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Procurement of Reconfigurable Assembly System a Justification for Effective Production ramp-up planning

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Abstract

Production ramp up is important activity in manufacturing through which the capacity to produce necessary product variety, size type, model, quantity , quality and feature is achieved. By introducing rapid changes in the product at manufacturing system levels value for customers is created to meet target market, free market economy is the only solution to meet the changing dynamics of the market and keeping a competitive edge in the market for staying in business. In this context, System dynamic has been used to address the volume and capacity yield issues. Other core issues of production systems is automated and manual assembly units in order to manage an effective and fast production ramp-up to respond rapidly to the niche market changes in the demand cycles. This paper contributes and attempts to describe the dynamic behavior patterns involved in managing the aforesaid challenges due to assembly by means of manual and automated assembly processes. Besides, this research concludes that procurement of reconfigurable manufacturing are essential for having effective and fast production.

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Keywords : Ram Up, Reconfigurable Assembly, Production System , Manual assembly , Fixed automation;

1. Introduction

Continuous technological advancement has increased the demand for variety and features in the products which in turn have shortened the product life cycle in the market. Rapid change of technology requires equipment which can manage to manufacture complex products within a shorter period of time, also require changes in their hard and soft enabler with every change in system capacity, design feature changes or fabrication and process changes. These relatively new requirements for more customized flexibility which accommodates sudden changes in production has lead to the concept of reconfigurable manufacturing systems (RMS). The production ramp-up process can be considered as an interconnection between product design and first pass to full production. Therefore, manufacturing ramp-up affects the company's economic position either to have an early market access or otherwise. As we see in the case of BlackBerry®, *i*-Phone and Samsung Galaxy competition. In spite of using the best, available to the companies, technologies in engineering design and manufacturing systems, issues may arise due to insufficient agility or rapid control of ramp up issues. "Designing a manufacturing system to achieve a set of strategic objectives involves making a series of complex decisions over time In practice, designing the details of manufacturing systems (equipment design and specification, layout, manual and automatic work content, material and information flow, etc.) in a way that is supportive of a firm's business strategy has proven to be a difficult challenge. Because manufacturing systems are complex entities involving many interacting elements, it can be difficult to understand the impact of detailed, low-level deficiencies and

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change the performance of a manufacturing system as a whole" [1].

2. Background

Earlier published research has suggested [2] that long ramp-up time for production system is undesirable and hard and soft enabler of the manufacturing system do not coordinate effectively, then problem will persist. For instance, core trouble areas are machinery, electronic and troubled software, but some main reasons behind it are the Design for Assembly (DFA) and the Design for Manufacturing (DFM). Furthermore, technology upgrades or design modifications, for part or feature or new user interface causes of time consuming ramp-up process. In fact, long testing of hardware in combination with control software is considered primarily a complex mechatronic issue. The review of ongoing research relating to stream-of-variation methodology shows that the variety and the market pull which are core aspects for the product accelerated acceptance by the customers are not considered [3]. However, how control software will work for both system design and later production is explained in [4]. The concept presented is based on scalable simulation a method for the economic application of virtual commissioning. Recently [5] an optimization technique which forecast those personnel requirements during ramp-up by taking into accounts the dynamic planning variables and organizational basic conditions, has been presented. This helps decision maker to calculate the necessary manpower for every single ramp-up phase and to realize it to economic optimum. Moreover, the scalability of production principles for a fast ramp-up; as well as advanced methods, processes and tools like a 3-cycles, is used to note the unintended disturbances and deliberate changes on overall maturity in [6] it also describes the risk during ramp-up. Next, an analytical solution for capacity planning which is based upon markov theory is presented [7] and the optimized solution takes in to account the effects of ramp-up phenomenon. But their analyses prove that ignoring the ramp-up effect in the decision process can lead to significant increases in overall costs. In fact their solution is based on optimal boundaries representing the optimal capacity expansion and reduction levels, explicitly considering production ramp-up. Further research describes [8] that "Companies that introduce new products quickly have been shown to be better performers. The effectiveness of the new product introduction process is critical to their performance. Production ramp-up is a necessary phase of new product introduction and both planning and execution need careful consideration especially for engineered products which are generally typified by design, purchasing and production complexity. Better understanding of the issues and more effective modelling of options should lead to more predictable and quicker ramp-up". Moreover, in [9] the knowledge base which is acquired helps and initiates guidance in reality to develop an architecture for a modelling tool for engineering product ramp-up. This is in fact a review work and looks in to the issues but does not address the design and system level issues. These are important as they are directly influencing the shorter life cycle and increasing complexity of the product process at hard and soft drivers where all changes occur during the ramp-up phase. In [10] the situations of the ramp up as described by focusing on the demand of design in developing market, suggests strategies to optimize the profit margin and as well as complexity of business processes.

Finally, Koren et al. [11] explained that reconfigurable manufacturing system (RMS) as a manufacturing system designed from the beginning for rapid change in structure, as well as its hardware and software components in order to adjust production capacity and functionality quickly, in response to sudden changes in market or regulatory requirements or in design for quality. Since, the industrial revolution, dedicated manufacturing system (DMS) has been favored for mass production, and most factories around the world make use of it. Mass production results in a low product unit price. Owing to the nature of the traditional dedicated manufacturing system, any slight change in product design may make further production of the new product on the line difficult, if not impossible. The reason is that DMS, by design, is made rigid to enhance mass production for profitable and cost-effective purposes. But this type of manufacturing system can only be effective in a stable market. Today's market is highly volatile competitive, dynamic, and customer-driven. Infact, a market scenario can be characterized by increased customer demand for a wider variety of products in unpredictable quantities. The basic idea of the reconfiguration philosophy is to achieve the exactly desired capacity and functionality exactly when needed by means of characteristics modularity, scalability, integrability, convertibility, diagnosability and customization as explained by Wiendahl, et al [12] and ElMaraghy, H.A. [13]. In fact the reconfigurable manufacturing system accommodates the gap between single product, high volume yields, and multi-product mix in low volume batch production needs. Also like mass production for a single module of a similar family parts high production turn out is achieved by scaling up capacity at high production rates just like the dedicated machines based production lines in case of mass scale production. Batch production is possible because of the ability to rapidly convert the lines between products in the family, a capability absent in traditional DMS based lines. Finally, in this context related works of Sterman, J.D. [14], have also been studied to understand the extent of the issue so as to be described by using system dynamics approach.

3. Fixed Assembly Automation Scenario Study

For this step of the research consider which type of the cost will influence more when it comes to the assembly of the parts in our case study. We first consider the fixed automation case, in this regard we have the following key variables and parameters as define in Table-1 along with the model and its key attributes as shown in the figure 1 and figure 2. Let us consider that the

Initial time

$T_i = 0$

Final time

$T_f = 10$ Year

Time Step:

$dT = 0.125$