Logistic and production models (contd..)

g) Multiple plants

In this section it is assumed that a manufacturing company has a network of M production plants, located in geographically distinct sites that manufacture a single product. The logistic system is responsible for supplying N peripheral depots, located in turn at distinct sites. Each production plant \( m \in M = \{1, 2, \ldots, M\} \) is characterized by a maximum availability of product, denoted by \( s_m \), while each plant \( n \in N = \{1, 2, \ldots, N\} \) has a demand \( d_n \).

We further assume that a transportation cost \( c_{mn} \) is incurred by sending a unit of product from plant \( m \) to depot \( n \), for each pair \((m, n)\) of origins and destinations in the logistic network. The objective of the company is to determine an optimal logistic plan that satisfies at minimum cost the requests of the depots, without violating the maximum availability at the plants. It should be clear that the problem described arises frequently in logistic systems, at different levels in the logistic network (e.g. from suppliers to plants, from plants to warehouses or from warehouses to customers).

The decision variables needed to model the problem described represent the quantity to be transported for each plant–depot pair,

\[ x_{mn} = \text{unit of product to be transported from } m \text{ to } n. \]

The resulting optimization problem is
Constraints (14.41) ensure that the availability of each plant is not exceeded, whereas constraints (14.42) establish that the demand of each depot be satisfied. Model (14.40) is a linear optimization problem, and can be therefore solved efficiently.

Revenue management systems

Revenue management is a managerial policy whose purpose is to maximize profits through an optimal balance between demand and supply. It is mainly intended for marketing as well as logistic activities and has found growing interest in the service industry, particularly in the air transportation, tourism and hotel sectors. More recently these methods have also begun to spread within the manufacturing and distribution industries. The strong interest shown by such enterprises in the themes considered by revenue management should come as no surprise, if we consider the complexity and strategic relevance of decision-making processes concerning demand management, which are addressed by marketing and logistics managers. Consider, for example, the complex interactions among decisions on pricing, sales promotions, markdowns, mix definition and allocation to points of sale, in a highly dynamic and competitive context characterized by multiple sales channels and several alternative ways of contacting customers.

Despite the potential advantages that revenue management initiatives may offer for enterprises, there are certain difficulties that hamper the actual implementation of practical projects and actions aimed at adopting revenue management methodologies and tools. We can identify several explanations for the gap between intentions and initiatives actually undertaken. Certainly the fear of
implementation costs and uncertainty over the results that can be achieved play an important role, as happens for many innovation projects. Empirical investigations show, however, that the primary reason for prudence in adopting revenue management should be sought in the prerequisite conditions necessary to successfully start a revenue management project. There is a high level of interaction between revenue management and two other themes that we described earlier – optimization of the supply chain and relational marketing.

On the one hand, in order to apply revenue management methods and tools it is necessary to have an integrated and optimized logistic chain that guarantees the efficiency and responsiveness of the logistic flows. On the other hand, it is also necessary to possess a deep knowledge of the customers and an accurate micro-segmentation of the market, achieved through data mining analytical models and therefore based on the analysis of the actual purchasing behaviors regularly recorded in the marketing data mart. Hence, to profitably adopt revenue management a company should be able to enhance and transform into knowledge, through the use of business intelligence methodologies, the huge amount of information collected by means of automatic data gathering technologies.

i) Decision processes in revenue management

Revenue management involves the application of mathematical models to predict the behavior of customers at a micro-segmentation level and to optimize the availability and price of products in order to maximize profits. In this respect, we can use the same definition introduced in Chapter 13 to summarize relational marketing objectives: to formulate for each segment, ideally for each customer, the appropriate offer through the most suitable channel, at the right time and at the best price.

The purpose of revenue management is therefore to maximize profits, aligning the offer of products and services to the expected demand, using both the major levers of the marketing mix (e.g. prices, promotions, assortment) and the levers of logistics (e.g. efficiency and timeliness). Specific and innovative features of revenue management strategies are a closer focus on demand than supply and a greater emphasis on costs than revenues; such features are often absent from the managerial policies adopted by most enterprises. As already observed, in recent years revenue management has been applied with more and more success by many
companies operating in the service industry. Among the pioneers in this field are airlines, hotel chains, automobile rental companies, theme parks, theaters and other entertainment-related enterprises.

The common characteristics of these fields are well apparent: a highly perishable product, a fairly low marginal sales cost and the possibility of applying dynamic pricing policies and exploiting multiple sales channels.

Revenue management affects some highly complex decision-making processes of strategic relevance, as shown in Figure 14.2:

- market segmentation, by product, distribution channel, consumer type and geographic area, performed using data mining models;
- prediction of future demand, using time series and regression models;
- identification of the optimal assortment, i.e. the mix of products to be allocated to each point of sale;
- definition of the market response function, obtained by identifying models and rules that explain the demand based on company actions, the initiatives of competitors and other exogenous contextual events;
- management of activities aimed at determining the price of each product (pricing) as well as the timing and the amount of markdowns;
• planning, management and monitoring of sales promotions, and assessment of their effectiveness;
• sales analysis and control, and use of the information gathered to evaluate market trends;
• material procurement and stock management policies, such as control policy, frequency of issued orders, reorder quantities;
• integrated management of the different sales and distribution channels.

Revenue management relies on the following basic principles:
• To address sales to micro-segments: segmentation carried out by means of business intelligence and data mining models is critical to achieve an adequate knowledge of the market.
• To exploit the product value cycle: to generate the highest revenues, it is required to grasp the value cycle of products and services, in order to optimally synchronize their availability over time and to determine the price for each market micro-segment. Notice that the value cycle also depends on the sensitivity of micro-segments to price variations.
• To have a price-oriented rather than cost-oriented approach in balancing supply and demand: when supply and demand are out of balance, most enterprises tend to react by increasing or decreasing capacity. In many instances it might, however, be more convenient to adopt price variations, avoiding repeated variations in capacity.
• To make informed and knowledge-based decisions: a consistent use of prediction models tends to mean that decisions rest on a more robust knowledge basis. In particular, a correct prediction of consumer purchasing behaviors is essential to evaluate elasticity and reactions to price variations.
• To regularly examine new opportunities to increase revenues and profits: the possibility of timely access to the available information, combined with the possibility of considering alternative scenarios, strengthens the competencies of marketing analysts and increases the effectiveness of their activity.

The adoption of revenue management methods and tools requires a few prerequisite conditions to be satisfied within a company, since without them the expected results are unlikely to be achieved. As with any innovation project, it is the people and the organization that constitute a key success factor rather than the use of specific software tools. In this case too, the culture and the structure of the processes within an organization must be prepared to adopt powerful tools that
may turn out to be unsafe and disrupting if improperly used. It is therefore necessary to develop within the enterprise an information culture, particularly among those knowledge workers who operate in the marketing and logistics departments, more directly involved with the application of revenue management strategies. This means that all marketing data must be systematically gathered, controlled, normalized, integrated and stored in a data mart. To segment the market and to create micro-segments, business intelligence methods and analytical models should be used. It is therefore advisable for an enterprise turning to revenue management to have already developed relational marketing initiatives or at least to be able to carry out data mining analyses.

On the other hand, the decisions involved in revenue management strategies share many aspects with the logistics department, and in particular with the management of flows in the supply chain. In this case too, particularly for manufacturing companies, it is advisable for an enterprise considering revenue management to have previously embarked on supply chain integration and rationalization projects, in order to guarantee an adequate cost reduction that, combined with the increased revenues obtained through revenue management, may lead to a significant increase in profits. Moreover, effective supply chain management is also required to guarantee timely restocking.