Chapter 6
Manufacturing, Control, and Automation

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ABSTRACT

This chapter identifies the common needs for process controls and automation that include methodologies to enable in-situ-level process controls, optimization at the plant or industry level, open-architecture software tools, adaptive control systems, methods and diagnostic tools for condition-based maintenance of process equipment in a manufacturing industry.

INTRODUCTION

Manufacturing typically starts with raw materials, which are then subjected to a sequence of processes to make individual products of certain value. In more elaborate manner, we can say that manufacturing means the production of products for use or sale of the said product using engineered sequence of processes and machines with labor. The product is what we focus on for the profit of an industry. Manufacturing processes involved in the production of products are engineered sequences of operations through which the products are produced. In simple words, we can say manufacturing methods are the steps for converting the raw materials into a final product. Industries for years have gone through lots of evolution to what it is today and is further evolving as we read this sentence. We humans are creative creatures blessed with lots of curious logical problems and solutions. Every second new ideas pop out of our imagination. Industries today have to face a lot of competition in the market. For example, one of

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the problems manufacturers and engineers face in this generation is the manufacturing of semiconductor. New generation phones have huge specification. The semiconductor chips in our phones can perform huge functions and with every new phone new specification pops out that, means more work done by the chips. However, the size does not increase with work and instead tinier chips are produced with the coming generation, i.e., minimum feature size increases with technology. This further means changes in the machines or processes of the manufacturing industry. The production and inspection of such small chips are difficult. We cannot risk any losses or waste whether it is labor or time etc. in this competitive market. Hence, to optimize the manufacturing processes we need to control these operations to automate it to some degrees. Generally, the aim of process control is to maintain the running processes at a preferred and steady operating condition (temperature, pressure, composition, etc.) in case of discrepancy or forces it to follow a desired route along the time of operation. From observations, we can say that control of manufacturing processes has direct impact on the product (Grover, 2002; Grady, 1986).

Over the years, rapid improvements in both computer software and hardware have resulted in a change leading towards automation in manufacturing industries. The word automatic comes from the Greek word "Autos" and "Matos" that mean self and moving respectively (Jouela, 2007). We can say that automation in manufacturing process can be said as the replacement of human interaction for decisions and operation by the use of logical programming instructions and computerized tools. Automation optimizes productivity by greatly reducing human intervention. In the present world of competitive technologies advancement, especially robots automation provides a compulsory tool for the survival of the company. They take a great role in enhancing the production flexibility, product quality and innovation in the international market and competition. Automation can and is being used to resolve the most fundamental control problems birthed by the rapid increase in product complexity and operational pace and decreasing product internal structure dimensions (Sadoyan, 2005). In modern big industries advanced automation tools used for the development of complex products, modeling, simulation, test and inspection and most importantly manufacturing in our case.

MANUFACTURING PROCESS CONTROLS

The conventional approach to process control involves primary equipment's calibration, crucial process parameters monitoring and final approval of the product. Those approaches mentioned are not capable of recognizing the interdependence of process parameters nor allows any modification or adjustment of the process to optimize yield. Traditional control methods are more like the control system and strategy for relatively simple processes. For modern machine tools, a more sophisticated control strategy was developed called feed forward that can compensate for the dynamic delay in the tools. Such control system can provide immense improvement in machining accuracy.

Computer and software usage have helped us to have an optimize control of the manufacturing in industries. Big industries have facilities and capital for high automation of manufacturing processes. The industry should be able to self-arrange the designing of process and tools, planning and controlling the production instructions, and assures product quality necessities. This ensures running the production of a product smoothly with minimum error and best quality. Manufacturing supports systems take a role in such area to accomplish these goals. Such support system consists of the people and actions, which help an industry to manage its manufacturing operations. However, most of these support systems have no direct connection with the product, but they help in planning and controlling of its progress (Sulli-