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Application of Cellular Manufacturing Concepts in an Automobile Workshop

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ABSTRACT

The paper proposes and outlines a method for introducing and implementing cellular manufacturing in an operating automobile workshop of a renowned transport company. This workshop handles the entire repair and maintenance works of the entire fleet of vehicles of the transport company. The prevailing problems in the workshop are excessive lead times and processing time for each vehicle. The quality of work being carried is also poor leading to frequent break downs of the vehicles. The main objective of this paper is to reduce the lead time and processing time required for each vehicle to be repaired. This can be done by application of few concepts of cellular manufacturing Viz. formation of cells and grouping the work to be completed. By doing so, better quality of work, reduction in lead and processing time and better delivery performance of the vehicle can be achieved.

Keywords – Cellular Manufacturing, Group Technology, Cells, Lead Time, Processing Time

I. INTRODUCTION

Cellular manufacturing system is the Group Technology (GT) based manufacturing systems in which parts similar in design and/or manufacturing are grouped together in one part family [1]. Group technology is the realization that many problems are similar, and that by grouping similar problems, a single solution can be found to a set of problems and thus, saving time and effort. Cellular Manufacturing, which relies on grouping of machines that can produce families of similar parts in the cell, increases production effectiveness through performing similar activities together., and standardizing similar tasks[2]. Cellular Manufacturing organizes the entire process for similar products into a group of team members, includes all the necessary equipment and is known as a "Cell". The cells are arranged to easily facilitate all operations. Parts are handed off from operation to operation eliminating setups and unnecessary costs between operations[3].Cellular manufacturing is based on a group of different processes located in close proximity to manufacture similar products[4]. A lead time is the latency between the initiation and execution of a process. Processing time is the time required to process the job[5].

This paper is the result of our study on the problems prevailing in an automobile workshop of a renowned and leading road transport company in Southern part of India. The transport company has a fleet of 500 vehicles. These fleets of vehicles are to be repaired and maintained in their well equipped automobile workshop. The workshop can facilitate up to 20 vehicles at a time for repair. Workshop has strength of 8 skilled mechanics and 30 supporting staff working at the repair yard. The workshop is always flooded by the vehicles to be repaired and the rate of repair was slow. So to overcome this problem, we have proposed a solution. Our solution to this problem is to apply the concepts of Cellular Manufacturing. Urban Wemmerlov and Johnson (1997) confirmed in their empirical study that 80% of the firms indicate that production control activities become simpler with cells[6]. In this automobile workshop, cells are formed with the vehicles and the mechanics. Here mechanic is analogous to machine and repair work to be done on the vehicle is analogous to job of a general production floor. Different repair works are generally carried out in a automobile workshop. On the basis of similarity in these repair works they are segregated into part families. Certain kind of repairs belonging to same part family on a vehicle and some group of mechanics form a cell.

II. PRESENT OPERATIONAL METHOD

When the problem is identified in a vehicle, the driver of the vehicle brings it to the notice of the person in charge of the vehicle maintenance section of the transport company. The person in turn opens a job card which consists of all the different repair and maintenance works that are to be carried out for that vehicle. The vehicle which is to be repaired, along with its job card enters the workshop. Now it is the duty of the Foreman to refer to the job card and facilitate a mechanic to complete the repair work as per the job card.

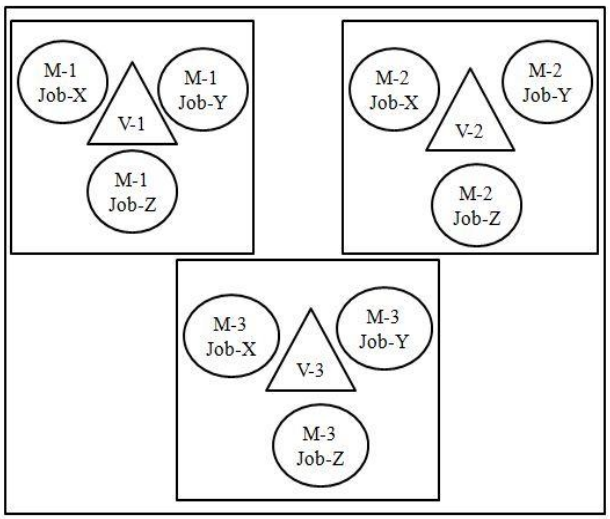

Fig. 1. Diagrammatic Representation of Present Operational Method

Per day each mechanic has to complete the job cards of 3 to 4 vehicles depending up on the load of work at workshop. The present operational method can be explained by using Fig.1. Here M-1, M-2 and M-3 represent three different mechanics. X, Y and Z represent three different repair works to be carried out. V-1, V-2 and V-3 represent three different vehicles. Each mechanic works on a vehicle to complete the repair works X, Y and Z. In this way he is responsible for the completion of the repair work of the vehicle which is allotted to him. We have understood there are lots of problems that have to be solved which occur by this method. The main drawbacks are

i. The resources (both men and machines) cannot be utilized to the optimal limit
ii. Supervision of the work being carried out would be difficult.
iii. It is rather individual's work where there is lot of effort to be made by the individual.
iv. Due to the overloading of work, the mechanic is easily affected to fatigue. This would affect the quality of the work being carried out. If the quality of the work is not up to the mark, it will lead to further problems viz., the vehicle will have to return to the workshop very soon due to the same problem and this cannot happen in a transport company because if a vehicle is not in proper working condition, huge loss of revenue have to be incurred.

III. How Cellular Manufacturing Concept can be Applied

In Cellular manufacturing, part families are formed based on the similarities of design and manufacturing attributes of the parts to be produced. Then a group of machines along with the part families to be produced are formed as Cells. As this kind of grouping and application of cellular manufacturing concepts cannot be done directly to an automobile workshop which is a job shop environment. So these concepts have to be tailor made to serve the purpose in this case.

For the application of cellular manufacturing concepts, we have considered the repair works to be done as parts to be produced and the mechanics as machines used to process those parts. Here a mechanic or a group of mechanics along with some concise category of repair works forms a virtual cell. So, this mechanic is responsible for the repair works which fall under his cell. This means that now his works is not constrained to completion of repair works of two or three vehicles assigned to him by the foreman but to complete the specific repair works that fall under his virtual cell of all the vehicles entering the workshop. So this means that a vehicle is now being repaired by many mechanics rather than one single mechanic being responsible for the whole repair work of a vehicle.

IV. Proposed Operational Method

In this method, when the vehicle enters the workshop, it is the responsibility of the mechanic or group of mechanics to go through the job card and identify the repair works that are assigned to them and start doing them. They have to keep doing this for all the vehicles entering the workshop. Here the vital responsibility of the Foreman is to divert and allot the repair of the vehicle to the other mechanic or group of mechanics who are comparatively free if the mechanic or group of mechanics who actually have to do that repair work are overloaded at that moment. In this way Foreman has to keep a watch of the work being carried out and allot to other mechanics so that the work is evenly distributed and it is completed on time.

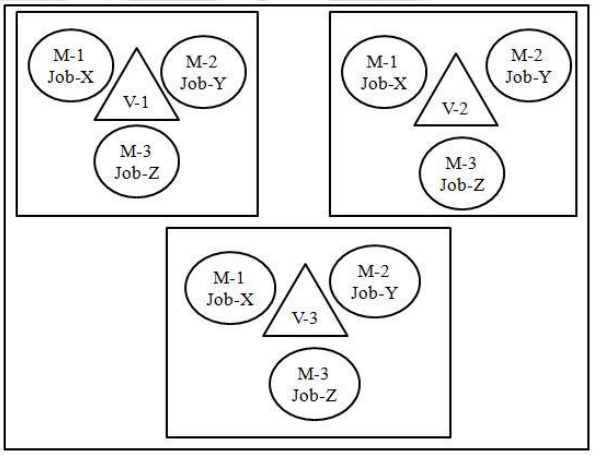

Fig. 2. Diagrammatic Representation of Proposed Operational Method

The present operational method can be explained by using Fig.2. Here M-1, M-2 and M-3 represent three different mechanics. X, Y and Z

represent three different repair works to be carried out. V-1, V-2 and V-3 represent three different vehicles. As illustrated, each vehicle is repaired by different mechanics or group of mechanics. Mechanic, M-1 is responsible only for repair work X. So he does the repair work X on all the vehicles in the workshop and he is completely responsible for the repair work X. Similarly, mechanic M-2 is responsible for repair work Y and mechanic M-3 is responsible for repair work Z. Thus each mechanic or group of mechanics is responsible for only some set of repair works assigned to them. By following this method, the following benefits can be drawn

i. Quality of the work can be improved as the mechanic has to do the same kind of work all the time.
ii. As he is repeating the same kind of repair work all the time, he can increase his pace to a great extent. This means the rate of work also increases.
iii. Supervision of the work is easier.
iv. Resources (both men and machines) can be utilized properly.
v. Mechanics will not be subjected to fatigue as the work being allotted to them is properly supervised by the Foreman.

V. JOB DATA AND RESULTS

To illustrate the difference between the present method and proposed method, the following job data is considered. In the Gantt charts below, jobs related to one vehicle is considered

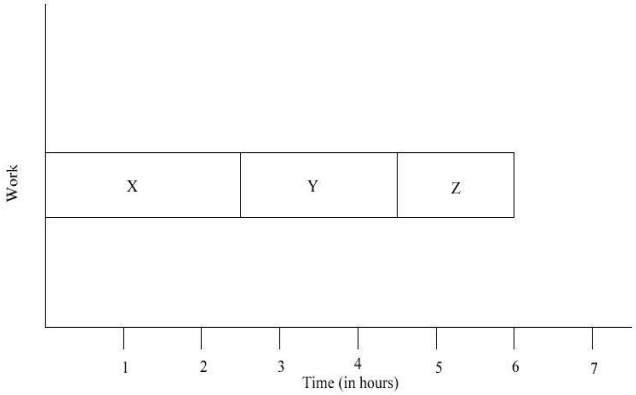

Fig. 3. Gantt chart representing the Present Operational Method

From the Gantt chart in the Fig.3, it can be understood that repair work X on the vehicle takes 2½ hours, repair work Y takes 2 hours and repair work Z takes 1½ hours. So the lead time for a vehicle being repaired is about six hours when only one mechanic works on it. When the same job is done by the proposed method the results are shown in the Fig.4

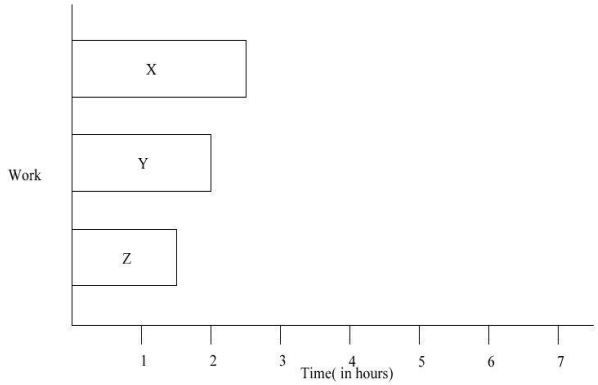

Fig.4. Gantt chart representing the Proposed Operational Method

When the job is done by the proposed operational method, the total lead time of this vehicle is 2½ hours. Here all the three jobs on the vehicle X, Y and Z are done simultaneously by mechanic-1, mechanic-2 and mechanic-3 respectively. So there is a huge reduction in total lead time of the vehicle.

Although one can argue that repair work related to same number of vehicles will be completed equally by both the methods, following are the points which strengthen the argument that Proposed Operational method is better over present Operational Method.

i. As the case considered here is of a logistics company, no vehicle can be halted for a long time. So, in present operational method, the excess lead time will affect the revenue that would be generated by that vehicle. As the lead time in proposed operational method is less, so it is the better method.
ii. Even the operational time per vehicle will be reduced by proposed operational method in a long run as the same mechanic will be doing the works again and again which would enhance his expertise to a great extent.
iii. Supervision of the work will be easier in proposed operational method as the foreman of the workshop will have a better idea about the work being carried out by each mechanic.
iv. Quality of the work will be enhanced and prevents the further problems in the vehicle leading to frequent break downs.
v. In the present operational method, negligence of one mechanic may lead to poor quality of repair work for that vehicle, but as the work is distributed among a team of mechanics in the proposed operational method, the complete repair work related to the vehicle

as per job card will be completed successfully.

Thus by means, the proposed operational method is better when compared to present operational method.

VI. CONCLUSION

The paper gives an insight into the prevailing problems with the present operational method and how the proposed operational method is better compared to present operational method. The proposed operational method reduces both lead time and operational time, improves quality of work and enhances the after repair performance of the vehicle by proper management of resources in the workshop

VII. ACKNOWLEDGEMENTS

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REFERENCES

[1] B.S.Nagendra Parashar and Dr.H.V. Somasundar, Cellular Manufacturing: A Taxonomic Review of Different Approaches, Industrial Engineering Journal (India), Vol. XXVII No.12, December 1998, pp 12-26

[2] Hyer.N.L and Wemmerlov.U, Group Technology and Productivity, Harward Business Review, 62(4), 1984, pp 140-149

[3] Kok and Alvin Lim Hui, Time Based Manufacturing.,Journal of Operations Management, 7 July 1999

[4] Liana María Alvarez López, Design and implementation of cellular manufacturing in a job shop environment, Massachusetts Institute of Technology, Cambridge,1997

[5] R Panneerselvam, Production and Operation Mangement(New Delhi: PHI Learning Pvt Ltd, 2010)

[6] B.S.Nagendra Parashar,Cellular manufacturing systems(New Delhi: PHI Learning Pvt Ltd, 2009)

[7] Mikell.P.Groover,Automation, production systems and computer integrated manufacturing(New Delhi: PHI learning Pvt Ltd,2011)