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Rescheduling of Production Process by Flexible Manufacturing System Considering Tool Failure and Machine Breakdown in CNC

D.Subramani[a], V.Dinesh Kumar[b]*, S.Jamilbasha[c]

[a]*Assistant Professor, Department of Mechanical Engineering, Hosur Institute of Technology and Science, Hosur*
[b]*Assistant Professor, Department of Mechanical Engineering, Sri Nandhanam College of Engineering and Technology, Tirupattur*
[c]*Assistant Professor, Department of Mechanical Engineering, Sri Venkateshwara Institute of Engineering, Krishnagiri*

A B S T R A C T

This paper describes in detail about the rescheduling of production process due to the failure of cutting tool or machine breakdown during an automated batch production. In general flexible manufacturing system is incorporated in the production process to achieve the desired rate of production without any distortions during the production process. Rescheduling of production process takes place due to the following factors; poor tool life, wear in machine component, poor tool grinding, tool breakdown and machine repair. In the above stated factors, tool breakdown is the most common problem faced during most of the machining operation/production process. This paper deals in developing a algorithm to reschedule the production process during cutting tool breakdown.

Keywords: Flexible manufacturing system, production process, rescheduling, cutting tool breakdown.

1. Introduction

In general the flexible manufacturing system refers to uninterrupted automated manufacturing. The flexible manufacturing system basically consists of two main phases namely design and production phase. The concept of flexible manufacturing system differs for each organization and it is dependent purely on the developer. The production phase consists of production planning, scheduling of plan and production controlling. Flexible manufacturing system consists of a group of automated machines that are being controlled by computer. These machines are generally incorporated with automated material handling system. The flexible manufacturing system reduces the human intervention in production process. As the CNC machines are equipped with Automatic pallet changer (APC) and Automatic tool changer to reduce the time associated with material handling and tool change, the breakdown of tool during the production process in CNC machines affects greatly the rate of production. The main objective of this investigation is to develop an effective production schedule in flexible manufacturing system at the time of tool breakdown.

2. Literature review

The ability to handle changes and quickly manage manufacturing and the production system to compensate for external demands is becoming an important competitive factor. The performance of the production system is largely dependent on the ability to be flexible as well as being able to

* *Corresponding author*
E-mail address: jv.dhinesh@yahoo.com

reconfigure operations for new demands. The flexible manufacturing system and reconfigurable manufacturing system techniques plays a vital role in manufacturing organizations (V. Malhotra et al.). The types of flexibility include machine flexibility, material handling flexibility, operation Flexibility, process flexibility, product flexibility, routing flexibility, volume flexibility, expansion flexibility, control program flexibility, production flexibility. FMS offers lower carryover effects when stations interrupt, and also lowers the cost of maintaining spare part inventories due to the fact that similar equipment can share components. FMS is actually an automated set of numerically controlled machine tools and material handling systems, capable of performing a wide range manufacturing operations with quick tooling and instruction changeovers (Rohit Pandey et al). FMS differs from the conventional systems in terms of flexibility in the flow of materials from one tool to another and performing the operations as per the required sequence. Flexible manufacturing system, the word is simple to understand but indeed difficult to achieve. Many firms failed to achieve flexible manufacturing system, become history and firms who effectively achieved it, have pioneered themselves in manufacturing industry. The ultimate need to flexible manufacturing system arises from very basic rule of environment, nothing is permanent. The changing needs, choices, priorities and preferences of business or its stakeholder dynamic behaviour forces firms to be flexible enough to deliver what is required (Vivekanand S. Gogi et al). Based on the methodology followed, FMS operations literature could be classified in the following ways: mathematical programming approach, multi-criteria decision making approach, heuristics oriented approach, control theoretic approach, simulation based approach and artificial intelligence (AI) based approach (Chuda Basnet). The main advantage of an FMS is its high flexibility in managing manufacturing resources like time and effort in order to manufacture a new product. The best application of an FMS is found in the production of small sets of products like those from a mass production (Mehrabi,M.,2005; Wilhelm,W.,1986). To put it in nutshell, the main advantages of FMS are: Reduced manufacturing times, lower cost per unit produced, greater labor productivity, greater machine efficiency, improved quality, increased system reliability, reduced parts inventories, adaptability to CAD/CAM operations, shorter lead times (Ahmad Afsari). An FMS is a group of processing stations (predominantly CNC machine tools), which are interconnected by means of an automated material handling and storage system, and controlled by an integrated computer system.

3. Identification of Problem

The flexible manufacturing system in this case is developed for CNC machine. It is well known that the tool magazine of CNC machines has several tools, which are quiet suitable to perform specific machining operations. Each machine is assigned to perform specific operation and the tool magazine of machine is equipped with more than one tool, so that during the tool breakdown the tool can be altered with fraction of seconds. In this case the material loading and unloading is automated and the entire handling system and CNC machines are controlled by electronic control unit (ECU). The sensors fixed in the fixture ensure the material loading and the appropriate information's are transferred to the electronic control unit. In this investigation each machine performs specific operation using the tool available in the magazine. In all the machines the material handling is accomplished automatically and the machines are placed nearer. In addition, in this case a separate machine is placed in addition than the requirement comprising the tools of three machines and is named as "AM', any breakdown in the machine is sensed by the sensor and the information is then transferred to the electronic control unit. The electronic control unit then transfers the machining operation to be done by the breakdown machine to the additionally placed one. The additional placed machine thus completes the specific machining operation that has to be accomplished by the machine which is under breakdown with the help of signal and stored program of electronic control unit. The flexible manufacturing system developed in this case also helps in sensing delay in production time and dimensional errors in the finished product, which might help in prior identification of problem in the specific machine and its rectification. The schematic layout of flexible manufacturing system used in this case is shown in the figure 1.

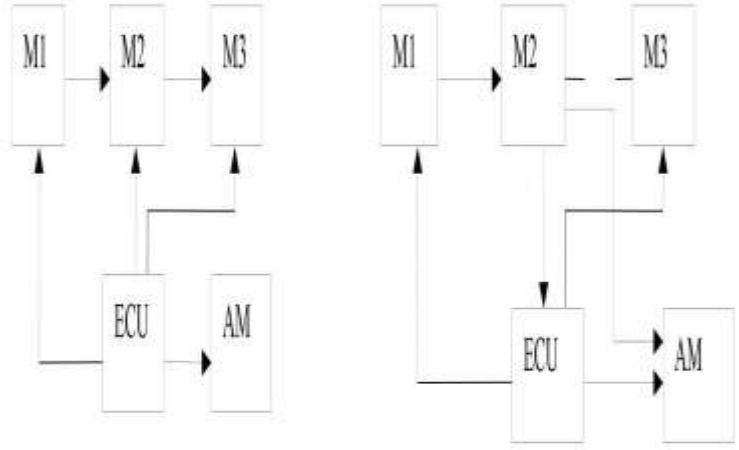

Figure 1.layout of FMS and layout with third machine (M3) breakdown

AM stands for additional machine, any failure in machine or tool breakdown is sensed by appropriate placed sensor units and is transferred to electronic control unit, which then bye pass the signal to the additional machine placed instead of breakdown one. This flexible manufacturing system is best suitable for automated batch production and the interruption in production unit is identified easily without human intervention.

4. Conclusion

The flexible manufacturing system thus developed is best suited for automated batch production process. This will help in reducing production time and human error and intervention can be minimized to the maximum extent. The production operations performed by each specific machine cannot be stopped under any circumstance.

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