A Review study on Cellular Manufacturing and Role of CMS

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***Abstract*: Cell production is a new Technology application in which machines or processes have been aggregated into cells, each of which is dedicated to the manufacturing of a component or family of products, or a limited set of goods, according to the needs of the customer. It is then determined which parts have similar processing requirements and organized into logical groups called part families, after which the equipment requirements for each component family are specified. A family of components is a collection of components that are similar in their geometrical shape and size, as well as the processing procedures that are required during their manufacturing. A production cell is made up of a number of functionally distinct machines that are located close to one another and are all dedicated to the manufacture of a single component family. A division and conquest strategy are used to divide a complex manufacturing facility into multiple groups of machinery (cells), each dedicated to the processing of a certain component family, and then to conquer those cells. Thus, each component type is produced in a separate cell, where it may be optimized. This paper illustrate streamlines the flow of materials and makes planning easier as a result.**

***Keywords*: Cell production, Complex Manufacturing, Manufacturing, CMS job scheduling problem**

I. INTRODUCTION

Component-based manufacturing (CM) is a hybrid system in which machines are located close to one another (machine cell) and dedicated to a component family (incorporating the flexibility of jobs and the high production rate of the flow routes). In other words, cellular manufacturing is restricted to two dimensions: the component and the machine. The usage of CM machines and equipment for general purposes enables machinery to be modified to meet new product designs and product demands with minimal cost and time effort. It thus offers considerable versatility in the production of a range of goods. In conclusion, the CM is a production system capable of producing kinds of medium/medium volume parts cheaper than other manufacturing systems. CM has grown more popular among manufacturers in the past several decades.

Development of CMS

The definitions of what the phrase 'fabrication cell' really means differ slightly amongst academics and to a great degree between practitioners. A manufacturing cell (Ham et al.1985) may be identified as an autonomous collection of functionally different machines placed together on the floor, devoted to the production of the component's family. CM is defined by Garza and Smunt [1991] as an "application of the GT in which comparable components are organized into partial families and are processed independently in the production of subsystems termed cells." Wemmerlov and Hyer [1989] remarked that "a manufacturing cell is a collection of different equipment or processes situated in the immediate vicinity and devoted to a cell family of components. Vakharia [1986] argues that "a manufacturing cell is a collection of machines or processes of functionally different kinds that are combined to produce a certain family of parts." We made a similar observation when we heard a remark from the shop floor supervisor, 'this is our press cell' in the case of a cluster made up completely of equipment of the same kind. Therefore, more recent authors frequently characterize CM as an application of GT or remove the reference to GT entirely, in many instances. Thus, academics and practitioners have differing views of the significance of CMS. These differences may make it difficult to compare the findings of research to measure cell efficacy.

ROLE OF CMS

In order for us to be more competitive, we must improve the quality and value of the goods and services we offer while being flexible enough so that we can respond quickly to market needs. On the other hand, we must embrace new technological advancements. This is particularly essential when the project involves hazardous labour and high-value capital investments. Many technical problems may prevent CMSs and FMSs from being widely used. Some of these issues, such as the machine device specifications, spindle rpm, the type of material that can be cut, and the adaptability and power required by the control system, could present challenges that would make the CMS technology more difficult to implement and thus prevent its widespread adoption. However, there are additional non-technical issues which need a management viewpoint to evaluate the situation. Therefore, besides the technical specifics of the system, the decision makers have a comprehensive knowledge of the organizational and human factors relating to the purchase and deployment of FMS. These difficulties help to highlight the different obstacles faced by Indian management while adopting modern manufacturing. These include financial, corporate and personal problems. Financial problems may usually relate to an organization's economic well-being and performance. Organizational problems relate to and influence on organizational culture, value systems and tactics. Personnel difficulties address the challenges emerging from the human system in an organization because of the choice of new systems. The benefits in terms of system performance obtained from cellular production compared to conventional production methods may be stated as follows:

1. Configuration time is decreased. A production cell has been developed to handle components of comparable forms and sizes. Many of the components may thus use the same or comparable holding devices (fixtures). Generic devices for the component family may be created so that the time needed for changing devices and instruments is reduced.

2. The size of the lots is decreased. Small batches are feasible and affordable if setup times in CM are significantly reduced. Small quantities also produce smoothly.

3. Inventories of work-in-process (WIP) and completed products are decreased.

WIP may be decreased via lower batch sizes and reduced set-up periods. Askin and Stand ridge have shown that when the setup time is halved, the WIP may be decreased by 50%. In addition to decreased installation times and a WIP inventory, the inventory of completed products is lowered. The components may be manufactured either just-in-time (JIT) or at set, short intervals instead of Make-to-Stock systems which are either running at lengthy, fixed intervals or at random intervals.

4. Costs and time for material handling are decreased. Each component of CM is fully digested in a single cell (where possible). The time and distance between cells is thus low.

5. A flow time decrease is achieved. Reduced handling time and reduced setup time significantly reduce flow time.

6. Requirements for tools are decreased. The cell components are identical in form, size and content. They thus frequently have comparable needs for tools.

7. Space reduction needed. WIP reductions, stocks of completed products and lot sizes have led to less space.

8. Due time is shortened. 8. In a workshop, components are moved in batches between machines. In CM, however, each component is instantly transported to the next machine after processing. Thus, the waiting time is significantly decreased.

9. Improved product quality. Since components move as a single unit from one station to another, they are fully processed in a compact space. Feedback is quick and if things go wrong, it can be halted.

II. SCHEDULING OF CMS

Scheduling is extremely essential for CMS, the initial investment in CMS-classified facilities is expensive so that these systems are planned to make greater use of all capacities while fulfilling the delivery schedule of customers. Timing involves the allocation of limited resources across time to activities. Production planning concerns resource allocation and sequencing of activities for the production of products and services. While allocation and sequencing choices are intimately linked, the interplay between them is extremely difficult to quantitatively describe. However, the allocation and sequencing issues may be addressed independently by utilizing a hierarchical method. The issue of allocation is addressed first and the results are provided as input to the problem of sequence. The issue of resource allocation may sometimes be addressed using aggregate planning methods.

VARIOUS APPROACHES USED FOR SCHEDULING CMS

Venugopal,V. &Narendran, T.[1992] in their work GAs have been used for the solution of a component grouping issue with various goals in a genetic algorithm approach to machine components. Using evolutionary algorithms to address a problem with many criteria in a real manufacturing facility, Starkweather et al. [1993] made history as the first researchers to do so. The criteria were to keep the average plant inventory as low as possible and to reduce the average waiting time to choose an order. These characteristics are negatively associated with one another (The larger the inventory, the shorter the wait; the smaller the inventory, the longer the wait). To demonstrate the problem of production/shipment optimization, a symbolic coding system was used for each member (chromosome) of the population. Orders from customers are represented in this system by discrete integers. As a result, each member of the population represents a permutation of a consumer order. In order to deal with this problem, the genetic algorithm was constructed using blind recombinant operators. This operator emphasises information on the relative order of the items in the permutation, since this has an impact on both the inventory and the time spent waiting for the things to arrive. Each member of the population was classified using a single evaluation function (a weighted sum of both criteria), which was applied to each member of the population. This categorization was determined by running a simulation of the facility's operations on the internet. This approach generated schedules that resulted in inventory levels and waiting times that were acceptable to the plant's upper management. Furthermore, the integration of the evolutionary algorithm into the on-line simulation enabled for the response of the system dynamics to be seen.

R. Di Lorenzo, S.Fichera, V. Grasso[1998] addressed Flexible Manufacturing Cell Planning problems in their article, Scheduling cellular manufacturing system using genetic algorithms, using a Multi-Objective Approach to jointly minimize range and minimize work waiting. The formulation of the scheduling issue will be addressed and how well suited sequences, such as widespread permutation sequences, are generated and JIT time frames properly constructed. They developed a method for evolutionary sequencing based on both conventional genetic and hybrid operators. The hybrid operators were established to build a fitting population, to conduct regular local population research and to preserve sufficient genetic variety in the current population. In determining the scheduling which minimizes the time and in process work jointly, the simulation work runs at a large number of randomly generated issues, shown the excellent performance of the suggested Evolutionary Hybrid Method in front of a modified NEH algorithm.

H.Balasubramanin, L.Monch, [2004] tried to reduce weighted late weight on parallel batch machines with incompatible workfamilies. The issue is NP- difficult. They suggested two distinct GA versions of three stages each. The first version creates fixed batches, then allocates them to GA machines and then sequences batches on each system. The second version distributes tasks to machines using a GA, then creates lots for the given jobs on each machine and finally sequences those lots.

X. Wu, Y.Wang, [2006] presented a novel method to the simultaneous resolution of CF and GL issues. It proposes a conceptual and mathematical framework that combines both choices and includes key variables, including operational sequence, component demand, transfer batch, machine capacity, and layout type. To address the integrated cell design issue, a hierarchical genetic algorithm is created.

In order to address dispersed scheduling issues, F.T.S. Chan, S.H. Chung[2006] developed a genetic algorithm with dominant genes particularly in the FMS context. Dominant genes are designed to discover and record important genes in the chromosomes and Improve genetic search performance. The suggested method has been compared to various ways for numerous distributed scheduling issues to evaluate and benchmark the dependability of the optimisation.

These examples emphasised the need of using genetic algorithms as a "stand-alone" method to solving problems. The intricacy and effectiveness of the problems addressed have been limited as a result of this. Recent research has shown that genetic algorithms are sensitive to the initial population used in their calculations. When the initial population is generated randomly, genetic algorithms have been shown to be less successful than annealing methods, but better than heuristic approaches alone in terms of effectiveness. However, if a heuristic population is created in the original population, the genetic algorithms may become as good as or better than the annealing methods in terms of performance. Integration with other search techniques (such as forbidden searches) has also helped to enhance the effectiveness of both. This result is not surprising since it is consistent with the results of non-linear optimisation experiments. Simply said, if you begin your search near the perfect solution, you are much more likely to find it than if you begin your search far away from the optimal solution.

In a nutshell, genetic algorithms (GA) are an optimization method that has many characteristics with Darwinian natural selection and biological reproductive changes. Genome-wide searches throughout concept space are encoded by genetic algorithms in their core, with each step striving to reach a coarse granularity of information (Goldberg 1988). Individuals of a species have the same characteristics as concept instances. It is determined which of these concepts will survive in the next generation by evaluating the changes and recombination's of these ideas using an assessment function. The use of genetic algorithms is required for the following five components:

1. A method to encode problems—fixed symbol length string.

2. An evaluation function that gives each answer a rating.

3. A method to initialize solutions population.

4. Parent operators who may apply their genetic composition to reproductions such as crossover (i.e. random chosen segment exchange between parents), mutation (i.e. gene modification), and other domain operators.

5. Algorithm parameter setup, operators, and so forth.

III. GENETIC ALGORITHMS

Year	**Name of Researcher**	**Work done**
1992	Venugopal, V. &Narendran, T.	Applied GAs in solving a machine component-grouping problem with multiple objectives.
1993	Starkweather et al.	Applied genetic algorithms to solve a dual -criteria job shop scheduling problem in a real production facility.
1998	R. Di Lorenzo, S.Fichera & V. Grasso	Scheduling a cellular manufacturing system with GA.
2004	H.Balasubramanin,L. Monch	Applied GA in scheduling of parallel machines with incompatible job families to minimize total weighted tardiness.
2004	P.Vrat, R.Shankar	Applied multi-objective GA approach to design of CMS
2005	K.L.Mak, X.X.Wang	Developed a Genetic scheduling methodology for VCM systems.
2006	X. Wu, Y.Wang	Developed Concurrent design of CMS using GA.
2006	F.T.S. Chan, S.H. Chung	Applied GA in a distributed scheduling problem in FMS

IV. CONCLUSION AND FUTURE SCOPE

The major contribution of this study is to use taboo search methods for the solution of the CMS task scheduling. In this study, an effort has been made to modify the task sequence such that optimum job sequence may be obtained. The aim behind this study is to disrupt sequences for better outcomes. The more sequences the greater the degree of objective optimization (COF). This method is appropriate for exploring the quantity and ability of work sequences from the given job sequence. The primary goal is to combine the maximum use of the machine in order to keep the cost of penalty zero. A timetable method is designed to preserve its flexibility and therefore the desired performance metrics for a particular FMS. The mechanism works on a taboo basis and concurrently optimizes two contradictory goals. Tabu search schedule is compared to solutions achieved under various timetable rules such as SPT, HPT, EDD etc. Tabu search. After the data have been compared, it can be determined that the taboo search technique is much better to alternative scheduling methods, because it provides the optimum value for penalty (COF). This allows to optimize the scheduling issue to a larger extent by using the tabu search technique. As the issue of scheduling in flexible manufacturing sectors is a very frequent problem, there is a great deal of additional study in this area. Some of the key points which may be examined in the course of the current study are provided. The issue in this study is seen as each work step has a particular processing time. In future, set timings of machines and intercellular motion times may be taken into account while resolving the planning issue. The Tabu search hybrid and the genetic algorithm may be used for the issue, such as cross-over rate, mutation rate etc. This hybrid method helps to solve the problem in a quicker period. It is doubtful, however, that the hybrid algorithm-produced answers would be as exact as the enumeration method. This implies that conventional optimization theory techniques may also be used to find the solution to the algorithm.

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