A REVIEW OF A BASIC CONCEPT OF CELLULAR MANUFACTURING

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ABSTRACT

Everyone can mention that some companies are more successful than other companies and they can meet their customers' requirement with almost no setup time and no waste. Cellular manufacturing gives materials and components ability to get a smooth flow during the production process. It also helps to increase the production velocity and make it more flexible. Cellular manufacturing pushes the company to produce a variant type of features at the same time and reducing the production time that can be taken for a single product. I will explain during this paper the concept which can help us to meet the customers' requirement with no waste. This paper will cover the basic concept of cellular manufacturing, which is the best way to apply lean manufacturing.

Key words: Cellular manufacturing, one-piece, lean manufacturing, Manufacturing flexibility.

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1. INTRODUCTION

In 1950s, researchers found that identify and group the same parts of manufacturing should be done together to take a big advantage of their similarities during manufacturing and mass production. Using this approach helped to create a group of similar parts; this helps to reduce setup time. This technique of manufacturing was tamed as a group technology. [1], [2]

Cellular manufacturing is an application of the group technology concept which helps companies to build an aviary of production to their customers with as little waste as possible. [2]

The cellular manufacturing is arranged in a sequence that supports a smooth flow of material and component through the process with minimal transport or delay.

Cellular manufacturing allows companies to provide their customers with the right product at the exact time. It does this by grouping similar product into families that can be processed on the same equipment in the same sequence.

Cellular manufacturing has big benefits, which include WIP reduction, space utilization, lead time reduction, productivity improvement, and quality improvement, enhance flexibility and visibility.

In this paper, I will explain the basic concept of cellular manufacturing, which is mainly in lean manufacturing.

2. FOUNDATION OF CELLULAR MANUFACTURING

Cellular manufacturing is working on the principle that similar things should be manufactured similarly that means the things which have the same design attributes such as size, shape, etc.. And manufacturing attributes such as length, diameter, surface finish, tolerance etc. These things should be together because that can help us to work with groups not with individual parts. Therefore, working with different groups is better than working with individual parts. We can make group by collecting the parts which are similar to one group such as machines, tools and equipment, which required processing these groups. So that can give us a big advantage. Consequently, if we collected these many individual parts to make one group that means we will have one problem, and it is easy to find a solution for this problem more than if we have many individual problems. So that will save time and effort. Cellular manufacturing is an approach which can be brought to tolerate in any plan where underlying similarities exist. It goes by grouping of parts and machines.

3. CHARACTERISTICS OF CELLULAR MANUFACTURING

In cellular manufacturing, the cell can meet the entire production requirement. Furthermore, these cells are self-efficient and self-managed. [1]

Manufacturing cell has got the following characteristics:

- Each cell has a particular set of family of components or products.
- Each cell is provided with all the machines and other facilities, which it needs to, complete its own particular family.
- Production targets for each cell are given as a whole and not separately of different individuals in the cell, and these targets are set by management in consultation with cell foreman and operators.
- Within the cells, there is a pool of labor with a certain degree of flexibility and a team of workers control each cell solely. The foreman or cell leader is in direct charge of each cell, working solely for that group.
- Each cell does its own inspection and work scheduling.

4. PRINCIPLE KEYS THAT MAKE LEAN CELL BETTER THAN THE TRADITIONAL JOB SHOP

There are many things can make the lean cell better than the traditional job shop setup such as:

Flexibility: the key function-design requirement for manufacturing system is flexibility. Manufacturing cell is designed for flexibility. It is typically arranged in U-shape, so workers can move from a machine to machine, loading and unloading part, with the shortest walk distance. Machines in a cell are at least single-cycle automatics, so that they can complete the machine cycle untended, turning off automatically when finished. The cell usually includes processing needed for a complete part or assembly.

Manufacturing flexibility considers:

- Adaptability to change of product design.
- Ability to reconfigure a manufacturing system or subsystem easily.
- Ability to adapt to product mix and volume change.

Using decouplers in manufacturing and assembly cells: Decouplers are placed between process and manual operations to provide cell flexibility, quality control, production control, and process delay. Between each machine is decoupler holding one part, processed and inspected, and ready to be pulled into a next process. Decouplers in the manned cell help the worker inspect a part while permitting the worker to move in the opposite direction of the part flow. Decoupler support material flow in the cell.

Product family: the customer may require more products, a different color mix, change in the product design, so cell system design can make many different types of product with a small setup time, but with the job shop system it will take a lot of time to produce a new production.

Multifunctional and multi-process workers: multifunctional means a worker can perform tasks related to setup, setup reduction, quality control, preventive maintenance, problem solving, and continuous improvement. To be a multi-process means a worker can operate various processes and/or carry out assembly tasks. A cell has multi-process workers who can operate more than one kind of process or multiple versions of the same process. They also carry out inspection and machine maintenance duties, making them multifunctional. Workers devise ways to eliminate setup time. Manufacturing and assembly cells eliminate the job shop concept of one person/ one machine. Therefore, increase worker productivity and utilization.

5. LAYOUT OF CELLULAR MANUFACTURING

The cell can be formed into a U-shape. Product moves in a counter-clockwise direction one piece at a time. One- piece technique can shorten the cycle time and changeover times Figure 1.

Machines in the cell are single – cycle automatics, so they can complete a machining cycle untended, and have it turn off automatically when it is finished with a processing cycle.

Unfortunately, "in a cellular layout as the product-flow layout, a machine breakdown may still cause a work stoppage in the cell" [2].

Figure 1 Manufacturing cell. [2]

6. CELLULAR MANUFACTURING OBJECTIVE

The primary objectives in implementing a cellular manufacturing are reduced. Therefore, some important objectives include:

- Reducing setup time by using part family tooling and sequencing.
- Reducing inventories.
- Reducing flow line (by reducing setup time and move times, wait time for movies and using smaller batch size).
- Increasing the labor and machine utilization.
- Maximization of output.

In addition, the cell appears as an approach that in more tendencies to teamwork. Manufacturing cells are natural candidates for just in time implementation.

7. BENEFITS OF CELLULAR MANUFACTURING [3]

Applying the concept of cellular manufacturing has a lot of benefits to the manufacturing which include:

- Reducing the number of product defects, it can be found the errors immediately and corrected.
- Reducing cycle time variability and line –balance constraints.
- Reducing WIP and finished goods inventories, producing only enough products to satisfy customer demand.
- Reducing or eliminating setup time.
- The flow will be smooth and faster through the operation.
- Reducing material handling costs and time.
- Reducing in manufacturing space required.
- Quality feedback between manufacturing and assembly operation is faster.

The summaries of the benefits of Cellular manufacturing comparing with job shop manufacturing shown in table1.

Table 1 The Benefits of cellular manufacturing after the First Two Months of Operation. [3], [4]

Criteria	Job Shop	CMS	Resulting Improvement
Work in process	\$590,000	\$116,336	\$473,664 (80%)
Finished goods	\$880,000	\$353,167	\$526,833 (60%)
Refractory supplies	\$8,333/month	0	\$8,333 (100%)
Lead time	14 days	2 days	12 days (86%)
Late orders	100	4	96%
Scraps	22%	14%	8%
Direct labor	198	145	53 employees (27%)
Mfg. Space (sq. ft.)	45,000	20,000	25,000 sq. ft. (56%)

Figure 2 Benefits of Cellular Manufacturing. [1]

Table 2 The Benefits of the Cellular Manufacturing. [3], [5]

Types of Benefit	Number of Responses	Average % Improvement	Minimum % Improvement	Maximum % Improvement
Reduction in throughput time	25	45.6	5	90
Reduction in WIP inventory	23	41.4	8	90
Reduction in material handling	26	39.3	10	83
Improvement of operator job satisfaction	16	34.4	15	50
Reduction in number of fixtures for cell parts	9	33.1	10	85
Reduction in setup time	23	32	2	95
Reduction in space needed	9	31	1	85
Improvement of part quality	26	29.6	5	90
Reduction in finished good inventory	14	29.2	10	75
Reduction in labor cost	15	26.2	5	75
Increase in utilization of equipment in the cells	6	23.3	10	40
Reduction in pieces of equipment required to manufacture cell parts	10	19.5	1	50

Table 3 The Performance Improvements. [3], [6]

Performance Measure	Number of Responses	Average % Improvement	Minimum % Improvement	Maximum % Improvement
Reduction of move distance/time	37	61.3	15	99
Reduction in throughput time	40	61.2	12.5	99.5
Reduction of response time to orders	37	50.1	0	93.2
Reduction in WIP inventory	40	48.2	10	99.7
Reduction in setup times	33	44.2	0	96.6
Reduction in finished goods inventory	38	39.3	0	100
Improvement in part/product quality	39	28.4	0	62.5
Reduction in unit costs	38	16	0	60

8. COMPARISON BETWEEN TRADITIONAL JOB SHOP AND CELLULAR MANUFACTURING

To make a comparison between traditional and cellular manufacturing, we can brief this comparison, according to a table which shown below.

Table 4 Comparison between Traditional Manufacturing and Cellular Manufacturing. [1]

SI. No.	Criteria	Traditional Manufacturing	Cellular Manufacturing
1	Capital investment	High	Low
2	Inspection cost	High	Low
3	Inventory cost	High	Low
4	Space	High	Low
5	Cycle time	High	Low
6	WIP inventory	High	Low
7	Waste(time , money, material)	High	Low
8	Material handling	High	Low
9	Machine utilization	Poor	High
10	Team work	Poor	Excellent
11	Control and Supervision	Poor	High
12	Use of available skill	Poor	Excellent
13	Communication	Poor	Excellent

9. CONCLUSION

The goal of this review is to get a basic understanding about the cellular manufacturing and how it can help the companies to improve its production and to reduce its waste. Therefore, the best concept to apply lean manufacturing is using a cellular manufacturing approach, which can help us to take the waste out. Furthermore, it has many effective ways to improve the manufacturing.

This paper has shown the basic concept of cellular manufacturing such as the objectives and the benefits of cellular manufacturing, which can achieve to meet the customers required.

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