International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 5
May 2018

Reduction of Production Cost by Flexible Manufacturing Techniques

Rahul*, Shekhar Kaushik*, Sanjeev Kumar**,
*M.Tech student, Mechanical Engg. Deptt. YMCAUST Faridabad
**Deptt. Of Mech.Engg. YMCAUST Faridabad

ABSTRACT

*The present paper discusses the scheduling of flexible manufacturing systems (FMSs) which is one of the most attractive areas for researchers andpractitioners.**unlimited progress has been made in the layout design with integrated scheduling**.In this paper we focused on production routing and scheduling of jobs within a FMS. The major objective is to develop a techniques that minimizes the manufacturing make span time, job completion time, which is optimises the completion time of all jobs and minimise the idle time. The proposed techniques can also be extended to problems of minimizing the maximum tardiness and minimizing the absolute deviation of meeting due dates, among others. With increased competition in the global market, manufacturers are faced many problem such as reduced profit margins and the increase the need of productivity. Scheduling is one way to meet this need to implement a flexible manufacturing system (FMS). Scheduling is an important aspect in the overall control of the FMS.*

Key Words: Scheduling, Technology, sequencing rules, FMS.

1. INTRODUCTION

Manufacturers adapt flexibility to changes the production environment as well as in the market in order to achieve more and maintain competitiveness in the market. Effectively designing and operating an automated manufacturing system (AMS) is important for manufacturers to reach this goal. An AMS conglomerates of machine tools, robots, buffers, fixtures, automated guided vehicles (AGVs), and other material-handling devices. Different types of parts enter the system at discrete points of time and are processed concurrently; these parts cause a high degree of resource sharing [1]. It is a difficult to predict the behaviour of manufacturing systems without modelling, analysing, and control techniques. Therefore, several techniques have been developed to describe the behaviour of manufacturing systems.

Manufacturing Industries are facing vigorous threats by inflation in market needs, corporate lifestyle and globalization. Hence, in current situation, Industries which are responding rapidly to market fluctuations with more competitiveness will have great capabilities in producing products with high quality and low cost. In the view of manufacturers, production cost is not at all a significant factor which affects them. But some of the factors which are important to the manufacturer are flexibility, quality, efficient delivery and customer satisfaction. Hence, with the help of automation, robotics and other innovative concepts such as just-in-time (JIT), Production planning and control (PPC), enterprise resource planning (ERP) etc., manufacturers are very keen to attain these factors. Flexible manufacturing is a theory which permits production systems to perform under high modified production needs. The problems such as minimum inventories and market-response time to bump into customer needs, response to adjust as per the deviations in the market.

A FMS is a computer-controlled integrated manufacturing system with multi-functional computer numerically controlled (CNC) machines and a material handling system. The system is designed such that the efficiency of mass production is achieved with the flexibility of low-volume production is maintained. One type of FMS is the flexible manufacturing cell (FMC), which consists of a group of CNC machines and one material handling device (e.g.,conveyors,cranes,Industrial Trucks, robot, automated guided vehicle, etc.).In order to cross market by reducing the cost of products and services will be compulsory to various companies to shift over to flexible manufacturing systems. FMSs as a possible way to decrease the said issues while making reliable and good quality of the product and cost effective the product.[2]

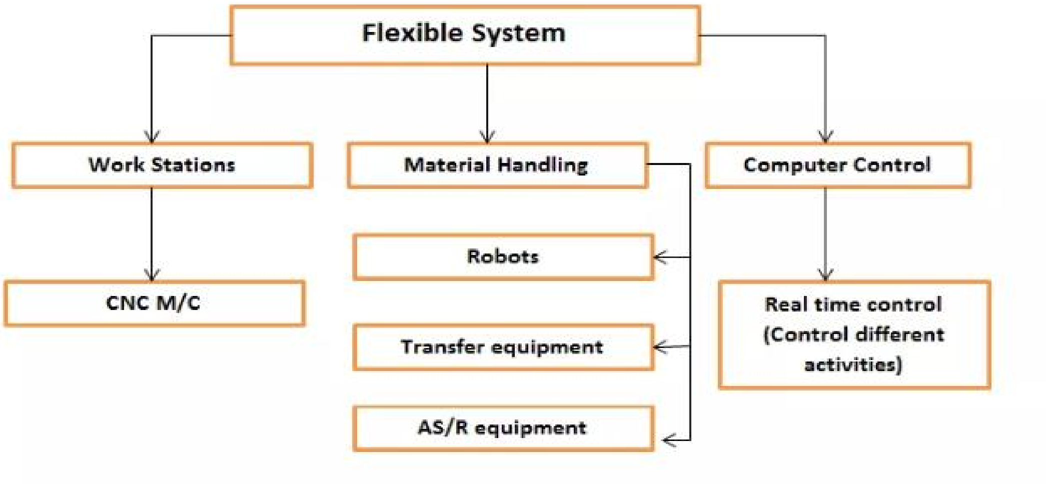

Fig 1.1: Flexible manufacturing system

Flexible manufacturing system has advanced as a tool to bridge the gap that use high machining process and CNC Machines is use with mid volume production of a different part types with minimum setup time, less working in-process time, less product inventory, minimum manufacturing lead time, high machine utilization and high quality . FMS is especially attractive for medium and low-capacity industries such as automotive, aeronautical, steel and electronics. Flexible manufacturing system incorporates the following concepts and skills in an automated production system:

1. Flexible automation
2. Group technology
3. Computer numerical control machine tools
4. Automated material handling between the machines

2. LITERATURE REVIEW

Flexible manufacturing systems (FMS) are distinguished by the use of computer control in place of the hard automation usually found in transfer lines. This enables FMS's to reconfigure very rapidly to produce multiple part types. Use of fixtures and tool magazines practically eliminates setup time. These features permit economic production of a large variety of parts in low volumes. FMS's are increasingly being adopted in the manufacturing sector on account of the additional advantages of rapid turnaround, high quality, low inventory costs, and low labour costs. The high investment required for an FMS and the potential of FMS as a strategic competitive tool make it attractive to engage in research in this area. The research problems raised by the industrial espousal of FMS could be broadly classified into two problem areas: design problems and operation problems.

At the design stage, one is interested in specifying the system so that the desired performance goals are achieved. The operation problems are aimed at making decisions related to the planning, scheduling, and control of a given FMS. This report presents a review of the published literature on the operation problems of FMS. We take stock of the progress in this area considering various aspects of the literature.

A considerable body of research literature has accumulated in this area since the late 1970's when the first papers were published in FMS research. A few surveys of the literature have also appeared.(Buzacott and Yao, Rachamadugu and Stecke). However, these reviews focused on specific perspectives such as analytical models, or scheduling problems.

Rohit Pandey et al.(2016) discusses about the flexible manufacturingsystem (FMS) which is a capital-investment intensive and complex system. In the present market scenario, the customer demand and specification of any product changes very rapidly so it is very important for a manufacturing system to accommodate these changes as quickly as possible to be able to compete in the market. This evolution induces often a conflict for a manufacturing system because as the variety is increased the productivity decreases, hence FMS is a good combination between variety and productivity.

Basnet and Mize (2014) reviewed the literature concerning the operational aspects of FMSs. They described scheduling techniques under six different categories: mathematical programming, multi-criteria decision making, heuristic oriented, control theoretic, simulation, and artificial intelligence. They concluded that the discrete-event simulation technique has the potential to make major contributions to FMS operation and stressed that simulation can be used to model FMSs comprehensively.

Narayan et al. (2013)discussed the design and schedule problem of flexible manufacturing cell with automatic setup equipment. An Optimal queuing network model with general service time and limited local buffers have been studied.

Frazier et al.(2010): investigated the effect of one-stage and twostage scheduling rules on different performance measures in a cellular manufacturing system. Fourteen scheduling rules and eight performance measures were used in the study. The simulation model was developed in subroutines incorporated, and represented a production cell with six machines with separate queues for each part family. Two decision points were employed: the first one was switching between queues of part families or selecting the next part family queue, and the second one was selecting jobs in each part family queue.

Chan et al.(2007): developed a fuzzy approach for operation and routeing selection in an FMS via simulation. The FMS consisted of six workstations, a finite input and output buffer at each station, a load/unload station, and three AGVs. The authors used a fuzzy approach to study operation selection first. It was compared with five operation selection rules, which were RAN, SNQ, LULIB, CYC, and WINQ. Performance measures employed were net profitmake span, average lead time, average tardiness, average lateness, average machine utilisation, average WIP at the input buffer, and average delay at the local buffer. Results showed that the proposed method performed better than the other rules on the performance measures other than make span and average WIP at input buffer. The authors then applied the fuzzy approach to routeing selection. It was compared with three rules, which were SNQ, WINQ, and SPT.

Gupta et al. (2013): Extended the review to cover simulation approaches to the FMS scheduling problems as well as analytical ones. They pursued two objectives:

1. Developing a framework within which the current literature on dispatching rules can be discussed.
2. Comparing the list of dispatching rules and performance criteria from the surveyed literature.

Buzacott and Yao (2013): Presented a comprehensive review of the analytical models developed for the design and scheduling of FMSs. They strongly advocated analytical methods as giving a better insight into the system performance than simulation models. This point of view was adopted since, most probably; simulation techniques had not been refined up that time. There was less attention to the use of simulation in manufacturing applications, mainly because of the lack of model building expert and they stated that analytical models are not efficient for reasonably sized problems. These models employ simplified assumptions that are not always valid in practice and also take a static view of the shop floor.

Stecke (2010) and many authors have divided the FMS operation problem into two sub problems, preproduction setup and production operation. In this view, an FMS is prepared beforehand for the given part mix loading the tools, allocating the operation to the machines, allocating the pallets to the machine and fixtures to the different part types. After this preparatory planning phase, the remaining problems are called operational problem. Stecke places stress on preproduction setup of the FMS. This is to be carried out frequently, as the part mix change.

In Stecke's techniques: the operations and corresponding tools are then assigned (loaded) to the machine groups. She suggests 6 different objectives to optimize during the loading phase:

1. Balance the assigned machine processing times.
2. Minimize the number of movements from machine to machine.
3. Balance the workload per machine for a system of groups of pooled machines of equal sizes.
4. Unbalance the work used for each machine for a system to groups of pooled machines of unequal sizes.
5. Fill the tool magazines as compactly as possible.
6. Maximize the sum of operation significances.

Ro. et al. (2008) there are four starting reasons that justify the use of Multi-criteria decision-making methods:

1. It allows for investigation and integration of the interests and objectives of multiple actors since the input of both quantitative and qualitative information from every actor is taken into account in form of criteria and weight factors
2. It deals with the complexity of the multiactor setting by providing output information that is easy to communicate to actors.
3. It is well-known and applied method of alternatives' assessment that also includes different versions of the method developed and researched for specific problems and/or specific contexts.
4. In this method's that allows for objectivity and inclusiveness of different perceptions and interests of actor without being energy and cost intensive.

Ro and Kim(2008): considered the FMS scheduling problem as a process of two loading and four dispatching subproblems and discuss heuristics for solving six operational control subproblems considering the criteria of makespan, mean flow time, mean tardiness, maximum tardiness, and system utilization to solve sub-problems A Multiple-criteria decision-making approach was composed of four CNC machining centres, each of which had a finite buffer space, a load/unload station, and two AGVs. Two loading subproblems were stated as follows:

1. Part type selection during initial entry.
2. Part type selection during general entry.

Four dispatching subproblems were stated as follows:

1. Part-to-machine allocation rule.
2. Process or machine centre selection rule.
3. AGV dispatching rule.
4. AGV route selection rule.

3.METHOLOGY

In these work comprehensive techniquesare used to check the flexibility of production systems in FMS that taking into consideration its requirements, procedure. Four flexibility dimensions have been described in this work and each dimension described with several factors. The existing techniques for learning work are considered to be of limited use, this research takes into account all possible combinations in a production system such as one machine one part to many-machines-many-parts. Therefore, predictive models are developed to quantifying scheduling and techniques become very useful for measuring flexibility in a production system. The sequence refers to the order in which the activities are performed. Programming is the moment (or the calendar) to carry out the activities. Production shops are classified into individual machine shops, flow shops and workshops based on the layout of the machines. In this research work, the workshops have three parallel machines or machines, which mean multiple copies of the same machine. In a flow laboratory, all the works have the same tour of the machines, while a laboratory, each job has a specific path of machines 4.

3.1 PROBLEM DESCRIPTION

Consider a programming problem for FMS machines in which 4 types of parts are processed in three machines, each with five tool slots and different processing times for each operation. Each type of piece consists of essential and optional operations, which can be performed on the machine with a unique path or a single inspection order of the machine. The adaptability of each machine and its potential to perform many different operations facilitate the duplication of different tasks of operations to generate paths of alternative parts. Therefore, there may be a fairly large number of combinations in which the part type operations can be assigned to the different machines while satisfying all the technological and capacity limits. The additional consideration of flexibility such as: flexibility of the instruments, flexibility of movement of the parts, etc., Together with the limits of the system configuration and of the operating profitability, makes the problem more complex.

To achieve an optimal solution for the machine loading problem, the machine combinations and the operations are evaluated using common performance measures: system imbalance. It is necessary to explore each assignment of combinatorial operations with respect to a given objective function, simultaneously satisfying all the constraints. It has been found that the number of possible tasks to be explored increases exponentially.These problems have been addressed considering the following objective functions:

1. Minimization of system imbalance.

2. Performance maximization alone.

3. Minimizing system imbalance and maximizing performance as a whole.

In a work shop, each job has a specific route or order to visit a car. Nor is it absolutely necessary that all jobs visit all the machines. A job can visit a subset of the existing machine set. So, let's explain the problem of Krishna Industries workshop planning. In this we take three machines and four jobs. The working time and the flow of the work sequence in the machine are shown in the table.

	M/c-1	M/c-2	M/c-3
j1	12	15	7
j2	30	17	6
j3	25	22	8
j4	13	19	10

Table 3.2: Job Flow Machine Time

	v.m.c	Dilling	grinding
Ji	m1 (12)	m2 (15)	m3 (7)
j2	m2 (17)	m1 (30)	m3 (6)
j3	m1 (25)	m3 (8)	m2 (22)
j4	m2(19)	m1(13)	m3(10)

Table 3.3: Job Flow Operation Sequence on machine

Then problem scheduled by all scheduling priority rule for finding optimal sequence for minimization of system unbalance alone, Maximization of throughput alone, Minimization of system unbalance and maximization of throughput considered together . The krishan industries currently follow the SPT(shortest processing time) rule with machining cost $ 450/hour with 20 hour working in day and 300 days in a year.The main aim of the research is to find optimise solution by applying above different explain technology. We find out make span time, job completion time, idle time, machine utility and production cost per year. by all seventeen technology and mention and discuses best four optimise solution that are LPT,FIFO,STPT and combination of LPT WITH FIFO.

International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 5
May 2018

3.5 SOLUTION

3.5.1.Solution by SPT

Step 1 make a solution chat by applying shortest processing time technique for each machine.

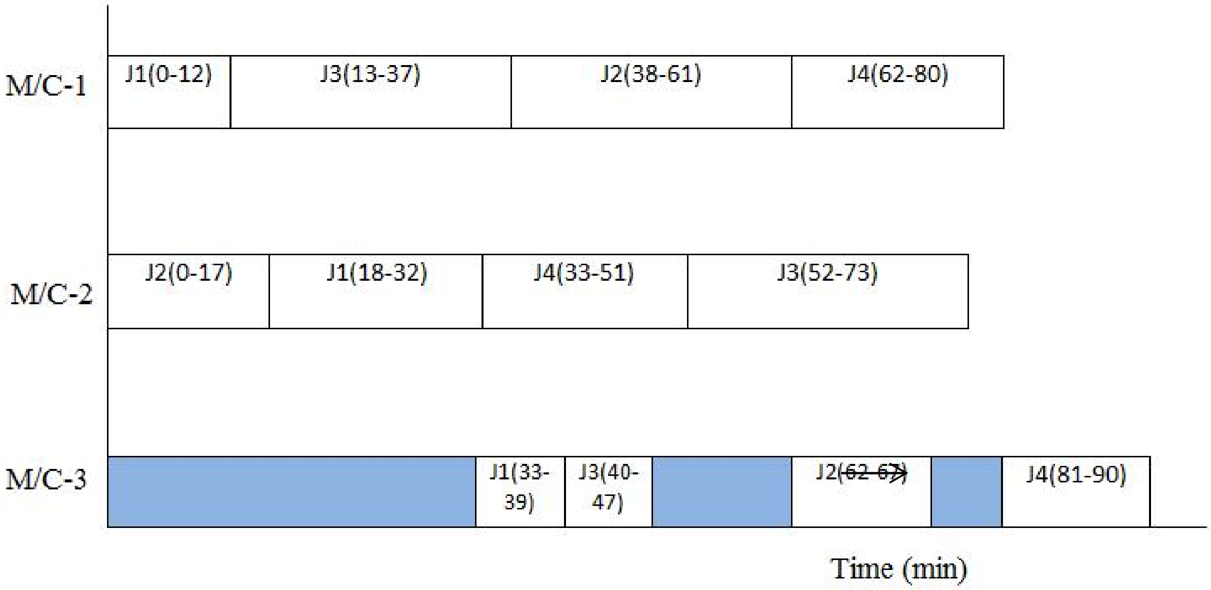

Figure 3.1: SPT

Step 2:

Make span time: 90 min

Job completion time:

J-1: 80 MIN

J-2: 73 MIN

J-3: 90 MIN

Idle time:

MACHINE-1: 10 MIN

MACHINE-2: 17 MIN

MACHINE-3: 59 MIN

Machine utility(in percentage):

MACHINE-1: 88.89%

MACHINE-2: 81.11%

MACHINE-3: 34.44%

Total production Cost per piece: Rs. 675/piece.

3.5.2. Solution by LPT.

Step 1: make a solution chat by applying shortest processing time technique for each machine.

Figure 3.2:LPT

Step 2:

Make span time: 94 min

Job completion time:

J-1: 88 MIN

J-2: 73 MIN

J-3: 94 MIN

Idle time:

MACHINE-1 : 14 MIN

MACHINE-2 : 21 MIN

MACHINE-3 : 63 MIN

Machine utility(in percentage):

MACHINE-1: 85.10%

MACHINE-2: 77.66%

MACHINE-3: 32.98%

Total production Cost per piece: Rs 705/piece.

3.5.3 Solution by FIFO and TSPT Technology

Step 1 Make a solution chat by applying shortest processing time technique for each machine.

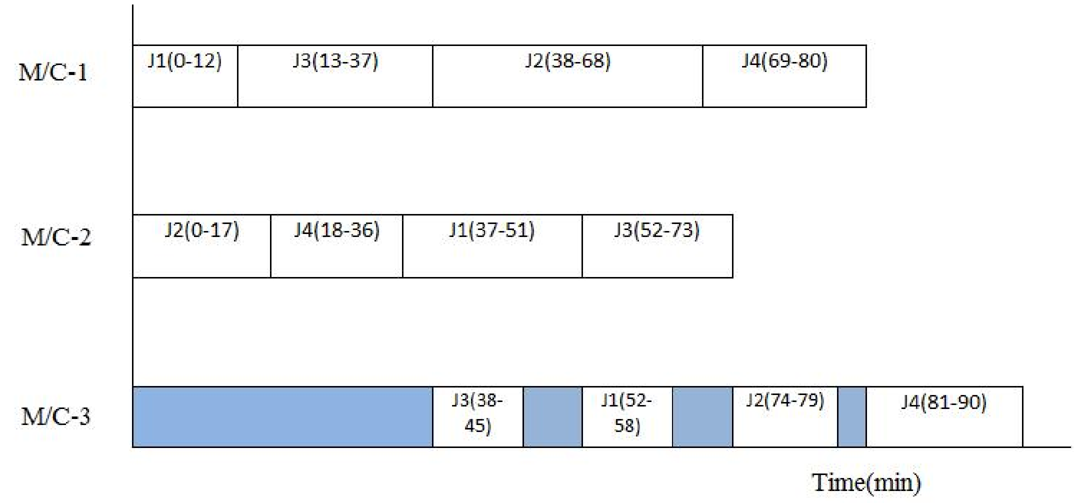

Figure 3.3:FIFO

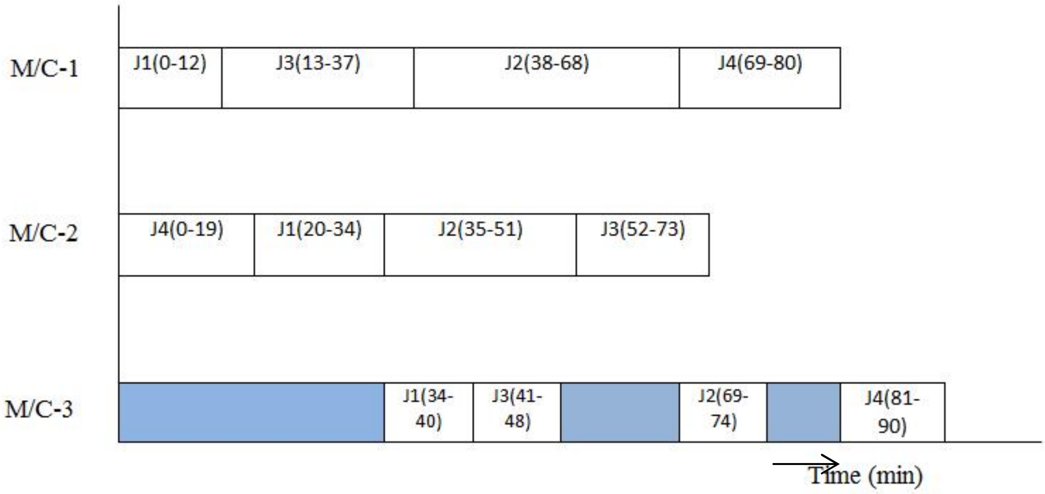

Figure 3.4:TSPT

Step 2:

Make span time: 90 min

Job completion time:

J-1: 80 MIN

J-2: 73 MIN

J-3: 90 MIN

Idle time:

MACHINE-1: 10 MIN

MACHINE-2: 17 MIN

MACHINE-3: 59 MIN

Machine utility(in percentage):

MACHINE-1: 88.89%

MACHINE-2: 81.11%

MACHINE-3: 34.44%

Total production Cost per piece: Rs 675/piece rupees.

3.5.4. Solution by LPT with FIFO

Step 1 Make a solution chat by applying shortest processing time technique for each machine.

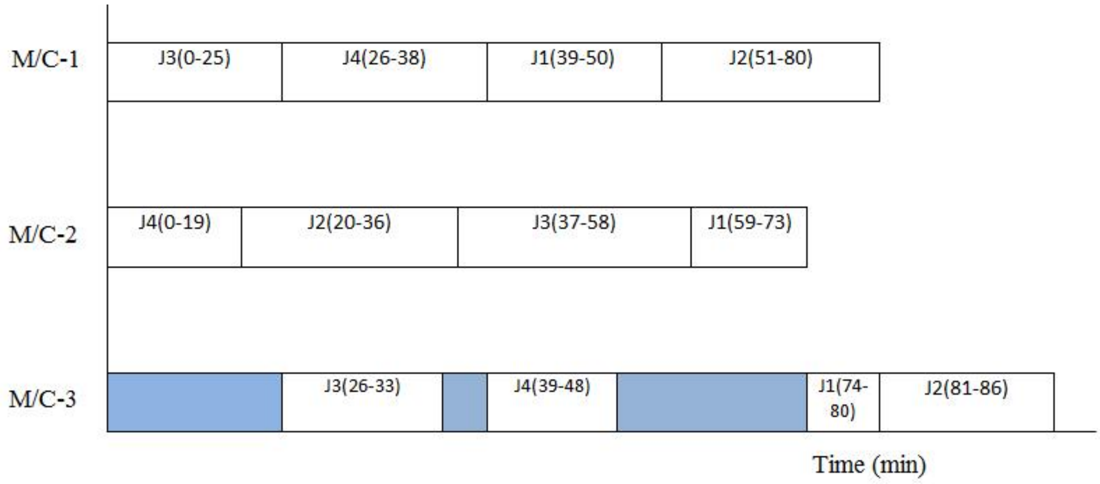

Figure 3.5: LPT with FIFO

Step 4:

Make span time: 86 min

Job completion time:

J-1: 80 MIN

J-2: 73 MIN

J-3: 86 MIN

Idle time:

MACHINE-1: 6 MIN

MACHINE-2: 13 MIN

MACHINE-3: 55 MIN

Machine utility(in percentage):

MACHINE-1: 93.02%

MACHINE-2: 84.88%

MACHINE-3: 36.05%

Total production Cost per piece: Rs 645/piece rupees.

RESULT AND DISCUSION

The krishan industries currently follow the SPT(shortest processing time) rule to machining cost Rupees 450/hour with 20 hour working in day and 300 days in a year.By using SPT technology the one component machining cost is Rupees 675 per fourjobs in three machines.We also find out make span time, job completion time, idle time and machine utility for a set of operation as mentioned below.

1. Make span time: 90 MIN.
2. Job completion time

JOB-1	80 MIN.
JOB-2	73 MIN.
JOB-3	90 MIN.

3. Idle time:

MACHINE-1	10 MIN
MACHINE-2	17 MIN
MACHINE-3	59 MIN

4. Machine utility(in percentage):

MACHINE-1	88.89%
MACHINE-2	81.11%
MACHINE-3	34.44%

5. Total production Cost per piece: Rs 675/piece rupees.

From above explained techniques we find optimum solution by combination of LPT and FIFO techniques. The solution of it is mention below:

1. Make span time: 86 MIN.
2. Job completion time

JOB-1	80 MIN.
JOB-2	73 MIN.
JOB-3	86 IN.

3. Idle time:

MACHINE-1	6 MIN
MACHINE-2	13 MIN
MACHINE-3	55 MIN

4. Machine utility (in percentage):

MACHINE-1	93.02%
MACHINE-2	84.55%
MACHINE-3	36.05%

5. Total production Cost per piece: Rs 645/piece rupees.

By using the LPT With FIFO techniques of optimising process, then production cost of the plant for producing 12000 set of product is reduce 54 lakh rupees to 51.6 lakh rupees. Then total saving of plant by using SPT with FIFO techniques is 2.4 lakhrupees. Then the plant efficiency is increase by 1.52% for using this technique.

CONCLUSION AND FUTURE SCOPE OF WORK

Integration of process planning and scheduling has been play an important role to form integrated manufacturing.This research work presents the Performance rating of Flexible Manufacturing System (FMS) in the manufacturing system. The performance of FMS has been optimized with the model developed of LPT with FIFO technology that includes the flexibilities in manufacturing. The combination of these two techniques provides optimum solution for make span time, ideal time, and utilization of reduced.

Future Scope: The other combination of scheduling techniques can also be applied and analysis can be done which will further can gives the optimise solution by decreasing make span time, ideal time and increasing machine utility.

REFRENCE

1. www.ignou.ac.in/upload/UNIT6-55.pdf.
2. shodhganga.inflibnet.ac.in/bitstream/10603/36612/10/10_chapter%203.pdf.https://en.wikipedia.org/wiki/FMS
3. Avonts, L.H. and Wassenhove, L.N., 1988, The part mix and routing mixproblem in FMS: a coupling between an LP model and a closed queuingnetwork. *International Journal of Production Research*, **26,** 1891-1902.
4. Hutchison, J. and Chang, Y.-L. (2009), Optimal nondelay job shop schedules.*International Journal of Production Research*, **28**, 245-257.
5. Lashkari and MacCarthy, B.L. (2015), The classification of FMS scheduling problems. *International Journal of Production Research*, **34**(3), 647-656.
6. Kimemia, J.G., and Gershwin, S.B., 1983, An algorithm for the computer controlof production in flexible manufacturing systems. *IIE Transactions*, **15,** 353-362.
7. https://en.wikipedia.org/wiki/Genetic_algorithm.
8. https://www.hindawi.com/journals/aor/2009/252989/
9. Rishu Sharma, Piu Jain and Garima Sharma “international Journal of innovations in Engineering and technology” ISSN:2319-1058,190-198.