International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.01, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Analysis for Simulation of FMS Tool Allocation Procedures

Ram PratapYadav[1], Sunil Kumar[2], Surendra chaudhary[3]

1,2 Assistant Professor, 3 Student Mechanical engineering Department,

Dr Apj Abdul Kalam Technical University, Lucknow,Bit Gida Gorakhpur, Up, (India)

ABSTRACT

Allocating the mandatory tools to meet the cutting wants of component parts and products is an important element of FMS production planning. This research describes three heuristics that can be used to allocate tools to an FMS. The three heuristic procedures are then evaluated, through a simulation study, for an FMS that processes a low part type mix and a high part type mix. Results indicate that a tool allocation approach that aims at full utilization of the tool magazine capacity produces better FMS performance than an approach that seeks to minimize the frequency of tool changes. An approach that aims at combining both minimal tool changes at the machines and greater tool magazine utilization will be even more useful, especially if the cost of tool changes is high relative to capacity utilization.

Keywords— Flexible Manufacturing Systems, tools Allocation, Tool Magazine Capacity, Tool Changes, recreation

I.INTRODUCTION

Introduction a flexible manufacturing system (FMS) is a group of numerically controlled machine tools with an automated material handling system and a central supervisory computer system. FMS machines come equipped with tool magazines that allow for quick and mechanical changeovers of sets of tools. Several configurations exist for the tool magazines at the machines, and each magazine has a tool slot capacity, typically 40 or 65, though some with 70-100 slots are also available The advent of FMS has very much increased the productive possible of manufacturers; however, managing the increased number of tools required for these systems and their application has hindered increases in productivity) Gray, note that as flexible manufacturing systems have become more common, manufacturers and machine tool suppliers have recognized that a lack of attention to tool management has resulted in poor performance of many FMS. Further, Carrie and note that neglecting tool management issue.

FMS have created operation problems, and many FMS users now recognize that inadequate tool flow control is a major obstacle in achieving expected performance. Suri and Whitney 5 emphasize that meeting the production schedules for an FMS depends as much on tool management as it does on the management of other FMS resources. All of the above point out the need for more research on tool management for FMS. An element of tool management for FMS is the allocation of cutting tools to the machines to meet the processing needs of the part types scheduled for production. This problem, also referred to as the loading problem, has been identified as one of the five production planning problems for an FMS .Proper tool allocation is important because of the large number of tools that might have to be allocated to the tool magazine and the fact that only a limited number of tools can fit on the tool magazines. The limited tool magazine capacity implies frequent tool changes (for increased flexibility) that must be weighed against productivity gains. Tool magazine capacity constrains the number of tools that can be mounted on the machine and hence constrains the capability of the system by limiting the number of parts that can be processed simultaneously. The publication capacity also constrains the flexibility of the system by limiting the number of different types of tools that can be mounted because of the magazine's weight requirement and integer of tool slot positions. Further, the mechanism of tool exchange and deliveries can affect the productivity of the FMS. The question to be addressed then is: Given the limited tool magazine capacity at the machines, what is the impact of using different tool allocation procedures on FMS performance.

II. PROBLEM IDENTIFICATION

1. The impulse for this study comes from a machine tool manufacturer in that operates an FMS. The FMS has four equal machines, which means that any part type can be processed on any machine if supplied with the needed cutting tools. During any production period, a part visits only one machine, where all its operations are performed. This is due to the versatility of the machines, and there are indications that these types of FMSs are becoming more common. Based on an empirical investigation of 156 flexible manufacturing systems worldwide, Jaikumar and Van Wassenhove 17 note that "individual machines in FMSs are becoming so versatile that most part processes can be accomplished by just one or two machine types, resulting in systems comprising identical parallel machines." The following quote from Flanders and Davis 8 in their description of Caterpillar's FMS indicates that such FMSs are typical: "...the milling machines were completely interchangeable (every machine could process every fixturing step for every iron part)...." Each order processed on the FMS consists of one unit of a particular part type; that is, the order size for any part orders is always one. This is due to the nature of the part types processed on the machine. This does not mean that both orders go through only one operation. In fact, an operation is not defined by a visit to a particular machine. somewhat, an operation, in this study, is defined by the type of tool required for a particular cutting activity that is going to occur at a machine on a part type note that in an FMS the assignment of cutting tools to a machine determines to a large extent the variety of operations that can be performed at the machine.

2. Tools to the machines. 8-7 the selection of a subset of orders leads to the processing of the orders in batches. To not delay orders unnecessarily, and to achieve the manufacturing objectives of the FMS, it is important that the time required for tool changes between subsets of orders be minimized

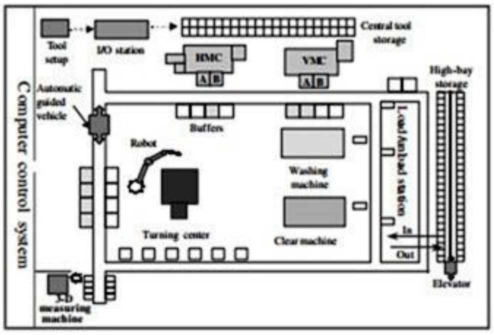

Fig-1 Flexible manufacturing system layout

. Tool changes affect the efficiency of the FMS. The more tool changes there are, the greater the chance that the FMS will become idle waiting for tools to be changed and for new tools that need to be loaded. In other words, if long times are spent between batches of parts to change tools, then unusual delays can be imposed on the FMS. It must be pointed out that the scenario described here is not unique to the FMS that formed the motivation for this study. Flanders and Davis 8 clearly document the difficulties faced by a Midwest manufacturer in its FMS scheduling because of tooling and allied constraints.

.

III. TOOL ALLOCATION PROCEDURES

The complexity of solving the part type selection and tool allocation problems simultaneously for a reasonably realistic FMS has been recognized by several researchers. Invariably, heuristic procedures have been proposed. A goal of this study is to discuss some heuristic procedures that could be used to address this problem and to evaluate them through simulation experiments. A simulation methodology is generally very appropriate for comparing different operating systems, and in this study the desire is to compare the influence of different allocation policies on the performance of an FMS. Specifically, the focus is on comparing tool allocation procedures that are aimed at reducing the frequency of tool changes with those aimed at better utilization of tool magazine capacity. Because this is a comparative study of the heuristics in identical FMS environments, how due dates are set for the part orders and due date tightness will not be a factor in this study. Due date information will, however, be provided to enable readers to understand the priority used in determining which part orders should be input next during the simulation. The three heuristic approaches for tool allocation for FMS production planning will now be discussed

IV. APPARATUS AND PART BATCHING

The first heuristic approach for part type selection and tool allocation to be discussed is referred to as tool and part batching. In this approach, part types for a specified planning period (may be a week, a day, or a shift) are partitioned into separate batches to be machined individually) s Assuming there is enough machine capacity to process all the parts during a planning period, the need to divide the parts into batches arises mainly because of limited tool magazine capacity at the machines. If the parts to be machined require more tools than space on the tool magazine allows for, then the parts have to be grouped into batches, s the main norm of interest in this case is to minimize the number of batches required to process all the parts, thereby minimizing the idle time associated with batch changeovers. Some heuristic procedures have been developed for assigning part types to a batch. One such procedure is based on first selecting part types that require the smallest number of tools. This will permit a larger number of parts to be assigned to a batch and, in turn, will reduce the total number of batches required to meet production requirements. As argued by Hwang, 21 this objective may translate into obtaining higher productive capacities of the FMS in situations where changeover times between batches are fairly uniform. Another procedure for assigning parts to batches may be based on first selecting part types that require the largest number of tool slots. The rationale for such an approach is as follows. If part i requires Ti slots and part j requires Tj slots, and if Ti > Tj, then selecting i before j will mean that fewer tool changes may be required. Fewer tool changes can mean fewer system delays imposed by tool changing. A procedure such as this can be especially beneficial for situations where tool changes are permitted within batches. Tool allocation is incorporated into the batching decision as follows. For each part type in the batch, a copy of each tool type needed for that part type on a particular machine is allocated to the machine's magazine. For example, if two part types use the same tool type, two copies of the tool will be allocated, one for each part type. In addition, if a particular part type requires multiple copies of the same tool, then depending on the tool life and processing time of the part, the appropriate number of copies of that tool is allocated to the tool magazine.

5. Tool allocation: As indicated earlier, a limitation of the tool allocation approach described above is the failure to recognize that sometimes several .part orders might have some common tool requirements. Failure to recognize tool commonality can lead to unnecessary tool duplication and further underutilization of tool magazine capacity. A suggested approach for overcoming these limitations is the tool sharing approach to be discussed next. Consider the following numerical example. Table 1 shows the tool requirements for a 10-part order. It is assumed that only one copy of each tool type is needed for each part type requiring that tool. Also assume each tool occupies only one slot. There are 20 tool slots at the tool magazine. Applying the tool batching procedure without tool commonality, and selecting part orders with the smallest tool slot requirements first, part orders 9, 7, 1, 2, 10, and 4 will be selected into a batch for processing; however, when commonality is recognized, the selected part orders will be 9, 7, 1,2, 10, 4, and 5, as illustrated in Table 1. This simplified example points out that with commonality more orders can be selected into a batch.

Data for illustrate Example:

Part order	Tool requirement
1	9,12,14
2	6,12,15,16
3	5,6,11,12,17,20
4	1,6,7,19
5	5,8,9,13,18
6	1,3,7,13,21

IJARSE
ISSN: 2319-8354

7	2,6,13,20
8	2,8,13,16,21
9	10,12
10	2,4,14,18

Table.1

As well, the further tool magazine capacity available can be used if a rush order arrives requiring three tool slots or if a changing situation occurs on another machine that requires the movement of orders to this machine. Thus the potential flexibility of the machine is enhanced. In fact, additional benefits can be obtained if the initial batch selection is based on selecting part orders that share the largest number of tools 21.

6. Flexible Tooling: These flexible approaches are meant at minimizing the bottleneck effects of the tool periodical capacity at each machine. A typical flexible approach might be implemented as follows. When part types are selected for production, their required tools are also allocated to the machines, and the tool slot consumption at each machine is updated just as in the tool-part hatching procedure. Following the completion of the part types requiring those tools, any tools not fully consumed are removed from the tool magazine while another part is being machined. This frees up space on the tool magazine to permit the selection of another part type to be processed and the allocation of the needed tools to the machine.

The removal of tools following completions of the part types requiring that tool means that bottom necking effect of tool capacity reduced. This requires frequent tool changes and another constraint requires tool system of mechanism tool changes.

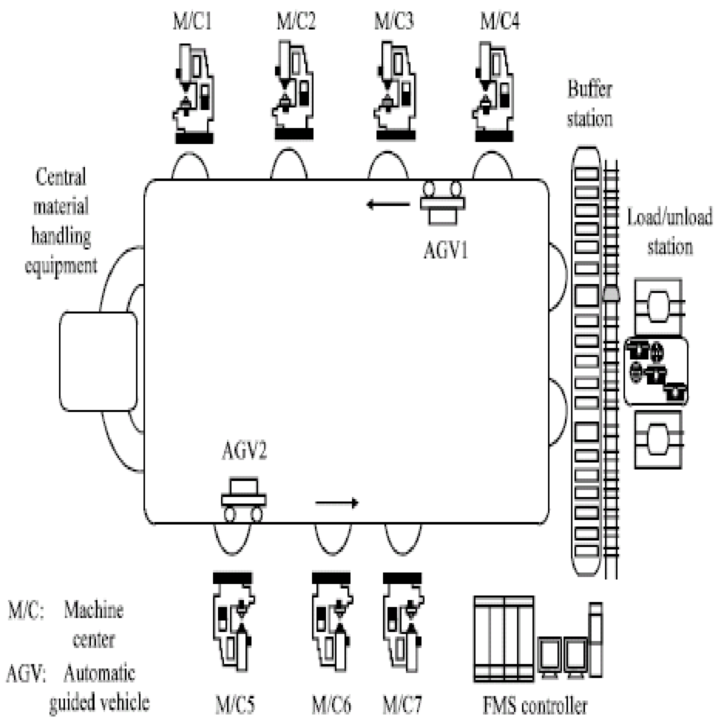

Fig-2 Flexible manufacturing system

VII.SUMMARY

This paper proposes the research to be discussed here is based on a two-factor factorial design. The factors are the tool allocation procedures and the number of part types processed on the FMS. The three heuristic actions described above were tested for an FMS processing 10 and 21 part types. The FMS consists of five the same machines. These machines are capable of processing any part types if allocated with the needed tools. The tool magazine at each machine has a tool slot capacity of 30. Automated guided vehicles (AGVs) are used to move parts to and from the machines. In addition to the AGVs, there is one robot that loads and unloads parts from the machines.

VIII.RESULTS AND DISCUSSION

The principle behind the flexible approach is to remove the tools from the tool magazine as soon as the processing of the part requiring those tools is completed. Because the parts have relatively short processing times, the implication is that space can frequently be freed on the tool magazine. Thus, the flexible approach results in better tool magazine capacity utilization in a given production period. On the other hand, with the tool batching approach, although the tools are in use for a short time, they are kept at the magazine for the entire production window. This means that parts generally have to wait longer because of the restriction imposed by the tool magazine capacity. Thus, the flow times and tardiness of part orders are affected by the lack of proper tools at the machines. The tool sharing approach does better on all performance measures than the tool batching approach, which confirms the expectation that scheduling part orders to take advantage of tool commonality can lead to improvements in FMS performance.

REFERENCES

[1.] A.E. Gray, A. Seidmann, and K.E. Stecke, "A Synthesis of Decision Models for Tool Management for Tool Management in Automated Manufacturing," Management Science (v39,2033), pp549-567.

[2.] C. Zhou and R.A. Wysk, "Tool Management for Computer Integrated Manufacturing," Proc. of 1999 Intl. Ind. Engg. Conf. and Mfg. and Productivity Symposium (Toronto: 1989), pp603-607.

[3.] A.E. Gray, A. Seidmann, and K.E. Stecke, "Tool Management in Automated Manufacturing: A Tutorial," Proc. of 3rd ORSA/TIMS Conf. on Flexible Mfg. Systems: Operations Research Models and Applications, K.E. Steeke and R. Suri, eds. (Amsterdam: Elsevier Science Publishers, 2006), pp93-98.

[4.] A.S. Carrie and D.T. Perera, "Work Scheduling in FMS under Tool Availability Constraints," International Journal of Production Research (v24, 1986), pp1299-1308.

[5.] R. Suri and C.K. Whitney, "Decision Support Requirements in Flexible Manufacturing," Journal of Manufacturing Systems (v3, n 1, 1984), pp61-