

AN INTRODUCTION TO RMS: RECONFIGURABLE MANUFACTURING SYSTEM

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Abstract: This paper gives a brief introduction on RMS, its objectives and importance. A Reconfigurable Manufacturing System is a system designed to adjust quickly its production capacity and functionality within a part family in response to sudden market changes or intrinsic system change. RMS aims at providing sufficient flexibility by the principle of modularity, integrability, scalability in a shorter period of time while the other manufacturing system provides generalized flexibility designed for anticipation variation. Here we have presented the components, characteristics, merits, demerits of Reconfigurable Manufacturing System. The new techniques and characteristics of Reconfigurable Manufacturing System are described along with its key role in future manufacturing system. A comparative study with other available manufacturing system is also given in this paper.

Key Words: *Reconfigurable Manufacturing System, Reconfigurable Machine Tool, Customized flexibility, Production Capacity*

1. Introduction: As the name indicates Reconfigurable Manufacturing System is a manufacturing system in which the configuration can be changed. Configuration refers to arrangement of things in a particular way. The change of configuration in RMS is required to change the production capacity and functionality of the system as per market demand. Production capacity means parts produced per unit time and functionality refers to part variety. Configuration change includes both hardware and software components. Reconfiguration allows adding, removing or modifying specific process capabilities, controls, and software or machine structure to adjust production capacity in response to changing market demands or technologies. The Reconfigurable Manufacturing System (RMS) as well as one of its components – the

Reconfigurable Machine Tool (RMT) were invented in 1999 in the Engineering Research Center for Reconfigurable Manufacturing Systems (ERC/RMS) at the University Of Michigan College Of Engineering.

2. Objectives of RMS: The objective of RMS is to provide the production capacity and functionality exactly required and exactly when required. Thus RMS possesses the advantages of both dedicated manufacturing system and flexible manufacturing system. RMS aims to react rapidly and cost effectively to:

- Market changes i.e. changes in product demand
- Product changes i.e. changes in current products and introduction of new products
- System failures (ongoing production despite equipment failure)

RMS goes beyond the economic objective of FMS by permitting

- Reduction of lead time for launching new system and reconfiguring existing system
- Rapid manufacturing modification and quick integration of new technology

3. Components of RMS

- CNC machines
- Reconfigurable Machine Tools
- Reconfigurable Inspection Machines
- Reconfigurable Assembly Machines
- Material transport systems

4. Characteristics Of RMS Ideal Reconfigurable Manufacturing Systems possess six core RMS characteristics:

Modularity: - Modularity is the degree to which the components of a system can be separated and recombined. The compartmentalization of production functions and requirements into operational units that

can be manipulated between alternate production schemes to achieve the optimal arrangement to fit a given set of needs. In a reconfigurable manufacturing system, many components are typically modular e.g., machines, axes of motion, controls, and tooling

Integrability: - It is the ability to integrate modules rapidly and precisely by a set of mechanical, informational, and control interfaces that enable integration and communication. At the machine level, axes of motions and spindles can be integrated to form machines.

Customized flexibility: - RMS is flexible but the flexibility is customized to a particular part family. Part family refers to a group of parts having similar characteristics (manufacturing as well as design characteristics). This characteristic drastically distinguishes RMS from flexible manufacturing systems (FMS), and allows a reduction in investment cost.

Scalability: - It is the ability of a system to be enlarged to accommodate a growing amount of work. RMS is scalable to achieve the production capacity as per the market demand. Scalability is the counterpart characteristic of convertibility.

Convertibility: - It is the ability to easily transform the functionality of existing systems, machines, and controls to suit new production requirements. System convertibility may have several levels.

Diagnosability: - It is the ability to automatically read the current state of a system for detecting and diagnosing the root-cause of output product defects and subsequently correct operational defects quickly.

5. Comparison of Manufacturing Systems

Comparison of the manufacturing system According to the

- COST
- FUNCTIONALITY
- WASTE

Cost

Reconfigurable manufacturing system is not more expensive in comparison to FMS and DTL. Because unlike others RMS aims to be installed with the exact functionality and product capacity which is needed may be upgraded in future if needed. It will

be associated with adding process capabilities, auxiliary devices, more axis motions, larger tool magazines and expensive controller.

Functionality

Dedicated transfer lines are typically having high capacity but limited functionality and are cost effective because as they produce a single few parts and demand exceed .But saturated markets and increasing pressure of global competition there are times when DTL doesn't work at their full capacity.FMS built with all the flexibility and functionality available, sometimes it is available with those that may not be needed at the installation time .In these case the capital lies idle on the shop floor and a major portion of the capital investment is wasted.

Waste

IN RMS two types of wastes are eliminated

- By adding extra capacity when needed
- By adding extra functionality

6. Merits of RMS

- Increased product quality.
- Reduce time required for product change over.
- Enhance the development of prototype with ease.
- For launching new manufacturing system reduce the lead time.
- Rapid upgrading and quick integration of new process technology.

7. Demerits of RMS

- Difficult integration of machine
- Expensive controller.
- Difficult selection of machine modules
- Difficult in measurement of changeability, configurability and their relationship.
- Difficult to prepare model to adequate the level of changeability

8. Future trends: Advances in manufacturing will not occur without the proper machine-tools and equipment. Machine tools are going under some fundamental changes in terms of their structure (modular structure), components (controllers, hardware/software, spindles, tooling), and sensors. Therefore, new theories, design concepts, and methodologies should be developed for these

purposes. These changes are fundamental to the success of future reconfigurable manufacturing systems. To help assess the near-future (5-10 years) developments and relevant issues in manufacturing systems, a survey is currently underway at the University of Michigan. In this study, national/international experts in the field of manufacturing are provided an opportunity, via a series of survey instruments, to make predictions based on their deep knowledge of the manufacturing field to present the rationale behind their forecasts, to discuss their own and other experts' predictions, and to revise their own in light of such discussions. This survey project hopes to accomplish two main goals. The first is to examine the results to date associated with the use of existing manufacturing systems such as flexible machining systems: its accomplishments, strengths, and short-comings in the manufacturing environment. The second is to examine the potential roles, justifications, and enabling technologies for reconfigurable machining systems in future manufacturing facilities.

9. Conclusion: The concept of reconfiguration has sparked interest in the academic and industrial communities. In this paper, we have tried to introduce the concept of reconfigurable manufacturing systems (RMS), the Components of reconfigurable manufacturing system, capabilities of reconfigurable manufacturing system, and characteristics of Reconfigurable Manufacturing Systems. The reconfigurable manufacturing systems approach proposed in this paper indicates an effort towards comprehensively addressing manufacturing under a global umbrella of reconfigurability.

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