

Reconfigurable Manufacturing Systems using the Analytical Hierarchical Process (AHP) -A Review

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Abstract

Manufacturing firms/companies in the present Century may have to face unpredictable un-expected high-rate, high risk market changes driven by global market competition. To stay competitive in the market, these companies must get equipped with the flexible manufacturing solutions and possess new types of manufacturing systems that are cost-effective and very responsive to all the market changes without compromising on the quality of the product and production. Re-configurability a new trend in the engineering technology that deals with cost-effective, quick reaction to market changes is needed. Reconfigurable manufacturing systems (RMS), adopts a system that is more sensitive to the changing market demands, whose components are reconfigurable machines and reconfigurable controllers, as well as methodologies for their systematic design and rapid ramp-up, are the cornerstones of this new manufacturing paradigm. In this paper a brief review on the Reconfigurable manufacturing systems (RMS) is drawn upon.

Keywords: Reconfigurable manufacturing systems, product, analytical hierarchical process

I. INTRODUCTION

Manufacturing organizations must provide sufficient flexibility to produce variety of products depending on consumers' preference, and to be in a good competitive market. Changes in customer requirements force a need for having new designs of manufacturing systems. With increase in the expectation of the customer there is a greater requirement of new designs in the manufacturing systems. Because of the enhanced demand for change in the products, has initiated a need for change in the design of the product resulting in the change of the manufacturing system. According to that manufacturing organizations started to use Reconfigurable Manufacturing Systems (RMS). Reconfigurable manufacturing systems are designed to produce different product types in shortest time and lower cost, but without compromising on the quality. The major characteristics of this system are reconfigurability. The ability of rearranging and changing manufacturing elements to adjust with the improved environmental and technological changes. There are many other meanings of RMS according to different researchers, such as: Zhao who consider RMS as "a manufacturing system in which a variety of products required by customers are classified into families, each of which is a set of similar products that correspond to one configuration of the RMS". For preparing layout configuration for different types of manufacturing systems; various researchers used mathematical programs .some of those researchers: Cheng and Chen (1996): proposed a simple quadratic assignment formulation to minimize the total distance between machines within manufacturing cells. Bazargan-Lari (1999): discussed layout design problem and emphasized that programming was one of the solution methodologies for making decision for layout design. Preparing RMS may require different layout configurations while switching from one product to the other. So there are some criteria's, which can influence on choosing layout configurations, as Analytical Hierarchical Process (AHP).

II. METHODOLOGY

A. Analytical Hierarchical Process (AHP)

Thomas Saaty, introduced the Analytic Hierarchy Process (AHP), in the year 1980. Analytic Hierarchy Process (AHP), is a very effective tool that deals with the complex decision making process. Analytic Hierarchy Process (AHP), will help the decision maker to set priorities and make the best decision among the available alternatives. The method adopts in reducing the complex decisions to a series of pair wise comparisons, that results in synthesizing the results, the Analytic Hierarchy Process (AHP) makes to capture both the subjective and objective aspects of a decision. Further, the Analytic Hierarchy Process (AHP) incorporates a useful method for checking the consistency of the decision maker's decision, the method makes an attempt to reduce the bias that exist in the decision making process.

The Analytic Hierarchy method (AHP), can have a collection of analysis method and ways, and a collection of other choices among that the nice or best call is formed. it's necessary to notice that, since a number of the factors maybe contrastive, it's not true

normally that the simplest choice is that the one that optimizes every single criterion, instead the one that achieves the foremost appropriate trade-off among the accessible completely different criteria.

The Analytic Hierarchy method (AHP) assigns a grade or weight for every analysis criterion consistent with the choice maker's pair wise comparisons of the factors. The upper the grade/ weight, a lot of necessary the various criterion. Next, for a set criterion, the AHP assigns a score to every choice consistent with the choice maker's pair wise comparisons of the choices supported that criterion. The upper the score, the higher the performance of the choice with relevance the thought of criterion. Finally, the AHP combines the factors weights and therefore the choices scores, therefore determinant a world score for every choice, and a resultant ranking. The worldwide score for a given choice may be a weighted add of the scores it obtained with relevance all the factors.

B. Features of the AHP

The AHP is a very flexible and powerful tool because the scores, and therefore the final ranking, are obtained on the basis of the pairwise relative evaluations of both the criteria and the options provided by the user. The computations made by the AHP are always guided by the decision maker's experience, and the AHP can thus be considered as a tool that is able to translate the evaluations (both qualitative and quantitative) made by the decision maker into a multicriteria ranking. In addition, the AHP is simple because there is no need of building a complex expert system with the decision maker's knowledge embedded in it.

On the other hand, the AHP may require a large number of evaluations by the user, especially for problems with many criteria and options. Although every single evaluation is very simple, since it only requires the decision maker to express how two options or criteria compare to each other, the load of the evaluation task may become unreasonable. In fact the number of pair wise comparisons grows quadratically with the number of criteria and options. For instance, when comparing 10 alternatives on 4 criteria, $4 \cdot 3/2 = 6$ comparisons are requested to build the weight vector, and $4 \cdot (10 \cdot 9/2) = 180$ pairwise comparisons are needed to build the score matrix.

However, in order to reduce the decision maker's workload the AHP can be completely or partially automated by specifying suitable thresholds for automatically deciding some pair wise comparisons.

C. Implementation of the AHP

The AHP can be implemented in three simple consecutive steps:

- 1) Computing the vector of criteria weights.
- 2) Computing the matrix of option scores.
- 3) Ranking the options.

Each step will be described in detail in the following. It is assumed that m evaluation criteria are considered, and n options are to be evaluated. A useful technique for checking the reliability of the results will be also introduced.

There are some objectives for selecting layout configuration, which are re-configurability, cost, quality, and reliability.

III. IDENTIFYING THE TECHNIQUES

A. Productivity and Competitiveness:

The lay out configuration has to be set in such a way that the productivity and Competitiveness of a product is enhanced (A productivity measure is expressed as the ratio of output to inputs used in a production process, i.e. output per unit of input.) of manufacturing should be enhanced with the ever changing dynamic industrialization. Competitiveness is the process of possession of a strong desire to be more successful than others, the quality of being as good as or better than others of a comparable nature.

B. Product Design

Product Design is to create a new product which is well received by the customer. It is essential that there should be a flexible method employed that allows the changes to be well integrated in the manufacturing system. Product design process is the method of creating new product/services to satisfy the customer. Identifying needs and concept generation and development, Production detail design/prototype production, Testing and sampling analysis, Low scale production, Marketing and selling process, Economic competitor analysis and a large scale manufacturing process.

C. Forecasting

Is essential to fore see the future and predict the requirements of the customer in advance to fulfill the needs of the manufacturing industries, Forecasting is: a planning tool that helps management in its attempts to cope with the uncertainty of the future, relying mainly on data from the past and present and analysis of trends. Forecasting starts with certain assumptions based on the management's experience, Knowledge and judgment.

Outcome of Implementing the Analytical Hierarchical Process (AHP) resulted in the following benefits, Effective product pricing, Improve product quality, Product differentiation, Flexibility to change, Time efficiency.

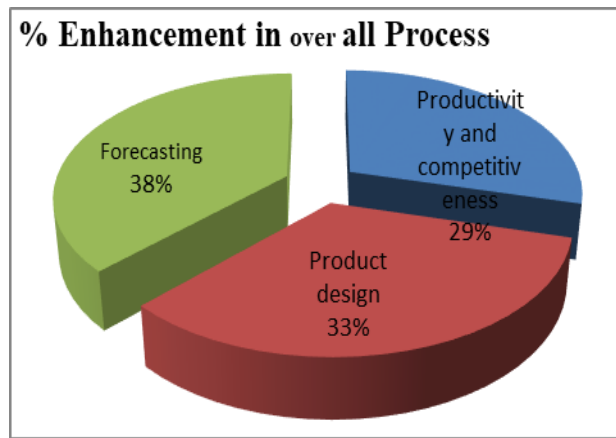


Fig. 1: %Enhancement in overall process

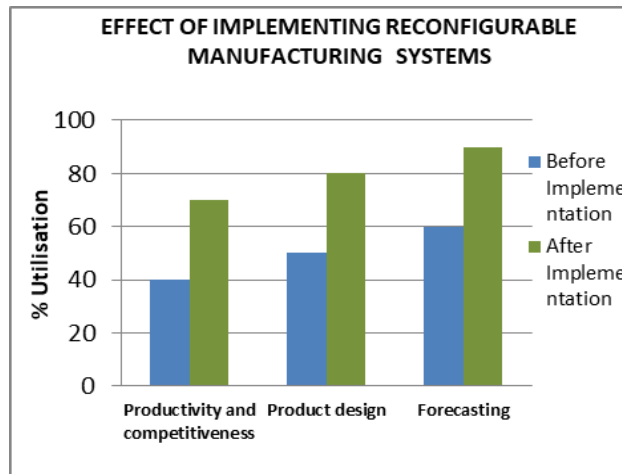


Fig. 2: Effect of Implementing Reconfigurable manufacturing Systems

IV. CONCLUSION

The company has to adjust the production process to re-design the manufacturing layout to accommodate the customer requirements. The company should use the effective product pricing, to achieve the lower products cost by applying latest manufacturing technologies, smart utilization of resources. Proposing the classical layout models to minimize material handling cost for a single product system. Use the time efficiency to produce different product families in the shortest time and at the lowest cost without sacrificing quality. Using the knowledge-based system, for creating the AHP model that will lead to the selection of the best layout. Lower products cost by applying latest manufacturing technologies, smart utilization of resources. Improve the productivity by reducing the cost and its ability to bend the system to suit the customers' needs. Make little different against the competitors' products by offering the extra feature in the product definitely. Start focusing on marketing and selling process in order to build the brand reputation in the market place. Measure, review and correct the forecast accuracy if we wish to improve and to overcome with the problems that the company might face.

REFERENCES

- [1] Business Dictionary.com. (N.D). Sensitivity Analysis. Retrieved Nov 1, 2012. From:<http://www.businessdictionary.com/definition/sensitivity-analysis.html>
- [2] Bushman, Melissa. (Apr 12, 2007). Why is Forecasting Important to an Organization? Yahoo Voices. Retrieved Nov 1, 2012. From: <http://voices.yahoo.com/why-forecasting-important-organization-280514.html>
- [3] Forecasting (N.D). Forecasting. Wikipedia. Retrieved Nov 1, 2012. From: <http://en.wikipedia.org/wiki/Forecasting>
- [4] Rozenburg, N.F.M., & Ekels, J. Product Design and Development
- [5] Buffa, S. Modern Production/Operation Management (8th ed.)
- [6] Perkins, G. Turning Corporate Pain to Gain.
- [7] Saaty, T.L., 1980. "The Analytic Hierarchy Process." McGraw-Hill, New York.