RESOURCE BALANCING FOR MANUFACTURING SYSTEM USING CELLULAR PRODUCTION

INTRODUCTION

The flow production system has been the most common method of production since the beginning of the last century. The ‘transfer line’ in which parts are moved from one station to the next upon completion. If the processing times at the stations are nearly deterministic, and the work is balanced across the stations, then the line is typically paced. In a paced transfer line, all the stations transfer their part to the next station at the same time. The elapsed time between two consecutive transfers is known as the cycle time (CT). A primary advantage of this type of line is easy to control and almost zero variability in its output. This line produces an output, almost every CT. When the processing times at the stations are variable, then the bottlenecks will occur. In order to reduce the bottlenecks, buffers are placed between the stations, and the line is then referred to as a production line. However, the presence of buffers gives rise to costs due to inventory and use of space. In cellular production system, components having certain similarity is grouped together and processed at one place. Family formation is important for processing. Therefore, buffer capacities should be carefully determined in order to minimize the overall production costs. Production rate need to be considered to decided cycle time and line balancing. Therefore line balancing plays important role for avoiding bottlenecking and optimum utilization of resources, particularly in cellular production system. The cellular-line production system is composed of multiple flow shops called ‘cellular lines’ in which several types of facilities intended to perform similar operation sequences are grouped and a number of operation sequences are assigned so as to balance the workloads among facilities constituting each cellular line by considering the planned product mix and its variations. In general a cell consists of several types of machines from which a variety of parts are produced and the routings of which differ from one another. On the other hand, a flow shop is usually considered to involve a manufacturing process in which different types of products having an identical routing are produced.

PRESENT THEORIES AND PRACTICES-

Following is a list of researchers who has worked in area of resources balancing for manufacturing of cylinder liners using cellular production system. M. Kuroda, Tomita has presented [1] a cellular-line production system consists of multiple flow shops which are individual sets composed of functionally different facilities. The cellular-line production system is carefully designed and controlled so as to group facilities that perform similar operations and balance the workload among facilities considering the planned product mix and its variations. Finally, the practical significance of quantitative analysis and evaluation in the stochastic design problem is discussed. Gerald R. Aase, John R. Olson, Marc J. Schniederjans have presented [2] The decision to move straight-line assembly systems to U-shaped assembly lines systems constitutes a major layout design change and investment for assembly operations. The purpose of this research is to empirically confirm that U-shaped assembly lines improve labor productivity. Results indicate that labor productivity will improve significantly under certain conditions when switching from a straight-line layout to a U-shaped layout. Steve Ah Kioon, Akif Asil Bulgak, Tolga Bektas, have presented [3] and analyzes a comprehensive model for the design of cellular manufacturing systems (CMS).

Iraj Mahdavi, Baha Mahadevan have presented [7] by developing an algorithm that not only identifies the cells formation problem but also the sequence of machines in the cells in a simultaneous fashion. The numerical computations of the algorithm with the available problems in the literature indicate the usefulness of the algorithm. Further, it also points to the untapped potential of such an approach to solve CMS design and layout problem using sequence data. Satya S. Chakravorty, Douglas N. Hales [8] using an implementation experience, developed a model for implementing cell design consisting of strategic, structural, and operational decisions. While their model was applicable in explaining the implementation experience, it failed to include an analysis of the existing system, operator assignment to cells, and management involvement in the implementation process.

Viviana I. Cesáñ, Harold J. Steudel have presented [9] to study labor flexibility in cellular manufacturing systems characterized by intra-cell operator’s
mobility. The special focus of the investigation is to explore the impact that using different labor allocation strategies have on system performance. This internal aspect of labor flexibility is referred to as labor assignment flexibility.

Cristo bal Miralles, Jose Pedro Garcý a-Sabater, Carlos Andre, Manuel Cardos have presented [10] a reengineering process is done starting from individual workplaces where only certain workers were capable of assembling the entire product, and finishing with an assembly line implementation. It is revealed how the traditional division of work in single tasks, typical in assembly lines, becomes a perfect tool for making certain worker disabilities invisible, providing new jobs for disabled people; always taking into account certain special constraints that are analyzed.

PROPOSED WORK-
In this dissertation work it is proposed to carry out resource balancing for manufacturing of cylinder liners using cellular production system. The proposed work is planned in the following phases.

Phase I- Product and process information collection
a) Product selection-
Cooper Corporation Pvt. Ltd manufactures verity of cylinder liners combined in different cells. These cells are on the basis of similarity of process on the products. Cooper K-11 plant having following cells:
1- Cooper Group Cell (CG)
2- Cummins Line (CIL)
3- DLW Cell (DLW)

It is not feasible and required to complete all product line balancing due to similarity of operations and physical properties of parts. So it is decided to take high volume product for dissertation.
For products selection the following guidelines are given below:
1- High sells volume.
2- All operations will cover.
3- Easily available for observations.

b) Process Mapping-
1. Process flow chart- Gives an overall view of the situation, say a process. It helps visualizing various possibilities of alternation or improvement.
   *Sets out sequence of flow (of a procedure or product)*
   *Records all events in sequence using process chart symbol.*
   *Marks distances traveled & time taken for completing an activity &*
   *Mentions other important points.*

2. Work cell designs- The work station design affects the production rates, efficiency & the accuracy with which an operation can be perform. Work station not only needs space for the worker & the machine, There are plenty of other its which also need accommodation.

Phase II- Cycle time analysis.
Study of cycle time of each operation.
*Time study using stop watch.*
*Use of MOST® technique (Maynard’s Operation Sequence Techniques).*
1. Study of machine cutting time.
   • Formula method.
   • Shop cutting Time.
   • CNC Machine screen.

2. Analysis-
   • Define line capacity as per bottleneck operation.
   • Reduction in Non Value Adding Activity (NVA).

3. Layout- All the facilities like equipments, raw materials, machinery, tools, fixtures, workers, etc. are given a proper place.

Phase III- Line balancing.
In this phase all data collected above will be analyze to balance the resources required for production. This will be done using various charts like Gantt chart, process flow chart etc., flow diagrams and layout models.

EXPECTED RESULTS WOULD BE:
1. Improvement in productivity of man and machine.
2. Smooth planning.
3. Reduction in setup time.
4. Improved material flow.
5. Reduction in process inventory.
6. On time delivery.

Conclusion will be drawn based on analysis and suggestion will be given. Depending on resource available and feasibility, company may implement some of the suggestion which would confirm the improvement in productivity.

REFERENCES:-
2) Gerald R.Aase, John R.Olson, Marc J.Schniederjans, “U-shaped assembly line layouts and their impact on labor productivity: An experimental study” Production, Manufacturing and Logistics
3) Steve Ah kioon, Akif Asil Bulgak, Tolga Bektas, “Integrated cellular manufacturing systems design with production planning and dynamic system reconfiguration” Production, Manufacturing and Logistics