Chapter 4
RMS:
A New Linkage with Pervasive Computing

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ABSTRACT

Today, markets increasingly require more customized products, with shorter life cycles. In response, manufacturing systems have evolved from mass production techniques to the flexible automation. This paper argues that **manufacturing** *systems of the next generation will have to incorporate more flexibility and intelligence, evolving towards reconfigurable manufacturing systems. In particular, the concept of intelligence becomes more relevant because of the need to maintain effective and efficient manufacturing operations with minimum downtime under conditions of* **uncertainty**. *This chapter presents some research issues related to the development of reconfigurable manufacturing systems with pervasive computing.*

INTRODUCTION

Reconfigurable pervasive computing is defined as "an ability to repeatedly configure machine to perform different and varying functions (Batia, 1997).It refers to the ability to customize the architecture to match the computation and data flow of the application (Bondalapati, et al., 2002). Reconfigurable Manufacturing Systems (RMS) can be cost-effectively reconfigured to rapidly adapt the system's manufacturing capacity and machine functionality in a changing marketplace (Koren, et, al., 1996). Reconfigurability and **adaptation** are achieved through flexible control architectures and open information exchange via networks. In achieving these goals, RMS devices must be designed to function modularly and intelligently. Modularity provides standardized units or dimensions for flexibility and variety of device operations, and intelligence enables devices to function independently and to interoperate with other devices to achieve system functionality goals. With the designated RMS devices, machines and systems can be efficiently and quickly reconfigured, both in hardware and software, to meet new task requirements. However, the successful cooperation

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of RMS devices also relies on the reconfigurability of the communication architecture. (Schickhuber, et al., 1997).

The reconfigurable hardware and software are necessary but not sufficient conditions for a true RMS. The core of the RMS paradigm is an approach to reconfiguration based on system design combined with simultaneous design of open architecture reconfigurable controllers with reconfigurable modular machines that can be designed by synthesis of modular machines. The ultimate goal of Reconfigurable manufacturing system (RMS) is to utilize a systems approach in the design of manufacturing processes that allows reconfiguration to achieve cost effective scalablity.

The pervasive computing technique for control systems on machining tools is point-to-point, which has been successfully implemented in industry for decades. However, expanding physical setups and machining systems functionality push the limits of the point architecture. Hence, a traditional centralized point control system is no longer suitable to meet new requirements, such as modularity, decentralization of control, integrated diagnostics, quick and easy maintenance, and low cost (Eccles, 1998).

When configuring sensors, actuators and controllers together in a reconfigurable machine tool, it is important to investigate the impact of the functionality and limitation of these devices on the capability of a network system. This is one of the issues being investigated in a research effort whose primary goal is to develop methodology and tools for assisting the implementation of a networked architecture at the machine level of an RMS.

BACKGROUND

Nowadays the market is characterized by over capacity and large fluctuations in demands. Therefore today's manufacturing systems should enable flexibility in capacity, **responsiveness** in market changes, product verity, adoption and utilization of new technologies and general scalability in a cost **effective** manner (Abdi, et al., 2003)

Cost in Dedicated manufacturing system (DMS) is low as long as they operate a full capacity. This means that demands should exceed supply. Furthermore, DMS are not scalable, as they have fixed cycle time and capacity (Astley, et al., 1996). Clearly, DMS do not offer an efficient solution for the current market conditions. **Advancement** in manufacturing system is the introduction of Flexible Manufacturing System (FMS). FMS are flexible, scalable systems that support product variety. They are however rather complex as they are constructed with all possible functionality built in despite of fact in many cases not all of it is needed. This level of complexity requires highly skilled personnel are to be employed.(Kamimura, et al, 2001) As a result the capital cost and acquisition risk are very high. Although FMS focus on flexibility they are obsolete, as their hardness and software are predetermined and fixed. This means that they are not adequately responsive to change as their capabilities in term of upgrading additions and customization are limited. Moreover FMS were built for low or medium volume productivity, so they are not suitable for large market fluctuations. The new paradigm needed by today manufacturing should incorporate the advantages of FMS but also be similar, responsive and less costly. The reconfigurable manufacturing system (RMS) paradigm attempts to satisfy these requirements and avoid the shortcomings of the previous conventional manufacturing philosophies. RMS, associated with pervasive computing is designed for rapid adjustment of production capacity and functionality in response to new circumstances by rearrangement or change of its components". This definition implies that the benefits of a reconfigurable manufacturing system arise from a constantly changing marketplace. The reconfigurable manufacturing is the latest development in the general field of computer integrated manufac-