3 A conceptual model of a manufacturing system

3.1 Introduction

This chapter provides a structured survey of the most important aspects of a modern manufacturing system, and develops a systems model for an important type of manufacturing organization. Reading through this chapter will be like taking a 'guided tour' through a manufacturing system. We will follow the route that a product takes as it goes through the system, from customer inquiry to final delivery. On the journey through this 'Manufacturing Park' we will visit various interesting places (or, in more professional terms, the functional areas) where advanced manufacturing technology (AMT) is being used to increase productivity. This chapter is a guidebook, with 'maps' to help you to find your way through the rather complicated structure of operations and anecdotal information to assist you to understand the basic concepts involved in various manufacturing functional areas.

The map, a conceptual model of the manufacturing system, will be presented in a systems description technique known as IDEF0. This technique provides a useful way of specifying the information and organization structure within a complex manufacturing system. The method, the features and the advantages and disadvantages of this particular systems description technique will be reviewed in section 3.2.

Next, a particular type of manufacturing system, the order-handling- manufacturing system (OHMS), is identified, defined and analyzed to reveal the general context of a manufacturing organization. OHMS is an ideal modeling subject for our purpose for a number of reasons. First, it demonstrates many of the key issues faced by the managers and engineers involved in contemporary manufacturing industry, such as the adoption of AMT in the areas of production planning and control, product design and development, and production-shop activities. Second, with continuously improving customer choice and the ever-increasing demand for variety, its modes of operation are becoming predominant in many industries.

A formal systems definition of OHMS will be developed step by step through interrelation and decomposition, using IDEFO. To aid the understanding process, the structure and operation of a real OHMS company will be examined to illustrate the key features of the manufacturing system.

Although this chapter is not intended to provide a complete description of AMT, brief introductions to the relevant topics will be given where appropriate, enough for the reader to appreciate the basic techniques, the scope of these techniques and, more importantly, the roles they play within the overall manufacturing framework.
In summary, therefore, this chapter is designed to serve three main purposes: to illustrate how systems concepts such as hierarchy, relation, decomposition and control can be applied to describe and analyze the system of a manufacturing organization, by using a systems definition technique such as IDEF0; to develop an overall manufacturing framework to which various manufacturing functions are fitted and related, so as to show what is involved; and to highlight the principles of relevant AMT topics and the problem areas involved in the structural, technical and operational aspects of manufacturing.

After studying this chapter, the reader should be able to:
• Develop a systems structure of a particular manufacturing organization, including its functions, its material and information flow together with its relationships and control structures.
• Identify the role and operations of various functions within the overall framework of manufacturing, including: sales and contract; production planning; product design and development; material and capacity requirements planning; production resource acquisition; production control; and production-shop activities.
• Understand the principles of the systems approach to production resource acquisition and the techniques of manufacturing planning and control, including: aggregate planning approaches, disaggregate planning approaches, and integrated planning approaches.
• Understand the principles and techniques of various AMT areas, including: factory layout; the machining center and numerical control; robots and AGVS; machining cells and FMS; automatic and flexible assembly; CAD/CAM, CAE, CAPP, and CAPM; computer integrated manufacturing; and quality control.
• Identify the important problem areas and the associated key issues in modern manufacturing systems.