ISSN PRINT 2319 1775 Online 2320 7876
Research paper **Volume 11, Iss 9 , 2022**

Resource Allocation and Task Scheduling in cloud computing Environment through Heuristic Algorithm

Nageswara Rao Medikondu

Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India-522302
E mail: medikondu1979@gmail.com

DOI : 10.48047/IJFANS/V11/ISS9/364

Abstract. Significant research has been carried out in the field of flexible manufacturing systems (FMS) planning, primarily focusing on established academic layout strategies. The selection process predominantly draws upon fundamental principles found in the intelligent system JSSE (workshop scheduling environment). However, there is limited existing literature on its specific application within an FMS context. This article seeks to examine the effectiveness of machine and AGV (Automated Guided Vehicle) scheduling models in optimizing the number of operations within an FMS, utilizing a Heuristic Algorithm (HA) approach. The methodology is assessed across a range of experimental conditions using an FMS simulation model that encompasses 40 different scenarios**.**

Keywords: Cloud computing, Task scheduling, Artificial intelligence and Makespan

1. Introduction

A universally accepted definition for Flexible Manufacturing Systems (FMS) does not exist. Groover (1987) characterizes FMSs as assembly systems comprising a collection of numerically controlled (NC) machines connected by Automated Guided Vehicles (AGVs) and all operating under computer control. FMSs are designed to handle a wide range of parts with low to medium demand volumes. Depending on the number of NC machines and their interactions with materials handling systems, various categories of FMS can be identified, as discussed in Dupont (1982), Browne et al. (1984), and Kusiak (1985). Throughout the life cycle of an FMS, it faces a variety of challenges, including operational, strategic, and tactical concerns, for which solutions have been proposed by Buzacott and Yao (1985), Suri (1985), and Kusiak (1986a).An FMS can be conceptualized as a computerized workshop, but its integrated nature necessitates additional considerations in scheduling, such as tools, fixtures, Automated Guided Vehicles (AGVs), pallets, and more. Due to the flexibility of machines and materials handling systems, planning decisions involve numerous alternative task sequences and material handling routes. The dynamic nature of an FMS exacerbates these issues. This paper focuses on simulation-based experimental investigations of the FMS scheduling problem, primarily considered a subset of the dynamic job shop scheduling problem, with a focus on scheduling rules specific to FMS. Mean flow time is employed as the primary performance metric. Decision-making rules are widely applied today, with applications ranging from online scheduling of machines and material handling devices under real operating conditions to offline scheduling algorithms that integrate various components. Panwalkar and Iskander (1977) have cataloged over 100 rules, distinguishing between scheduling rules, dispatching rules, and priority rules. Additional literature on these rules can be found in works by Conway et al. (1967), Blackstone et al. (1982), and Kiran and Smith (1984a, b). Scheduling rules are used to prioritize machines and AGVs based on completion times, including travel times.

2. Heuristic Algorithm Design

The input data for this study is derived from the research conducted by Bilge and Ulusoy in 1995. This dataset includes information on a series of machines, their respective processing

IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
Research paper **Volume 11, Iss 9 , 2022**

times, and a matrix representing the travel times between these machines. The configuration, as depicted in Figure 1, involves four CNC machines that are equipped with pallet changers and a set of tools.

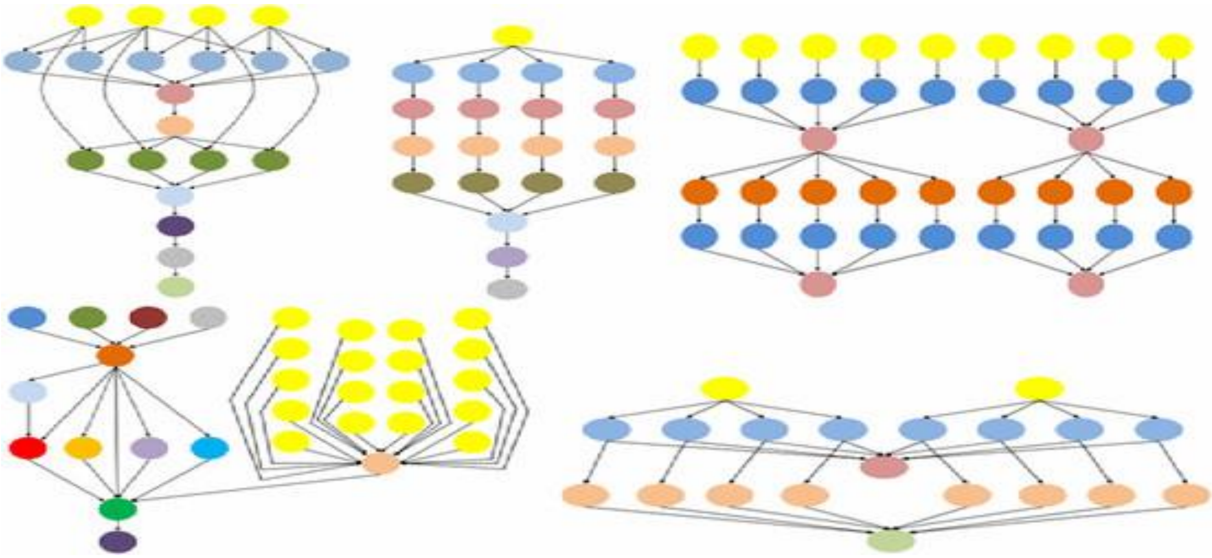

Figure 1: Basic structure of Heuristic Algorithm

2.1. Methodology

Layout 4 and Job set 5 play a crucial role in the execution of the Heuristic Algorithm (HA) as an example with half the movement time and double the process time. The HA is explained in the following steps for Job Set 5:

Step 1: Consider Job Set 5. Step 2: Initially, place item '1' at the beginning of the primary line, arranged as follows: 1 – 2 - 3 - 4 - 5 - 6 - 7 – 8 – 9 – 10 - 11 - 12 - 13. Step 3: Determine the maximum completion time, representing the possible completion time (makespan) for the given job set.

Table 1 displays the specific constraints for all the activities involved in the HA:

Table 1. Completion Time Using HA

Order	Machine	Operation	TT	JRT	Job Reach Time	Process Time	Makespan
1	1	1	0	4	4	6	10
2	2	2	10	14	14	12	26
3	4	1	26	32	32	9	41
4	1	2	34	38	38	18	56
5	3	2	56	62	62	6	68
6	2	1	68	74	74	15	89
7	3	2	74	84	84	9	93
8	4	1	93	99	99	3	102
9	1	2	102	116	116	12	128
10	4	1	113	127	127	6	133
11	2	2	133	145	145	15	160
12	3	1	141	151	151	3	154
13	1	1	154	162	162	9	171

Table 1 illustrates the activity scheduling through the HA algorithm for Job Set 5, resulting in a total completion time (makespan) of 171.

Total completion time = 1231

Average flow time = Total completion time / Total number of operations = 1231 / 13 = 94.69Average number of operations in the FMS = Total Flow Time / Makespan = 1231 / 171 = 8

IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

ISSN PRINT 2319 1775 Online 2320 7876

Research paper **Volume 11, Iss 9 , 2022**

3. Results and Discussion

The results must be presented in a clear and concise manner, focusing on the most significant or primary findings of the research. In the discussion section, it is essential to delve into the importance of the research outcomes. The workshop scenario described for Flexible Manufacturing Systems (FMS) involves the utilization of Job Set Model 5 and Layout 4

Problem. No	Lay out	No of Operations in Greedy System
EX1	10	8
EX 2	10	8
EX 3	10	8
EX 4	10	10
EX 5	10	8
EX 6	10	10
EX 7	10	10
EX 8	10	11
EX 9	10	9
EX 10	10	12
EX1	20	8
EX 2	20	8
EX 3	20	8
EX 4	20	10
EX 5	20	9
EX 6	20	10
EX 7	20	9
EX 8	20	11
EX 9	20	9
EX 10	20	12
EX1	30	8
EX 2	30	8
EX 3	30	8
EX 4	30	10
EX 5	30	8
EX 6	30	10
EX 7	30	10
EX 8	30	11
EX 9	30	9
EX 10	30	12
EX1	40	8
EX 2	40	8
EX 3	40	8
EX 4	40	10
EX 5	40	8
EX 6	40	10
EX 7	40	10
EX 8	40	11
EX 9	40	9
EX 10	40	12

In the context of optimizing the arrangement of Automated Guided Vehicles (AGVs) and machines, priority rules are employed to manage three distinct processing time values. These rules are outlined in two separate tables. An analysis of the makespan and mean flow time across different job sets and layouts is visually represented in Figures 2.

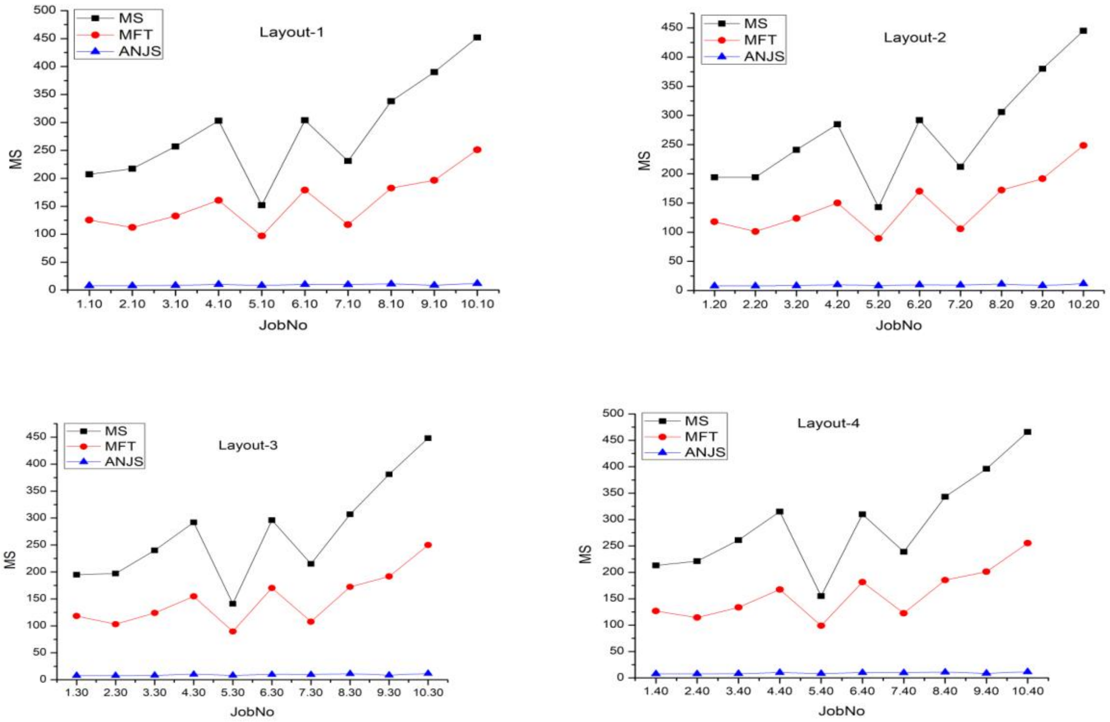

Figure 2: No of jobs in the smart manufacturing system

4. Conclusions.

Challenges in FMS are tackled through the application of a Heuristic Algorithm (HA) with the goal of minimizing the number of operations within a system that comprises four layouts, each featuring four identical machines and two material handling systems. This comprehensive investigation covers not only machine scheduling but also the scheduling of Automated Guided Vehicles (AGVs). The findings are as follows: The study reveals that as the number of jobs within the system increases, there is a corresponding uptick in machine and AGV utilization. An important observation is that the distribution of completion times within the FMS is notably influenced by the quantity of operations in the system. When both AGV and machine workloads increase due to scheduling rules, the number of operations within the system becomes a critical factor, directly impacting the overall utilization of the FMS. Consequently, this leads to an increase in job tardiness. The performance of the HA rule was consistently superior when tested in a system involving 40 operations, surpassing other approaches, including AGV-based rules. Future research endeavours should concentrate on the development and integration of new rules within the FMS environment, facilitating ongoing testing with diverse objective functions

Acknowledgements

DST-SERB, GOI, (Sanction No: SB/EMEQ-501/2014)

References

1. E.S. Acree and M.L. Smith, "Simulation of flexible manufacturing system applications of computer operating system techniques," in the 18th Annual Simulation Symposium, pp. 205-216, IEEE Computer Society Press, Tampa, Florida, 1985.

ISSN PRINT 2319 1775 Online 2320 7876
Research paper **Volume 11, Iss 9 , 2022**

2. J.A. Buzacott and D.D. Yao, "Flexible manufacturing systems: a review of analytical models," Management Science, vol. 32, no. 7, pp. 890-905, 1985.
3. J.H. Blackstone et al., "A state-of-the-art survey of dispatching rules for manufacturing job shop operations," International Journal of Production Research, vol. 20, no. 1, pp. 27-45, 1982.
4. J. Browne et al., "Classification of flexible manufacturing systems," The FMS MaHAzine, April, pp. 114-117, 1984.
5. H.C. Co, T. Jaw, and S.K. Chen, "Sequencing in flexible manufacturing systems and other short queue-length systems," Journal of Manufacturing Systems, vol. 7, no. 1, pp. 1-7, 1988.
6. R.H. Choi and E.M. Malstrom, "Evaluation of traditional work scheduling rules in a flexible manufacturing system with a physical simulator," Journal of Manufacturing Systems, vol. 7, no. 1, pp. 33-45, 1988.
7. R.W. Conway, "Some tactical problems in digital simulation," Management Science, vol. 10, no. 1, pp. 47-61, 1963.
8. R.W. Conway et al., "Theory of Scheduling," Addison-Wesley, Reading, Mass., 1967.
9. G.C. Dupon, "A survey of flexible manufacturing systems," Journal of Manufacturing Systems, vol. 1, no. 1, pp. 1-16, 1982.
10. P.J. Egbelu, "Pull versus push strategy for automated guided vehicle load movement in a batch manufacturing system," Journal of Manufacturing Systems, vol. 6, no. 3, pp. 209-221, 1987.
11. P.J. Egbelu and J.M.A. Tanchoco, "Characterization of automated guided vehicle dispatching rules," International Journal of Production Research, vol. 22, no. 3, pp. 359-374, 1984.
12. P.A. Kumar et al., "Scheduling of machines and automated guided vehicles in FMS using scatter search algorithm," International Journal of Mechanical Engineering and Technology, vol. 8(5), pp. 471-481, 2017.
13. K.V. Subbaiah, M. Nageswara Rao, K. Narayana Rao, "Scheduling of AGVs and Machines in FMS with Make Span Criteria Using Sheep Flock Heredity Algorithm," International Journal of Physical Sciences, vol. 4(2), pp. 139-148, 2009.
14. M. Nageswara Rao, S. Vara Kumari, P. Manohar, B. Madesh, P. Naveen Krishna, R. Suraj Krishna, "Simultaneous Scheduling of Machines and AGVs in FMS Through Ant Colony Optimization Algorithm," International Journal of Engineering and Advanced Technology, vol. 9(3), pp. 1392-1397, 2020.
15. M. Nageswara Rao et al., "Simultaneous Scheduling of Machines and AGVs in FMS through Simulated Annealing Algorithm," International Journal of Innovative Technology and Exploring Engineering, vol. 9(4), pp. 2235-2240, 2020.
16. M. Nageswara Rao, et al., "Application of BPSO in flexible manufacturing system scheduling," International Journal of Mechanical Engineering and Technology, vol. 8(5), pp. 186-195, 2017.