International Journal of Engineering Sciences Paradigms and Researches (IJESPR)
Vol. 48, Special Issue, (TAME-2019, April 4-5, 2019)
(An Indexed, Referred and Impact Factor Journal approved by UGC- Journal No. 42581)
ISSN (Online): 2319-6564
www.ijesonline.com

CASE STUDY TO ENHANCE PRODUCTIVITY IN CELLULAR MANUFACTURING

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Abstract
The cellular manufacturing is a strategy to enhance manufacturing flexibility and productivity by utilizing the available resources in the best possible way. This paper offers a case study, in which cells are fabricated to respond the production process is discussed and a flexi manufacturing system is described. This is a method to enhance the production with effective layout.

Keywords: *Cellular Manufacturing system, flexi Cell, Plant layout.*

1. Introduction

"Cellular manufacturing" is a practice of manufacturing set up in which there is combination of batch production and product manufacturing incorporating group technique type of production. The main aim of "cellular manufacturing" is to react as fast as imaginable, by making a broad range of similar type of parts, while making as little as scrap as imaginable (Datta et. al., 1992). The requirements of customer are changing frequently in nature enforces to make a strong need for a newer technique of manufacturing systems. For getting the adequate competency and to remain in survival with highly dynamic markets, Industries should have minimum flexibility to respond over a range of products to produce on the shop floor (Singh et al., 2010). The manufacturing has witnessed drastic changes in the later part of 20th century (Ahuja and Khamba, 2008). Cellular manufacturing systems (CMSs) are the type of manufacturing system which is used to produce different product families based on similarity of operations in the minimum time with different machine cells based on similar processing at the minimum possible cost without negotiating with the quality of the product (Sundharam et. al., 2013).

The products which are manufactured in the production industries within HSIDC, Bawal are done using various procedures with specific layouts such as, Product layout, Process layout, mass production. In the surrounding where the customer needs are of small quantities from a large range of products, the cellular manufacturing becomes critical.

From the above it has been concluded that there is delay in manufacturing time (Suresh 1991). Then, now it is the challenge to eliminate these delays. The large range of products and average time delays are considered. Now it is to set-up a new flexi cell environment to get the maximum utilization of resources. In this paper a case study is carried to reduce the processing delays at various phases by changing the methods of production at lowest cost.

2 Flexi Manufacturing

Flexi Manufacturing Cells, is a concept initially reported in 1982 by Simpson, according to them FMC can be seen as systematic arrangements of machines, for various purposes, to be worked in cellular manufacturing for a given limit of time without distressing their physical layout. The advantage of flexi cells remains memoric that dynamic flexi cell can sufficiently be taken out at lowest cost.

In the context of Cellular manufacturing system it uses the existing layout of process type layout (Chowdary et. al., 2005). FMC utilizes the process layout in relation with Group Technology. The traditional process layout the products are not group into families, as compared with CM where the application of GT is utilized (Herage 1994). However, with FMC since it follows on from the concept of CM, the products are grouped into families.

2.1 FMC: WITH A CASE STUDY

To demonstrate the new concept of CM a case study organized. There are 17 jobs in a particular industry. The works finish with a mean of 45 minutes. These jobs to be manufactured require handling in 1 to 3 departments. The arrangement of processing in their native departments is shown in table 1.

Table 1: Sequence of Jobs

No.	Works code	Work name	Number of operations	Departments sequences at which Processing take place		
1.	II2	Washer Big	2	1	2	
2.	I1	Cylinder Head	1	1		
3.	III2	Cylinder Body	2	1	3	
4.	II3	Key	2	1	2	
5.	VI3	Washer Small	2	6	3	
6.	II1	Bush large	2	1	2	
7.	I2	Bush small	1	1		
8.	III4	Sprocket	2	1	3	
9.	III1	Pump Shaft	2	1	3	
10.	VI2	Rod Splined	3	6	3	1
11.	IV2	Shaft	3	4	1	5
12.	III3	Spline Shaft	2	1	3	
13.	VI1	C Clamp	3	6	3	1
14.	IV1	Angle Plate	3	4	1	5
15.	V2	Jig	3	6	1	2
16.	IV3	Taper Shaft	3	4	1	5
17.	V1	Plates	3	6	1	2

This processing is accomplished with the help of 15 machines arranged in 6 functional departments in the workshop (WS), (table 2).

Table 2:Machines in the Departments

Sections (S)	**Type of machines**	**Measure**	**Machine Code**
1.	Lathe	6	Mc1, Mc2, Mc3, Mc4, Mc5, Mc6
2.	Drills	1	Mc7
3.	Milling	4	Mc8, Mc9, Mc10, Mc11
4.	Boring	2	Mc12, Mc13
5.	Grinding	1	Mc14
6.	Shapers	1	Mc15
Total		15	

2.1.1 Traditional system used

As jobs arrive in the workshop they are kept in a waiting queue. The works are estimated and the process procedures requirements are estimated. On the basis of these procedures, the jobs are sequenced through the concerned departments. When jobs arrive in a department after been sequenced to it, they operated the first free machine in that department for its process operation. After which they then proceed to the next department in their sequence and again use the first free machine which is available in that department, and continues so until all the process operations are completed.

The processing events of the existing system for the jobs are presented with a sample description of these events at a given time until 405 minutes, in table 3. The progression of events follow the same format as described.

Table 3: A Sample Processing Description of the Existing System

Time (minutes)	Event Description
0	Job II2 arrived and loaded on Mc1 in Dept. I
45	Job I1 arrived and loaded on Mc2 in Dept. I
90	Job III2 arrived and loaded on Mc3 in Dept. I
135	Job II3 arrived and loaded on Mc4 in Dept. I
180	Job VI3 arrived and loaded on Mc15 in Dept. VI
225	Job II1 arrived and loaded on Mc5 in Dept. I
245	Job II2 set-up and processing completed on Mc1, and move to Mc7 in Dept. II
270	Job I2 arrived and loaded on Mc1 in Dept. I
315	Job III4 arrived and loaded on Mc6 in

	Dept. I
360	Job III1 arrived and waits in the queue in Dept. I for 20 minutes
375	Job I1 set-up and processing completed on Mc2, and released from the MS
380	Job II3 set-up and processing completed on Mc4 in Dept. I, and move to Mc7 in Dept. 2; Job III1 loaded on Mc4 in Dept. I
385	Job VI3 set-up and processing completed on Mc15 in Dept. VI, and move to Mc9 in Dept. III
390	Job II2 set-up and processing completed on Mc7, and released from the MS
405	Job VI2 arrived and loaded on Mc15 in Dept.VI

3.1.2 FMC SYSTEM

For the new concept of CM (Chowdary et al., 2005) the jobs under study are grouped into families based on similarity in their processing and moved to the shop when they are constructed. However, the maximum waiting time before the family is released is 150 minutes. Table 5 shows the grouping of the jobs into families. The allocation of families and machines to cells are shown in table 4; shows the cells arrangement within the existing layout.

Table 4: Division of Jobs into Families

Family Type	Jobs in the family	Job Name	Process Sequence
I	I1	Cylinder Head	1
	I2	Bush small	1
II	II1	Bush Large	1 → 2
	II2	Washer Big	1 → 2
	II3	Key	1 → 2
III	III1	Pump Shaft	1 → 3
	III2	Cylinder Body	1 → 3
	III3	Spline Shaft	1 → 3
	III4	Sprocket	1 → 3
IV	IV1	Angle Plate	4 → 1 → 5
	IV2	Shaft	4 → 1 → 5
	IV3	Taper Shaft	4 → 1 → 5
V	V1	Plates	4 → 1 → 5
	V2	Jig	4 → 1 → 5
VI	VI1	C Clamp	4 → 1 → 5
	VI2	Rod Splined	4 → 1 → 5
	VI3	Washer Small	1 →

Table 5: Distribution of Families and Machines to Cells

Cell	**Family**	**work code**	**Machines**
I	I	I1;I2	Mc1;Mc2;Mc3
	II	II1;II2;II3	Mc7;
	III	III1;III2;III3; III4	Mc8;Mc9
II	IV	IV1;IV2;IV3	Mc4;Mc12;Mc13;Mc14
III	V	V1;V2	Mc5;Mc7;Mc15
IV	VI	VI1;VI2;VI3	Mc6;Mc10;Mc11M Mc15

The processing events for the FMC system for the jobs a sample description of these events at a given time is explained until 375 minutes, in table 6. The progression of events follow the same format as described.

Table 6: Depiction of the FMC System

Time (minutes)	Event Description
0	Job II2 arrived and waits in queue
45	Job I1 arrived and forms family;
	Job II2 loaded on Mc1;
	Job II2 loaded on Mc2;
90	Job III2 arrived and loaded on Mc3;
135	Job II3 arrived and waits in queue;
180	Job VI3 arrived and waits in queue;
225	Job II1 arrived and loaded on Mc2;
270	Job I2 arrived and loaded on Mc1;
290	Job II2 set-up and processing completed

	on Mc1, and move to Mc7 in Dept. 2;
	Job II3 leaves queue and loaded on Mc1;
315	Job III4 arrived and waits in queue;
360	Job III1 arrived and waits in queue;
375	Job I1 set-up and processing completed on Mc2, and release from the MS.

4. CONCLUSION

By applying the new concept of FMC for the case the average WT and ST were reduced by 41% and 59% respectively. The merit is of saving in production time after the first part from the family has been processed on a machine within a department along with the reducing the flexi formation in manufacturing various families of parts. It creates a workforce with a culture for continuous improvement and a highly motivated staff thereby increasing productivity and profitability. It is assumed that additional research is required in this area to get the benefits derived along the value chain, by way of reduction of waste and making organization lean.

REFERENCES

- Ahuja, I.P.S. and Khamba, J.S., (2008) 'Total productive maintenance – literature review and directions', International Journal of Quality and Reliability Management, Vol. 25, No. 7, pp. 709–756.
- Chowdary, B. V.; J. Slomp; and Suresh. N. C., (2005) "A New Concept of Virtual Manufacturing". West Indian Journal of Engineering, Vol. 28, No. 1, pp. 45-60.
- Datta, V., Samasivarao, K.V., Rambabu, K. and Deshmukh, S.G., (1992) 'Multi-attribute decision model using the AHP for justification of manufacturing systems', International Journal of Production Economics, Vol. 28, No. 2, pp.227–234.
- Herage, S.S., (1994) "Group Technology and Cellular Manufacturing". IEE Transactions on Systems, Man. And Cybernetics Vol. 24, No. 2, pp. 203-214.
- Inman, A.R., (1991) "Flexible manufacturing systems: issues and implementation", Industrial Management, Vol. 7, No. 2, pp. 7-11.
- Irani, S.A.; and Huang. H., (1998) "Layout Modules: A novel Extension of Hybrid Cellular Layouts". ASME International Mechanical Engineering Congress and Exposition.
- Singh, R.K., Garg, S.K. and Deshmukh, S.G., (2010) 'The competitiveness of SMEs in a globalized economy: observations from China and India', Management Research Review, Vol. 33, No. 1, pp. 54–65.
- Sundharam, V.N., Sharma, V. and Thangaiah, I.S.S., (2013) 'An integration of BSC and AHP for sustainable growth of manufacturing industries', International Journal of Business Excellence, Vol. 6, No. 1, pp.77–92.
- Suresh, N. C., (1991) "Partitioning Work Centers for Group Technology: Insights from an Analytical Model". Decision Sciences. Vol. 22, No. 4, pp. 772-791.
- Wemmerlov, U., and Johnson. D.J., (1997) Cellular manufacturing at 46 user plants: implementation experiences and performance improvements. International Journal of Production Research, Vol. 35, No. 1, pp. 29-49.