new product development (NPD) and customer experience (CE), together known as CNPD, and to examine their respective approaches and resources in relation to AM (BuyuKozkan et al, 2004).

The ability to swiftly, affordably, and environmentally responsible reconfigure a flexible system is referred to as an agile and environmentally conscious manufacturing paradigm. E-supply chains, which incorporate web-based electronic markets and the Internet, are a viable method of achieving agility in modern manufacturing firms. Configuring the partner network is a critical component of integrated e-supply chains' (IESCs') strategic logistic planning. A single- and multiobjective optimization approach is presented in this paper to configure the network of IESCs. A process to choose the right linkages is described, taking into account an Internet-based distributed manufacturing system with several phases connected by material and information links. A set of performance indices is connected to the network links. Optimization models with one or more criteria, as well as multicriteria, are given under structural constraint definitions. The integer linear programming (ILP) problem solution offers several network structures that enable enhanced supply chain (SC) flexibility, agility, and environmental performance during the design phase. Two case studies that describe two networks utilized in the production of desktop computers are subjected to the recommended optimization technique (Dotoli et al, 2005).

Nature of Agile manufacturing

A framework for implementing agile manufacturing is presented in this study. Using a bottom-up methodology, the framework guides the business through three iterative phases of implementation: proactive growth strategies, responsiveness to customers, and robust operation. A thorough evaluation of the degree of turbulence in the business environment and its effects on the organization is integrated into the framework. The assessment's findings are used to create and modify an implantation strategy, as well as to choose the instruments and performance indicators needed to track the plan's advancement. This is maintained while coordinating every move with the business plan (Ismail et al, 2006).

In the manufacturing sector, agility has gained widespread acceptance as a novel idea for competitiveness. It is unclear, nevertheless, how to create a manufacturing strategy that emphasizes agility. In addition to outlining the creation and examination of a numerical taxonomy of agility methods utilizing the framework, this study offers a framework for applying agility as a manufacturing strategy. Based on the proportional weight that various UK manufacturing organizations assigned to seven agility characteristics, a taxonomy was created using cluster analysis. Throughout the market under study, three unique clusters of strategy groups were identified: Proactive, Quick, and Responsive Players. Quick Players prioritize speed and a strong client focus. They place little value on being proactive and forming partnerships, and they do not stress being adaptable and quick to change. Flexibility and adaptability to changes are important to responsive players. They place little value on rapidity and do not promote collaborations or being proactive. Proactive Players place a high priority on being proactive and customer-focused, place a high value on all of their talents, and recognize the significance of partnerships. Using factor analysis and canonical discriminant analysis, the underlying agile capabilities aspects that separate the three approach groups were examined. The "manufacturing strategy choices," or manufacturing techniques used by members of various strategic groups to achieve agility, were examined. Members of different strategic groups also compared the changes and uncertainties they faced in the business environment. For every strategy group, the typical instances and business characteristics were examined (Zhang and Sharifi, 2007).

Agile manufacturing systems—especially assembly systems at the final stage of product differentiation—operate in a globally competitive market that is always changing. Concurrently, the importance of sustainability in industrial strategy is growing. In this study, a systemic criterion of sustainability in agile manufacturing is formulated and computed using complexity and flexibility. It is described as a sustainability measurement that is a ratio of utility to entropy. Utility, within a single framework, makes it possible to measure the contributions to agility—specifically, system flexibility. Entropy is a measure of complexity. As a result, an innovative complementary function between system complexity and adaptability is suggested. The systemic approach to sustainability in terms of output evolution is enhanced, having been developed from the distribution of system states. A first quantitative study based on a simulation of a simple assembly line integer model demonstrates the topics presented (Calvo et al, 2008).

Agile manufacturing is a new paradigm for manufacturing, and in order to successfully accept and use the idea and practice, it needs to be thoroughly studied in terms of its enablers. This study finds and establishes a connection between the several agile manufacturing philosophy enablers. Researchers and industry can better understand the complexities and dynamics involved in fostering and implementing agile manufacturing in a suitable and effective manner by looking at the systemic relationships among different enablers. Literary materials are used to identify and bolster enablers. Interpretive Structural Modeling (ISM) is used to develop the systemic link among these enablers (Hasan et al, 2009).

In an agile manufacturing scenario, this article examines a supply chain design dilemma for a new market opportunity with uncertain demand. We take into account the coordinated optimization of supply chain participants' manufacturing expenses and logistics. Numerous industries, including consumer appliances, multi-tier automotive supply chains, and semiconductor production, are among those where these issues frequently arise. Decision variables come in two varieties: continuous variables related to production planning and binary variables used in the selection of businesses to construct the supply chain. The uncertainty of demand is managed through the use of a scenario strategy. Three elements make up the objective function of this strong optimization model formulation: predicted total costs, cost variability resulting from uncertain demand, and expected penalty for unfulfilled demand at the end of the planning horizon. A heuristic is required due to the fact that the number of echelons and members within each echelon increases the processing time. A heuristic that utilizes a k-shortest path algorithm is created by designating each supply chain member's effectiveness with a surrogate distance. In certain small- and medium-sized scenarios, the heuristic can discover an optimal solution extremely quickly. In a brief amount of computational time, a "good" solution for big issues with a small gap in relation to our lower bound is found (Pan and Nagi, 2010).

Theorized and tested is a structural model with agile manufacturing as the central construct. The model combines operational performance and firm performance as outcomes of agile manufacturing, and the two main components of JIT (buying and production) as antecedents. Utilizing information gathered from production and operations managers employed by sizable American businesses, the model is evaluated using a structural equation modeling approach. The findings show that whereas JIT-production and agile manufacturing have a positive association that is mediated by JIT-purchasing, JIT-purchasing itself has a direct positive link with agile manufacturing. The findings also show a direct positive relationship between agile manufacturing and the company's operational performance, a direct positive relationship between the company's operational performance and its marketing performance, and a mediating role for the marketing performance in the relationship between the company's operational performance and its financial performance (Inman et al, 2011).

This study discusses the supply planning issue in relation to the Manufacturing Supply Chains (MSC) configuration challenge. We offer a method for the strategic management of the chain that addresses supply planning and enhances MSC adaptability in terms of its capacity for reconfiguration to meet performance, assuming that the manufacturing system is made up of many stages. More specifically, we improve upon an earlier design approach by a few of the authors that uses integer linear programming and digraph modeling to best build the MSC. The original method can handle the distribution of spare parts while avoiding stock outs and disruptions to the supply chain. We incorporate supplier capacity restrictions in this new formulation to account for the amount of requests and maximum production capacities with single/multiple sourcing. An Italian manufacturing company's ideal MSC arrangement is described in a case study. The acquired results demonstrate that the design process offers managers important solutions to problems pertaining to the strategic configuration and agility of the supply chain, such as where distributors and retailers should be located to maximize MSC performance and flexibility. We incorporate supplier capacity restrictions in this new formulation to account for the amount of requests and maximum production capacities with single/multiple sourcing. An Italian manufacturing company's ideal MSC arrangement is described in a case study. The acquired results demonstrate that the design process offers managers important solutions to problems pertaining to the strategic configuration and agility of the supply chain, such as where distributors and retailers should be located to maximize MSC performance and flexibility (Constantino et al, 2012).

We study a supply chain network design challenge in an agile manufacturing scenario with numerous periods and echelons when there are multiple clients with high demands in this research. Choosing one or more businesses for each tier, production, inventory, and transportation are among the decisions involved in our supply chain design dilemma. Under production and transportation capacity limitations, we frame the problem integrating all options to minimize the entire operating expenses, including fixed alliance costs between two enterprises, production, raw material holding, finished product holding, and transportation costs.In this study, a Lagrangian heuristic is proposed. While a viable solution is produced by adjustment approaches based on the solution of subproblems at each iteration, optimizing a Lagrangian relaxation problem yields a lower bound. Computational results show that the method in this work provides good quality solutions with less than 5% optimality gap fast. Furthermore, an improvement of 15% to 25% for the proposed approach is not exceptional in some instances when compared to initiative management alternatives (Pan and Nagi, 2013).

Knowledge is essential in the industrial sector to enable effective and efficient real-time decision making. Manufacturing system knowledge must first be captured and then modeled in order to be made available to the decision maker. Consequently, a variety of industrial sectors and business sizes (big, SME) need tools that offer a viable method for gathering and representing manufacturing system knowledge. An evaluation of the literature regarding the best practices for gathering requirements for modeling system knowledge and developing simulations has been done. This study set out to determine which open-source manufacturing system knowledge modeling tool would be most effective. A number of criteria were chosen, and these criteria were used to examine and rate a number of tools before choosing this one. After that, a model use case was created utilizing the chosen tool, Systems Modeling Language (SysML). Thus, using a chosen open-source technology, the best practice was examined, assessed, chosen, and then implemented to two industrial use cases

(Constatinescu et al, 2014).

There is constant demand on modern production to find answers for extremely difficult tasks. Achieving customer happiness is essential for business survival in a highly competitive climate. This calls for the development of products with shorter lifecycles and higher quality while also lowering production costs. A paradigm known as "agile manufacturing" has been established in order to accomplish such goals. Despite the fact that this technology is frequently utilized in major corporations, study is currently being done to determine whether it is also applicable to small and medium-sized businesses (SMEs). This article uses ten case studies from Malaysia andIt advances theory by classifying the primary obstacles to the adoption of agile manufacturing into three groups: "lack of management skills," "technological limitations," and "lack of workforce experience." In order to serve as guidance for the sectors using these approaches, it also offers recommendations for each of the aforementioned issues. the UK to evaluate if SMEs can effectively implement agile manufacturing principles (Moradlou and Asadi, 2015).

Manufacturing businesses are searching for new manufacturing systems that may meet their needs in order to remain competitive in the global market, which is characterized by volatility and shifting client demands and global rivalry. Systems that can adapt to the demands of the contemporary manufacturing industry are known as agile manufacturing systems, or AMSs. However, AMS acceptance and implementation are difficult tasks. Certain characteristics have an impact on the implementation process as well as on one another. This paper's primary goal is to identify and evaluate these qualities. These qualities were found in the literature, ranked using a questionnaire-based survey, and their interactions with one another were examined using the fuzzy agility evaluation (FAE) approach in the current study (Sindhwani and Malhotra, 2016).

Organizations have found great success with agile manufacturing (AM) in overcoming the uncertainties brought forth by fast changing markets, shorter product life cycles, variable client demand, and outdated technologies. AM is being embraced as a novel idea to boost the competitiveness of various businesses, from the manufacturing to the service sectors. However, due to certain environment-specific obstacles, many businesses have actually encountered numerous difficulties during the AM implementation process. Without making an attempt to address the underlying causes of Agile Manufacturing Impediments (AMIs), the AM implementation process is becoming more and more delayed. These AMIs have their origins in a number of the organizations' material and immaterial problems. Because it is impractical to focus on every AMI, an organization must choose which AMIs to prioritize.This research proposes an approach for the systematic analysis of AM obstacles that combines the Fuzzy Matrices Impacts Croisés Multiplication Applique Un Classement (MICMAC) algorithm with Interpretive Structural Modeling (ISM). An Indian automaker was the subject of a case study that was done to show how useful it was (Potdar et al, 2017).

This paper's main goal is to use a graph theoretic approach to measure, assess, and compare the agile manufacturing program's implementation performance. Three important categories were established by identifying and grouping eleven agile manufacturing enablers together with associated KPIs. To measure the performance level of agile manufacturing implementation, the suggested model takes into account the interdependencies and performance of important categories, as well as the enablers of agile manufacturing and associated KPIs. The proposed approach was implemented to an Indian automobile manufacturing company in order to illustrate its usefulness. To determine performance gaps and establish future goals, the performances over the timeline were assessed and contrasted with various scenarios. Even though the example company's performance level in implementing agile manufacturing increased significantly over the course of six quarters, there remained a performance gap that needed to be closed (Potdar et al, 2018).
Businesses must confront novel issues as a result of complex market dynamics. A production or assembly system must produce goods at the lowest feasible cost while meeting client requirements and responding quickly to outside influences like shifting political or market trends. To address these challenges, flexible and quick-to-change production and assembly technologies show promise. Small and medium-sized businesses used to be less vulnerable to volatile market conditions because of their more manageable and compact organizational sizes. This feature made it possible to quickly readjust the industrial facilities. The prevailing instability in the market compels small and medium-sized businesses to seek novel strategies.With a focus on small and medium-sized businesses (SMEs), this paper demonstrates how an Axiomatic Design-based approach could be effectively used to attain these goals by outlining principles for the design of flexible and agile production and assembly systems. Customer demands and functional requirements were outlined and converted

into a set of design guidelines for adaptable and agile production and assembly systems for SMEs using the Axiomatic Design method and the Acclaro DFSS software. With the use of this method, designers can optimize their designs far earlier on, saving money and time by avoiding costly decisions, laborious simulations, and computer-aided engineering studies (Rauch et al, 2019).
One of the key components of Industry 4.0 is location information on items. Workpiece monitoring in a plant may become more difficult if flexible and agile manufacturing processes are used more frequently. We provide in this paper a state-machine-based method for RFID reader-based workpiece monitoring. We offer a method in which every object is modeled as a deterministic state machine, allowing us to track the object's path through the production process. Runtime event-based state machines can be used to monitor several objects simultaneously. We demonstrate our solution's use utilizing OPC UA and RFID readers (Azangoo et al, 2020).
In order to succeed and maintain continuous growth, industries must develop New Product Developments (NPD) that are innovative, quick, and adaptable. NPDs must also be closely linked to new production technologies. Among the cutting-edge technologies from Industry 4.0 that can meet these difficulties is Additive Manufacturing (AM). It offers more effective and useful product development, enabling testing to be conducted quickly and cutting down on time to market—all of which contribute to overall agility. The application of Agile Project Management (APM) theory to NPD is undergoing parallel evolution, particularly in the area of developing novel goods and technologies. But in order to fully profit from these novel approaches to the NPD process, research and comprehension of the optimal ways to integrate AM and PM are required. The current study offers a novel framework for managing NPD with AM that combines APM to envisage novel things, involve customers, and successfully produce a finished product more quickly than with traditional methods. The proposal is founded on a thorough Systematic Literature Review (SLR) process that determined the best techniques to combine in order to support an agile and adaptable NPD when employing AM. The suggested framework was created by carefully organizing and analyzing all ideas and procedures. As an outcome, the model can serve as a guide for businesses looking to integrate APM and AM (de Almeida et al, 2021).
Agile manufacturing is a cutting-edge approach to manufacturing that has emerged in the competitive manufacturing period. It maximizes profit and meets changing consumer expectations by managing quality, innovation, responsiveness, product launch time, and uncertainty. Organizations always find it difficult to decide whether to use agile manufacturing because they are afraid of the process not working as planned. By assessing the possible effects on an organization, the novel methodology presented in this research can assist decision-makers even before agile manufacturing principles are put into practice. Agility cost, Agility fitness, and Agility outcome form the foundation of the framework. The framework was created following a thorough review of the literature, a field study of SMEs involved in manufacturing, and expert interviews. A knowledge-based system (KBS) has been created to assist SMEs in decision-making during the implementation stage, based on the framework. Case studies and in-depth discussions with industry experts verify the system (Ali and Wasim, 2022).
In this work, we discuss the most critical issues facing the manufacturing industry, with a focus on small- and medium-sized business (SMEs) manufacturing, where the shift to high-mix low-volume production and the availability of affordable solutions are critical. This article offers 14 creative methods that can help SMEs adopt agile manufacturing processes in order to overcome these obstacles. Reconfigurable fixtures, low-cost automation for printed circuit board (PCB) assembly, computer-vision-based control, simulations of wireless sensor networks (WSNs), Internet of Things (IoT)-based predictive maintenance, virtualization for operator training, naturalistic robot programming through virtual reality (VR), autonomous trajectory generation, force-based task programming through demonstration, on-line task allocation in human-robot collaboration (HRC), projector-based graphical user interface (GUI) for HRC, human safety in collaborative work cells, and integration of automated ground vehicles for intralogistics are just a few of the key technologies covered by these solutions. The aim of each of these solutions is to improve the manufacturing sector's agility. They are made to make it possible for SMEs to operate affordable, easily integrated, and modular production systems. They therefore have a great chance of being used in the manufacturing sector. They help to improve the flexibility, effectiveness, and competitiveness of manufacturing businesses and can be utilized separately or in combination to tackle increasingly challenging tasks. The solutions that are suggested have undergone application testing in settings that are pertinent to the industry in an effort to guarantee their usefulness and practical use. This study does not discuss the specifics of these solutions, but it does present them and provide an overview of their techniques and evaluations. In order to address the changing needs and demands of the industrial sector, it offers summaries of thorough and complex solutions, enabling SMEs to prosper in a fast-paced and cutthroat market (Denisa et al, 2023).

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