IMPORTANCE OF GROUP TECHNOLOGY AND LEAN CONCEPTS IN MANUFACTURING – A REVIEW

P.Sivasankaran[1]
[1](Asst Prof, Dept of Mechanical, Manakula Vinayagar Institute of Technology, Pondicherry, sivasankaran.panneerselvam@yahoo.com)

Abstract*—One of the most significant changes in the manufacturing was reduced lead time, improved inventory systems with demand and well planned maintenance systems to improve the breakdown failure of machineries. For all this we need to have well planned manufacturing systems for processing the work parts as well as segregating the components based on geometrical and manufacturing attributes. In this paper modern manufacturing system is compared with conventional manufacturing by means of performance efficiency. Also in this paper weakness present in the conventional manufacturing is clearly focused and thereby to overcome the problems modern manufacturing system was needed with added flexibility. One among the modern manufacturing concepts was group technology. Thus group technology concept was explained in this paper along with its several advantages.*

***Keywords*—Group technology, Performance efficiency, Geometrical attribute, Manufacturing attribute**

1. INTRODUCTION

In conventional manufacturing system worker plays a important role in the organization. Because humans are the important assets in a manufacturing organization, hence most of the works are being spared by the persons with various skills and abilities. Also material plays a important role in manufacturing enterprises because it converts the raw materials into finished products with value addition by means of cost but however in olden manufacturing methods the biggest challenge is getting work from persons as well as monitoring the material status of inventory. To overcome this challenge we need more manpower with highly skilled forces. But in India even still now requirement of skilled workforce is said to be big demand in manufacturing. Also over time shift is considered to be another challenge in manufacturing environment. So each and every person in the department must have vast experience in manufacturing domain. That is knowledge about machineries, process knowledge about the materials; allowances to be fixed while machining the job and minimizing the scrap rate.

These are the challenges affecting the perfection of product in conventional manufacturing systems. Thus it creates more inconvenience while manufacturing the products on time.

To overcome the above problem we need to have the support of automation in manufacturing because automation puts an end for all the problems faced in the conventional manufacturing systems.

There are certain benefits of automation as follows:

- Increased accuracy
- Increased efficiency of work
- Reduced lead time of product
- Improved customer satisfaction
- Sustainable growth

There are many modern manufacturing systems are still existing even today one among these modern systems is said to be group technology.

Group technology is drawing increasing interest from manufacturers because of its many applications for boosting productivity. GT is an approach to manufacturing that seeks to maximize production efficiencies by grouping similar and recurring problems or tasks.

Group technology is a manufacturing technique in which parts having similarities in geometry, and manufacturing processes. GT depends on a general rule that numerous issues are comparable and by gathering comparative issues, a solitary arrangement can be found to an arrangement of issues, consequently sparing time and exertion. The gathering of comparative parts is known as part family and the gathering of hardware used to prepare an individual part family is known as machine cell. It is a bit much for each piece of a section family to be prepared by each machine of comparing machine cell. This kind of assembling in which a section family is delivered by a machine cell is known as cell assembling.

The assembling efficiencies are for the most part expanded by utilizing GT in light of the fact that the required operations might be restricted to just a little cell and hence staying away from the requirement for transportation of in-process parts.

Group technology is an approach in which similar parts are identified and grouped together in order to take advantage of the similarities in design and production. Similarities among parts permit them to be classified into part families.

The advantage of GT can be divided into three groups:

- Engineering
- Manufacturing
- Process Planning

Disadvantages of GT Manufacturing:

- Involves less manufacturing flexibility
- Increases the machine down time as machines are grouped as cells which may not be functional throughout the production process.

2. LITERATURE REVIEW

The methods formulated to form component-machine groups in group technology can be generally classified as:

- Descriptive methods
- Block diagonal matrix method
- Similarity coefficient method
- Other analytical methods

Notwithstanding, since these frameworks constitute just a single part of the Cell arrangement issue (they are for the most part used to distinguish segment families) these are definitely not Considered as techniques by which creation cells are shaped.

Descriptive Methods:

Production Flow Synthesis (PFS), developed by De Beer and de Witte [3], is a method that is an extension of PFA in that it also considers forming cellular subsystems for the subassembly and assembly aspects of the production process. The data requirements include, in addition to the component routings and processing times per operation, the product structure of the final products.

The division into creation subsystems or cells depends on the distinguishing proof of operations as essential (which can be performed on one machine as it were), auxiliary (for which just few machines are accessible), and tertiary (where the quantity of machines is sufficiently substantial so that each machine can be dispensed to each creation cell). This strategy continues promote as in once routings are relegated to a subsystem the workloads for every subsystem are evaluated lastly work processes inside and between cells are additionally settled. The PFS strategy does appear to deliver great outcomes in little building shops as represented by the case introduced by the creators. It is not clear how viable this strategy would be in circumstances where countless can be performed at a solitary machine or in situations where extra venture might be financially supported.

The Flexible Production Cells (FPC) method was proposed by Tilsley and Lewis. This method is proposed to consider the fluctuations in demand that may be experienced for individual components. This demand variability is implicitly considered in forming the production cells by ensuring that a component family for which variability is the highest can be manufactured in almost all the cells formed. The three basic factors considered in forming the cells are as follows:

1. A component family should constitute enough work to justify the establishment of a machine group.
2. Machine utilization should not be lower after cells are formed compared to utilization before cell formation.
3. The number of machines in a cell is limited to ensure that each cell can be controlled by one direct worker.

The greater part of the graphic strategies investigated require a lot of data. Moreover, the majority of the creators accentuate the significance of neighborhood components that are not effectively recognized; therefore, the examiner utilizing any technique must be exceptionally comfortable with the generation framework in terms of machine contrariness, segment outline particulars, and additionally the materials taking care of gear accessible.

3. BLOCK DIAGONAL MATRIX METHODS

These strategies proposed by king, king and Nakomchai, and Chan and Milner are an immediate aftereffect of the PFA system proposed by Burbidge. In the gathering investigation phase of PFA, Burbidge utilizes atomic union to control the machine-part steering framework, and the calculations proposed under this technique all utilization an indistinguishable lattice from the beginning stage.

King's Rank Order Clustering (ROC) Algorithm rearranges the rows and columns of the machine-component routing matrix by associating binary values with each row and column, and ranking the decimal equivalents in decreasing order. Ring also discusses some methods of identifying exceptional elements and goes on to discuss a matrix reorganization in case of bottleneck machines. However, as pointed out by Chan and Milner [3], as the number of machines and components gets to be extremely large, computing the decimal equivalents of the binary values gets to be a very time consuming task.

The essential benefit of the block-diagonal matrix techniques are that they may be easily solved on an interactive basis and require best the use of a fairly properly sorting process. However, those methods do now not address the unique issues of a way to account for device incompatibility, the supply of extra funding, and the development (or discount) of substances glide between and within cells.

Similarity coefficient method:

McAuley was among the principal analysts to propose the utilization of bunching techniques for framing machine bunches. He utilized Single Linkage Cluster Analysis and a likeness coefficient "separate" grid to frame machine bunches. The similarity measure of machine i and machine j was computed as the total number of components visiting both machines divided by the total number visiting machine i plus the total number visiting machine j .McAuley also determined the optimum number of groups from the dendogram obtained by the clustering method.

$$Sij = Xij/ Xii + Xj – Xij$$

Where

Sij = similarity coefficient of machines i and j

Xij = number of components visiting machines i and j

Xii = total number of components visiting machine i

Xi = total number of components visiting machine j.

This approach works well in case where the number of machines is small, as the number of possible cliques varies exponentially with the number of vertices in the graph.

Other Analytical Methods:

Optimization methods and mathematical programming applied to the cell formation problem would tend to restrict the scope of the solution in the sense that conflicting objectives could not be considered. Furthermore, the constraint matrices would also be extremely large and thus computational problems may arise.

Purcheck also proposed the use of a mathematical classification scheme to test the hypothesis that under a specific grouping of components there would be forecast workloads that are sufficient to keep one or more corresponding groups of manufacturing facilities busy at an economic level of utilization. The classification scheme suggested combines machine requirements and sequences by coding them in the form of letters and digits. The major drawback here is that code lengths tend to be very long and in most cases are difficult to handle effectively.

Strategic and operational considerations in group technology:

In order to obtain desirable profit and survive as long as possible, manufacturing firms should make their best efforts to establish various planning activities in different levels of the management hierarchy. Planning activities are usually classified into three levels: strategic, managerial, and operational. Production planning—mostly concerned with managerial and operational planning—is one of the most important functions in production management planning activities.

Strategic considerations are efficient business plans, efficient financial plan to execute the task successfully. Operational considerations involve job routing, part flexibilities, machine flexibilities and production flexibilities.

In order to be more successful both strategic and operational considerations are said to be the important factor in manufacturing.

In the first phase of literature review quantitative methods of group technology is discussed. Now in the next phase group technology concept is linked with lean manufacturing. Lean manufacturing has attained competitive more advantage in today's manufacturing world. Lean systems purely emphasizes on wastes occurring in manufacturing. Waste can be in the form of overproduction, defects, excess inventory, excessive transportation and poor efficiency of the system. Lean manufacturing is considered to be the excellent tool in improving the quality of manufacturing by minimizing the wastes.

Thus in literature lean manufacturing can be linked with analytical hierarchy process. It is nothing but multi criteria decision model. Analytical hierarchy process is highly influential in reducing the manufacturing lead time, improving the quality by increasing the productivity. As a whole lean manufacturing improves the flow of material continuously without any interruption.

4. Conclusion

Thus group technology and lean concepts are considered to be highly prominent technology in manufacturing enterprises. Therefore group technology saves the time in changing over the part from one cell to another cell thus it attains part flexibility. In this paper various methods of cell formation is discussed in the literature survey based on that it clearly states that block diagonal matrix method is considered to be near optimal method in grouping the parts and machines as per sequences.

But to measure the behavior of manufacturing system simulation is the best alternative to assess the performance efficiency of manufacturing system.

References

[1] "Definition from Businessdictionary.com". Www.businessdictionary.com. Retrieved 12 May 2013.

[2] Jump up^ "Definition from All Data Labs". Www.alldatalabs.com. Retrieved 1st Jan 2016.

[3] Burbidge, J.L. The Introduction of Group Technology. New York: John Wiley and Sons, 1975.

[4] Chan, H.M. and D.A. Milner. "Direct Clustering Algorithm for Group Formation in Cellular Manufacture." Journal of Manufacturing Systems, Vol. I, No. 1 (1982) pp. 65-74.

[5] De Beer, C. and J. de Witte. "Production Flow Synthesis." CIRP Annals, Vol. 27 (1978) pp. 389-392.

[6] De Beer, C., R. Van Gerwen, and J. de Witte. "Analysis of Engineering Production Systems as a Base for Production-Oriented Reconstruction." CIRP Annals, Vol. 25 (1976), pp. 439-441.

[7] Edwards, G.A.B. Readings in Group Technology. London: Machinery Publishing Company Ltd., 1971.

[8] El-Essawy, I.F.K. "The Development of Component Flow Analysis in Production Systems." Ph.D. diss., University of Manchester, Institute of Science and Technology, Manchester, UK, 197 1.

[9] Flynn, B.B. and F.R. Jacobs. "Group Technology versus Process Layout Design: A Comparison." Proceedings ofMidwest AIDS, (May 1984), pp. 19 l- 193.

[10] Fox, B. "OPT-An Answer for America." Parts II, III, IV. Inventories and Production Magazine, November/December 1983, January/February 1984, March/April 1984.

[11] Arash Shahin et al " Group Technology and Lean production : A conceptual model", International journal of business research , vol 3, No: 4, 2010.