

## Chapter 10

# Hierarchical Production Planning

*Gabriel R. Bitran\**

*Sloan School of Management, Massachusetts Institute of Technology, Cambridge,  
MA 02139, U.S.A.*

*Devanath Tirupati*

*Department of Management, University of Texas, Austin, TX 78712, U.S.A.*

### 1. Introduction

In general terms, production may be defined as the process of converting raw materials into finished products. Manufacturing systems are typically composed of large numbers of components which have to be managed effectively in order to deliver the final products in right quantities, on time and at an appropriate cost. In systems characterized by multiple products, several plants and warehouses, a wide variety of equipment and operations, production management encompasses a large number of decisions that affect several organizational echelons. To understand the role of Management Science models in supporting those decisions, it is useful to classify them according to the taxonomy proposed by Anthony [1965]. He classifies decisions into three categories: strategic planning, tactical planning and operations control.

*Strategic planning* decisions are mostly concerned with the establishment of managerial policies and the development of resources to satisfy external requirements in a manner that is consistent with the organizational goals. In the area of production management these decisions relate to the design of production facilities and include the following: (i) location and sizing of new plants, (ii) acquisition of new equipment, (iii) selection of new product lines, and (iv) design of logistic systems.

These decisions are very important because, to a great extent, they define the competitive position of the firm, its growth rate, and eventually, determine its success or failure. Also these decisions, which are made at fairly high managerial levels, involve large investments, have long term implications and are affected by both external and internal information. Thus, any model-based system to support these decisions should have a broad scope, long planning horizon, and recognize the impact of uncertainties and risk attitudes.

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*Tactical planning* decisions focus on the resource utilization process. At this stage, after decisions have been made regarding physical facilities, the basic problem to be resolved is the allocation of resources such as capacity, work force availability, storage and distribution resources. Typical decisions in this category include utilization of regular and overtime labor, allocation of capacity to product families, accumulation of seasonal inventories, definition of distribution channels, and selection of transportation alternatives. These decisions involve a medium range planning horizon, and the aggregation of items into product families. In the literature, models addressing these issues are classified as aggregate planning models.

*Operations control.* Decisions in this category deal with day to day operational and scheduling problems which require complete disaggregation of the information generated at higher levels. Typical decisions at this level include the following: (i) production sequencing and lot sizing at the item level, (ii) assignment of customer orders to individual machines, (iii) inventory accounting and inventory control activities, (iv) dispatching, expediting and processing orders, and (v) vehicle scheduling.

The three types of decisions identified in Anthony's framework – strategic planning, tactical planning and operational control – differ markedly on several dimensions which have important implications in developing a solution approach to address production planning and scheduling problems. Table 1.1,

Table 1.1  
Differentiation factors of the three decision categories

Factor	Strategic planning	Management control (tactical planning)	Operational control
Purpose	Management of change, resource acquisition	Resource utilization	Execution, evaluation, and control
Implementation instruments	Policies, objectives, capital investments	Budgets	Procedures, reports
Planning horizon	Long	Medium	Short
Scope	Broad, corporate level	Medium, plant level	Narrow, job shop level
Level of management involvement	Top	Middle	Low
Frequency of replanning	Low	Medium	High
Source of information	Largely external	External and internal	Largely internal
Level of aggregation	Largely aggregated	Moderately aggregated	Largely detailed
Required accuracy	Low	Medium	High
Degree of uncertainty	High	Medium	Low
Degree or risk	High	Medium	Low