Chapter 10

# INDUSTRY PROFILES

Implementing revenue management requires an understanding of real world market conditions. Regulations, technology standards, consumer behavior, product characteristics, pricing policies, and industry distribution practices are all important factors that affect the way RM is practiced. This chapter explores these institutional factors affecting RM in industries that are both mature and emerging users of RM. For each industry we begin by describing its products, consumers, and pricing practices. We then summarize the current state of RM in the industry and the key issues affecting its RM practices. Our progression is from industries in which RM is a mature practice to those in which it a relatively new or emerging practice.

A word of caution is in order here, however. Industry practices can change rapidly as new technologies and business models emerge, and such changes can fundamentally alter the way RM is practiced. Consequently, this chapter represents at best a snapshot of current RM practice. Continuing innovations in business models and technologies will no doubt keep RM an evolving discipline for many years to come.

## 10.1 Airlines

As the earliest and largest user of RM, the airline industry deserves special attention. Hence, we begin our industry discussion with an in-depth look at RM practices in the airline industry.

### 10.1.1 History

As mentioned in Chapter 1, RM has its origins in the rise of capacity-controlled discount fares after the deregulation of the U.S. airline indus-

try. Before deregulation, the only service options offered by commercial airlines were first-class and coach-class service. Fares on a route were identical for all carriers and set by the Civil Aeronautics Board (or by the International Air Transport Association (IATA) on international flights) based on standard costs.

The first innovation in fare structures occurred in international markets with the development of APEX—*advance-purchase excursion*—fares. APEX fares offered travelers the option of buying a coach-class seat at a discount but were restricted to round-trip travel and required an advance purchase and a minimum stay.

The period after deregulation in the United States was characterized by successive innovations in creating discounted products. As discussed in Chapter 1, American Airlines introduced "Super Saver" fares in 1975. These fares had a seven-day advance-purchase requirement and minimum-stay conditions and required round-trip travel. Advance-purchase restrictions were lengthened progressively over the years, culminating in 1985 with American Airlines' introduction of "Ultimate Super Saver" fares that required a 30-day advance purchase. In 1987, Texas Air Corporation introduced a "Max Saver" fares that had the further restriction of being non-refundable. The practice of limiting refundability (or imposing cancellation or change-of-itinerary fees) became an industrywide practice shortly thereafter. In the mid-1980s, airlines introduced Saturday-night stay requirements to further prevent business travelers from buying discounted products.

Today, most airlines offer discounts based on a relatively stable set of restrictions, typically a combination of advance-purchase restrictions of 7, 14, 21, and 30 days, the requirement to stay a Saturday night, non-refundability, and penalties for changes in the itinerary after purchase. The low-cost carriers, which concentrate primarily on the leisure market, use primarily advance-purchase discounts and change penalties.

### 10.1.2 Customers, Products, and Pricing

Airlines serve a wide range of customers, both individual travelers as well as groups. The classic segmentation of individual travelers is between business and leisure customers.

Those traveling for business purposes have strong time preferences. They thus tend to value schedule convenience and booking/cancellation flexibility and are considered relatively price-insensitive, because, in most cases, their travel expenses are paid by their employers or charged to clients.

Leisure travelers, on the other hand, tend to be more sensitive to price because they are paying from their own pockets. However, because they

are traveling for discretionary purposes, they tend to have more flexibility in their travel dates and will modify their schedule to find a good deal. They are also willing, and even prefer sometimes, to precommit to travel many days ahead of departure.

The two segments differ also in their travel-time preference, with business travelers preferring to leave on weekdays and return by the weekend, and leisure travelers preferring to depart at the end of the week and stay over a weekend. Leisure travel peaks around major holidays, while business travel drops at these points in time.

Of course, this is at best a crude description of the behavior of the many customer segments an airline serves. Some leisure travelers with high disposable incomes are more sensitive to schedule convenience and in-flight amenities than they are to price. Many business travelers are as price-sensitive as leisure customers (for example, those who are self-employed). Business travelers sometimes travel over the weekend, and leisure travelers often need to travel midweek. Some business travelers can easily commit to an advance reservation with no refund, while some leisure customers decide to travel at the last minute. Therefore, in general, there are many variations in preferences for schedules, routings, and in-flight service among travelers, and there are many differences in their ability to plan and commit to their travel plans.

Besides individual travelers, airlines also serve various wholesale travel groups. For example, cruise lines will often book blocks of seats connecting to their various sailings for packaged holidays. Tour operators also purchase blocks of seats to offer as part of combined air-hotel packages.

Airline sales can also be classified by sales channel. Travel agencies have long been the dominant sale channel, but Internet sales (either own-website sales or third-party travel sites) are rapidly growing in importance. Consolidators and wholesalers are two other significant sales channels in many airline markets.

All these differences in sales channels, customer types, and behavior affect RM and are targeted by various airline products, as explained below.

#### 10.1.2.1 Itineraries and Combinability Rules

Airline products are itineraries (seats on a routing on a date and time in the future) on its network of flights. An itinerary may involve multiple connections.[1] Because of the many connection possibilities, an airline with 500 flights a day may offer hundreds of thousands of possi-

[1]Most full-service carriers have significant network traffic. The newer low-cost carriers deal exclusively in point-to-point service and do not offer connections.

ble itineraries for sale. Added to this complexity, airlines offer different compartments of service (first, business, coach), and within each compartment, multiple fare products with different rules and restrictions—all offered for travel up to a year in the future. Prices are set at the level of itinerary, date of travel, fare product, and point of sale—requiring hundreds of thousands of products to be priced regularly.

Because of the immense number of combinations involved, airlines post prices for only a fraction of their itineraries. They then define rules on how these simpler fares can be combined (so-called *combinability rules*). Another pricing method—called *constructed fares*—involves specifying a base fare between regions (such as Spain to North America) and then defining add-on charges based on specific origins and destinations (for example, Spain-Chicago, +30 Euros). It is the responsibility of the reservation system and the travel agent to follow these combinability and fare-construction rules, interpret them properly, and charge customers the correct fare.

#### 10.1.2.2 Interlining

An itinerary can also consist of flights involving several airlines (called *interlining*). The price for interline flights depends on the agreements between the two carriers. The revenue is then split by a mutual proration agreement or, lacking such an agreement, by IATA-specified guidelines. The prorated revenue settlement is most often done by agencies dedicated to this task, which introduces significant delays in even accounting for revenue.

#### 10.1.2.3 Pricing Itineraries

Even if all flights are on a single airline, pricing an itinerary is complicated by the fact that there are often many different ways to do so. Figure 10.1 shows an example of an itinerary and some ways of pricing it as a combination of one-ways, round-trips, open-jaws and one-ways with stopovers, and so on. A pricing solution is made up of these components. For each one of these components, in turn, there are many possible fare products. Each fare product has its own rules and restrictions attached to it. If a passenger qualifies for all the restrictions *and* all the combinability rules are satisfied *and* the airline reservation system indicates that the booking classes for the desired fares on *all* the legs are open, then the agent can book the itinerary. The rules indicate conditions on the amount of time available for purchase, the cancellation penalties, and so forth, and footnotes indicate exceptions and clauses. This rule and footnote interpretation is complicated, with sequential sets of logical clauses specified at one or more levels (such as flight level, geographic

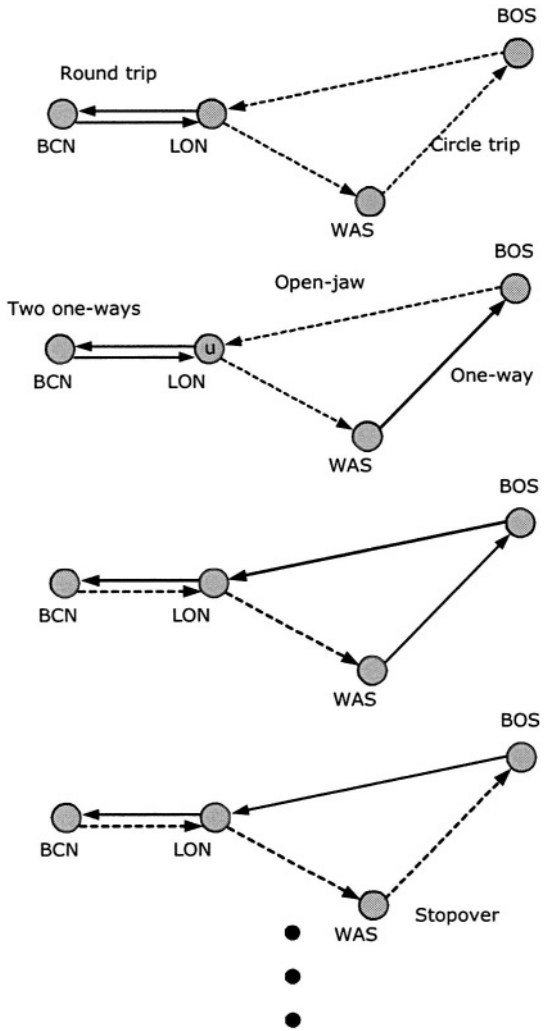


*Figure 10.1.* Different ways of pricing an air travel itinerary.

level and periods of application). Indeed, the industry at present time has more than thirty categories of rules, restrictions, and footnotes. As a result, an itinerary such as the one shown in Figure 10.1 can have several thousand possibilities for pricing.

A travel agent or GDS searches among the valid combinations (usually to find the cheapest). However, because of the large number of possible combinations involved and the difficulty in interpreting the combinability and footnote rules, even automated systems sometimes miss

the lowest possible price. This is one reason that one travel agent can sometimes produce a lower price than another. Web-based price search engines (e.g., Expedia, Orbitz, Travelocity) also show differences in their ability to search these combinations correctly and find the best price, as their performance depends on the quality of the rules interpretation code and the number of combinations priced.

#### 10.1.2.4 Managing Prices

Prices are distributed through two agencies, ATPCO and SITA.[2] ATPCO (Airline Tariff Publishing Company) is an industry organization that aggregates fares and rules from a large number of airlines and distributes them to GDSs. Anyone can subscribe to its service for a fee. Distribution is electronic with different frequency of downloads that can be restricted by filters to reduce the volume of data. A change service sends new and changed fares only, by market and region.

Airline pricing departments price their fare products by monitoring competitors' prices and their own traffic data. Airline analysts closely monitor competitor price changes. Pricing departments respond to competitors' price moves very quickly, often filing a response on the same day.

Fares available for such public distribution are called *public fares.* However, in addition to public fares, airlines offer a large number of *private fares.* Private fares are discounts or special rates given to important travel agencies, wholesalers, and corporations. They are not revealed to the public (or competition) and are available only by corporate agreements or qualified agents. In some international markets, private fares constitute 90% of sales, though in Europe and the United States, they are a smaller fraction of total sales. Private fares are sometimes sold via GDSs (a special code is required to access them), though many are off line paper agreements. Field sales agents monitor these private fares and send intelligence back to the airline when possible, though pricing analysts usually have only a vague idea of the private fares offered by competitors.

#### 10.1.2.5 Priceline.com and Internet-Only Fares

The Internet has opened up a new sales channel for airline tickets with its own fare structure and sale practices. Many airlines use their websites to make last minute fares available at very low prices, a tactic

[2]Schedule information is distributed mainly by another organization called the Official Airline Guide (OAG).

little used previously. These fares are not advertised ahead of time and are usually not sold through any other channel.

Intermediaries, such as Priceline.com and Hotwire.com, have also created new channels and pricing mechanisms in the U.S. airline industry, and similar sites have emerged in other countries. Priceline.com defines its process as a "buyer-driven commerce," and it has many similarities with reverse auctions (see Section 6.1.2). A customer specifies an itinerary and a price they are willing to pay. The request is a commitment by the customer to buy at the offered price; if an airline accepts the offer, the flight is booked and the customer is charged. However, customers must accept considerable uncertainty over the details of their itinerary, including not knowing the airline they will fly, the number of connections it will have, or the exact time of arrival and departure. Moreover, they cannot change or cancel the booking once it is made. Customers can also buy only economy, round-trip tickets and cannot use frequent-flyer points.

Once a request is made, the Priceline.com system searches for an airline willing to sell below that price and sends an accept/reject decision back to the customer within 15 minutes. Priceline.com keeps the margin between the customer-quoted price and the airline price.

The Priceline.com mechanism is designed to appeal to price-conscious customers who are flexible about their travel times and routings. The deliberate uncertainty introduced into the transaction (in airline, arrival time, routing) makes it unattractive for most business travelers (and many leisure travelers as well). The fact that the airline's identity is uncertain also offers *brand shielding,* allowing airlines to discount without making the discounts widely known, thus limiting the threat to their main channels of distribution. (For these reasons, such fares are called *opaque fares* in the industry.)

Several airlines have also started similar sale procedures on their own websites, combining them with regular sales and last minute, Internet-only offers and posted-price offers.

## 10.1.3 RM Practice

Since the practice of RM in the airline industry is quite mature, several standard practices have developed. Here we summarize and discuss these practices.

### 10.1.3.1 Fare Classes and Fare Basis

RM systems for airlines book reservations in fare classes (or *booking classes*). Each compartment (first, business, and coach) has a number of

fare classes—typically eight or more for coach, one or two for business, and one or two for first. These booking classes are represented by letters; some industry-standard booking classes are F for first-class, J and C for business class, Y for full-fare coach with no restrictions, and M, B, K, H, Q, Z, and others for the discounted fare classes in coach. The exact codes used for the classes vary from airline to airline.

Each fare class is used to book tickets sold under different *fare codes* or *fare-basis codes*. Each of these fare-basis codes (with names such as "QXE30") have specific fares associated with them, and the main requirements for booking under that fare basis code is encoded (somewhat cryptically) into the name of the fare code. For example, the 30 in QXE30 represents a 30-day advance-purchase requirement. Table 10.1 gives an example of fare codes and their mappings to booking classes and restrictions. The primary reason for grouping fare-basis codes into

*Table 10.1.* An example of airline fare codes, classes and their restrictions.

| *Fare Code* | *Fare* | *Booking Class* | *Main Restrictions* |
|---|---|---|---|
| QDBQ | 137 | Q | Senior fare, Sat. night stay, 1-month max. stay |
| WDRK4DLZ | 86 | W | Youth fare, 3-day AP, 4-day min, 1-month max. stay |
| SDFKSLMC | 110 | S | Sat. night stay, 1-month max stay |
| KDAP | 167 | K | 4-day min., 1-month max. stay |
| BDBO | 198 | B | Senior Fare, 6-month max. stay |
| BDZZ | 198 | B | Youth, 6-month max. stay |
| BDAP | 216 | B | 3-month max. stay |
| YD | 260 | Y | |

fare classes is that many reservation systems can accommodate only a relatively small number of fare classes (typically five to eight) per cabin. Thus, grouping fare codes into fare classes allows an airline the flexibility to post a wide range of fares yet control their availability through a smaller number of fare classes.

### 10.1.3.2 Booking Processes and Availability

Airlines start selling seats on flights up to a year before departure. However, since flight schedules are usually not finalized until three months prior to the departure date, most bookings that are made very early on are tentative, consisting mostly of group bookings by tour operators. Most regular fare class bookings come in during the last two or three months before departure. Typically leisure passengers book earlier than

business passengers and the restrictions imposed on the cheaper fare classes try to exploit this preference of business passengers to book late.

A typical booking process proceeds as follows. An airline posts availability in each fare class to the reservation systems stating the availability of seats in each fare class. This is done using codes such as Flight 314: Y4 M4 BO …, a notation that indicates up to four seats are available in Y class, four in M class, and zero in B (put another way, Y and M are open, B is closed). When a customer requests an itinerary, a travel agent retrieves this availability information from the GDS. If a fare class is open, the travel agent is allowed to make a booking in that fare class. Within a fare class the agent quotes a fare for the itinerary based on one of the fare codes. The fare code is then recorded under the passenger name record (PNR).

Booking data are also grouped based on fare classes rather than fare codes for forecasting purposes in most RM systems. This aggregation often makes it difficult to precisely estimate demand and revenues from historical data.

#### 10.1.3.3 Global Distribution Systems (GDSs)

A *global distribution systems* (GDS) provides centralized control and distribution of bookings. There are a number of GDSs currently in operation worldwide (see Table 11.5). The operation of these GDSs is governed by regulations intended to prevent the host airline or airlines from biasing the display to their advantage, though there has been considerable controversy surrounding "display bias" over the years.

GDSs communicate with the host reservation system of each airline to periodically obtain availability information. A travel agency subscribes to a GDS and makes bookings through it. The GDS in turn sends messages to the host reservation system of each airline involved in the itinerary of a given booking. Airlines are charged a fee for each one of these GDS booking transactions.

When the host reservation system of an airline closes a booking class, it sends a message to all GDSs indicating that a particular class on a particular flight is closed. The GDSs in turn display the new availabilities to travel agents' queries. The communication requirements between the travel agent, GDS, and the host reservation system are very demanding, usually requiring that the connect and transaction be completed in a second or less. A few million transactions are processed by the GDSs each day.

For competitive purposes, so as not to reveal their inventory decisions to competing airlines, airlines do not reveal their complete availability information to GDSs. For example, an airline may post an availability

of Y4 to a GDS; meaning four seats are authorized for sale in Y class, even though there may be 50 seats remaining on the flight.

## 10.2 Hotels

The hotel industry is another industry in which RM is well established. Hotels are categorized as business, extended-stay, resorts, or a mix of business and leisure and also by size (large, small) and location (airport, urban, central business district or CBD, highway, beach). Hotels may be managed by independent owners, as part of a chain that is managed directly by employees of a single corporation, or as part of a franchise. Some hotel companies manage only individual properties, while large hotel chains can own thousands of properties under multiple brand names. Chains sometime manage a property without taking ownership. This diversity in the types and operations of hotels means RM practices in the industry also vary quite a bit.

### 10.2.1 Customers, Products, and Pricing

Like airlines, hotels have both individual and group customer segments. Free individual travelers *(FITs),* are guests who book their own rooms, whether for business or leisure. Some FIT segments include corporate, long-stay guests (those who stay greater than one week), individual vacation packages marketed by the hotel itself (such as honeymoon or golf), weekend packages, and walk-in customers. In addition to FITs, hotels receive demand for single rooms from travel packages sold by travel agencies or airlines. The groups segment is made up of tour groups, conference groups, incentive groups (such as salesforce reward parties), ad-hoc groups (an excursion group), and recurring groups (airline crew, cruise-line).

However, despite some of the similarity with airline customer types, the segmentation mechanisms used in hotel RM are somewhat different from those used by the airlines. For example, advance-purchase discounts, a prominent segmentation mechanism of airlines, are not that commonly used by hotels. The equivalent of the Saturday-night-stay restriction of airlines—intended to restrict access for business customers—is the weekend rate, applicable only for stays on Friday and Saturday nights.

#### 10.2.1.1 Room Revenues

Rooms are the primary source of revenue in most hotels, but hotels also generate significant revenues from secondary sources such as food and beverage sales, function space, activities (golf, ski, entertainment),

and gambling (in the case of casinos). For this reason, the value of a customer to the hotel may be hard to determine exactly. For example, a customer's restaurant spending for food and beverages is uncertain at the time of booking. Table 10.2 summarizes the typical revenue sources for a hotel. Despite their importance to customer profitability, these additional sources of revenue are often not accounted for in hotel RM systems, though some RM systems do work with the average *net* revenue for each rate product.

#### 10.2.1.2 Room Types

The rooms of a hotel are usually classified into several *room types* with up to 40 room types, each with a potentially different rate. Some examples of room types are presidential suites, suites, deluxe rooms, business-floor rooms, standard rooms, executive rooms, lower-floor rooms, preferential rooms and room with a view. Other classifications include smoking or nonsmoking rooms, and single or double bed, with small differences in prices between these classifications.

Even though there can be many different room types, they are normally grouped together into three or four categories for capacity-control purposes. For example, the classification may be reduced to suites, business rooms, and standard rooms, equivalent to airline compartments. There is normally a gradation of rates in these categories and a large difference in the average rate between categories. The rates for each room type are again grouped together into only a few classes for RM purposes.

#### 10.2.1.3 Room Rates

Rates start off with what is called a *rack rate*—or the *published rate*—which is the highest rate for a given room type (equivalent to Y for the coach class in airlines). Rates go down as a percentage off the rack rate. The rates are usually referred to as 90%, or 80% (off rack).

A customer can qualify for a particular rate based on his affiliation (company, government, diplomats), membership (automobile clubs such as AAA), or individually negotiated discounts. Travel agencies negotiate discounted rates, called wholesaler's rates, which can be lower than corporate rates. Even these *wholesalers' rates* vary significantly from one vendor to another. It is not unusual for a large hotel to end up with up to 150 rates. The rates are usually adjusted only once or twice a year. Hotels typically aggregate both the rates and the customer types, leading to about 10 to 12 *rate bands* (or classes) for inventory control.

Pricing for a multiresource inventory (multinight stay request) for hotels is almost universally taken as the sum of the daily rates. This is

in contrast to airline pricing where the fares of a multileg itinerary have little to do with the prices on the individual segments. This difference arises because a multinight stay does not constitute a different "market" per se, whereas in the airline industry different itineraries serve quite distinct geographical markets with potentially very different levels of competition. The only exception to this simple way of pricing multiday stays is when a hotel offers one or two nights free for longer stays (akin to a volume discount).

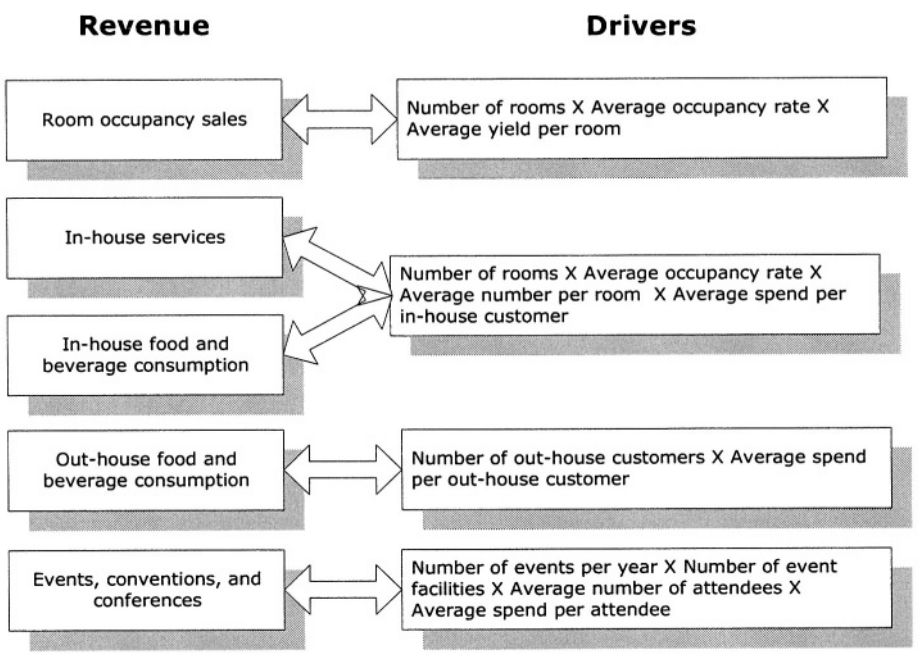


*Figure 10.2.* The main revenue sources and revenue drivers for a hotel.

## 10.2.2 RM Practice

As mentioned, hotel RM practices tend to exhibit greater variation than airline RM practices, mainly due to the more fragmented nature of the industry. Still, one can identify common elements.

#### 10.2.2.1 Booking Process

In a typical large hotel, approximately 60 to 80% of bookings are made directly with the hotel, either locally, through the Internet, or through a centralized call center. The remaining bookings come from GDSs.[3]

Customer bookings arrive anywhere from one to 18 months in advance. However, a large part of the reservation activity—at least corporate and transient bookings—happens during the last few days preceding the room-usage date. Reservations may or may not be guaranteed by credit card, though this practice varies by region and country. Not surprisingly, cancellation rates are quite different when reservations are guaranteed by a credit card versus when they are not guaranteed.

Hotels typically follow one of two distinct policies with respect to rate quotations. One policy is for the reservation agent to quote the "best-available rate"; the second is to use a "top-down" quotation policy, where the quote starts with the higher rates and the agent in essence "bargains down" the rate depending on the customer response, by offering different room types or packages. This latter policy is partly due to the richer variety of the inventory in hotel products and can be considered a type of information discovery mechanism between the agent and customer. However, the practice of negotiating rates, which is a rather unpleasant experience to many customers, is declining with the increased use of Internet booking engines where the norm is to offer a menu of available rooms and packages and customers self-select the class and room-type combination.

Corporate bookings in many hotels follow a somewhat different process. If the request is turned away because that corresponding class is closed, then reservation agents typically attempt to sell a higher room category, rather than quote a higher rate for the requested category. This is normally because of contractual restrictions between the hotel and the corporation or wholesaler. Some corporate contracts guarantee last-room availability, which ensures the customer can book a room if one is physically available.

#### 10.2.2.2 Property Management Systems (PMS)

Hotel reservations are controlled by a *property management system (PMS)* that automates the flow of the vast information required in the operation of a hotel.

[3]The Hotel Electronic Distribution Network Association (HEDNA) reported that in 1999 the GDSs delivered over 43 million bookings for hotels, with a value in excess of $12.5 billion [96].

*Table 10.2.* Features of a hotel property management system (PMS).

*Reservations Options*
Individual, group, shared, and multirate reservations
Add, change, cancel bookings including multiple legs
Standard, package, negotiated, and group rates
Multicurrency rate displays
Reservation agent opportunity messages
Online automatic up-sell messages
Geographic and regional property search
Property detail
User definable products available by rate code
Unlimited rate availability strategies and restrictions
Multiple rate codes for automatic entitlement rate display
Wait-list capability; automatic wait-list queue
Query system for reservation action items
*Rates and Inventory Control*
Multilevel inventory control by room class and room type
Maximum occupancy by room type
Rate plans
Property rates in multiple currencies
Rates confirmed in multiple currencies
Support for packages
Negotiated rates
Tax calculations
Available rate codes based on arrival date, number of nights etc.
Supports generic room types
Room and rate management
Transaction activity by agent
Online written, e-mailed, or faxed confirmations
Capture brochure requests
Revenue and forecasting reports
Security controls
User-definable work menus

*Customer profiles*
Multiple address capability for each profile
Member or club numbers
Profile merging
Client ID number automatically or manually assigned
Profiles include preferences for products, room types.
Preferences may be used as defaults when assigning rooms
Ability to over-ride overbooking parameters
Notation of special commission for client, agent, or source
Membership tracking
Profile relationship linking
Credit-card numbers
History statistics
Groups and Blocks
*Room and rate restrictions*
Open
Closed
Closed to arrival
Minimum length of stay
Maximum length of stay
Maximum number of persons
Seasonal close
Stay through
Advance booking
Open/close room types by rate code, property, room class, etc.
Administration
*Group rooms control*
Room inventory allotments with cutoff date or days
Online customer surveys
Tour series (recurring group stays)
*Global distribution system interface*
Interfaces to GDSs

The PMS records many transactions, like meal and beverage sales, in real time, and many others, like arrival updates and billing, in batch mode at night. In addition, the PMS controls many other functions such as accounting, billing, employee records, security, and supplies inventory and ordering. The features of a modern PMS are given in Table 10.2.

The PMS is usually linked to external GDSs or, for a hotel chain, to a hotel's own corporate reservation system. Most of the principal GDSs, as well as many travel and tourism Internet sites, list hotels with live (seamless) connections either to the hotel-chain reservation system or directly to the hotel PMSs. The GDSs list room types and attributes (bed type) and typically store only the rack rate and one or two discounts below the rack rate. Therefore, GDS bookings come only in a relatively limited number of classes.

The PMS communicates with a GDS through a *consolidating system* (belonging to so-called *switch companies).* The two leading consolidating systems belong to Pegasus (formerly THISCO—The Hotel Industry Switch Company) and WizCom (owned by Cendent Corp. and previously owned by Avis Rental Car Company). These consolidating systems broadcast the PMS availability message to the major GDSs and also consolidate the GDSs' booking messages. As a result, the communication between PMSs and GDSs is not instantaneous, but the systems are moving toward a query-reply mode.[4] Hotels have to pay a fee for each booking through a GDS (approximately $4.50), the switch company (approximately $0.45), and also a commission to the hotel chain/representative (if applicable). In addition, frequent-flier costs (about $8 to $9 per booking) and travel-agent fees (about 10% of revenues), reduce the revenue received for a room.

### 10.2.2.3 Overbooking and Cancellations

No-show rates in hotels range from 7% to 20% depending on the rate category. Cancellations and no-show depend on time of booking (later bookings tend not to no-show), credit card guarantees, whether the room is being shared, and so on. A cancellation happens not only when the customer calls to cancel but also if the customer decides to check out early. This means that the future capacity of the hotel is often uncertain.

Overbooking is widely practiced in the hotel industry. The hotel equivalent of an airline denied-boarding is when a customer is "walked" to another hotel. In general, hotels are conservative in overbooking, and walking a customer is a relatively rare event. Sometimes hotels walk a

[4]See the discussion of seamless availability in Section 11.2.3.2. Many GDSs today have this capability.

"less valuable" customer (a one-night stay guest) even when a room is available, to avoid walking a "more valuable" customer (long-stay guest) who is slated to arrive later. Aggregate supply and demand in the locality is taken into consideration when setting overbooking limits. For example, if there is a convention or festival in the city and all the surrounding hotels are likely to be full, a lower overbooking limit is normally set.

Overbooking of a different type occurs in resorts and leisure hotels that work with tour operators. The hotels sign an agreement with the tour operator to guarantee a minimum number of rooms (*allotments*), but the tour operator is usually not obliged to fill the rooms. The hotel can sign for more allotments than it has rooms, hoping that by pooling the allotments across tour operators the final show demand will be less than its capacity.

#### 10.2.2.4 Capacity Controls

Hotel capacity controls follow the traditional nested allocation and bid price[5] schemes of airlines, with a few important differences. For one, control is often based on the length of stay. A *minimum length-of-stay control* is often used to accept only stays over a certain duration. The rationale for this type of control is that during high-demand period, the hotel does not want short-stay customers occupying rooms for a small number of days and displacing demand of longer-stay customers. A *maximum length-of-stay control* is the opposite; it sets an upper bound on the duration of stay, so lower-revenue, long-stay guests do not displace higher-revenue, short-stay guests. A *closed-to-arrival control* restricts bookings that start on a selected date. An *open-for-day use* means only bookings with zero nights (only day use) will be offered (in a specified rate code).

These length-of-stay controls are somewhat redundant if a hotel RM system uses a bid price system; nevertheless, many PMS systems still offer them to support incumbent hotel pricing structures and management practices. (See Table 10.2.)

Most hotel RM systems make intraday forecasts and optimize much more frequently than do airline systems. It is not unusual to see optimization being run every hour as the date of usage nears.

[5]With bid price implementations dominating. In the hotel industry, bid prices are sometimes referred to as *hurdle rates.*

## 10.3 Rental Car

RM practices in the rental-car industry have similarities to both the airline and hotel RM. However, again there are differences worth noting.

### 10.3.1 Customers, Products, and Pricing

There are six major rental-car companies in the U.S.: Hertz, Avis, National, Budget, Alamo, and Dollar, with nearly 95% market share between them. The business is somewhat similar to that of hotel chains: some own all their properties, some work on a franchise basis, and a few, especially at remote locations, just take bookings and subcontract out actual car rentals to a local company.

A significant percentage of their business comes from airport locations, so it is no surprise that the customer segments for rental cars closely mirror those of airlines. The deregulation of the airline industry also affected rental-car companies significantly, increasing the volume of business and changing the mix of business and leisure customers.

The product of a rental-car company is a combination of car type (there can be up to 20 car types), insurance options, pickup and drop-off location, advance purchase restrictions, and length of rental. Many corporations and travel agencies negotiate special rates with car-rental companies, which are accessed through special discount codes. These contracts are usually for a fixed-per-day price across all or most locations for a given period. Segmentation also occurs in the channels of distribution, with special discounts for booking directly on the company's website.

There are some subtle differences in customer booking and rental behavior compared with airlines and hotels. A customer who shows up at a hotel or for an airline flight at the last minute (called a *walk-up)* is usually willing to pay a high price for the service because the limitations imposed by airline schedules or hotel locations restrict their alternatives. Such walk-ups, therefore, pay near full price in those industries.

On the other hand, most car-rental counters are located at airports, clustered together; so walk-up customers have many alternatives to choose from with little search costs for shopping around. Therefore, the prices quoted to such walk-up customers are heavily influenced by the local availability of cars and competition. In periods of low demand, prices may actually be lower on the day of the rental than they are when booked in advance. On the other hand, during peak-demand periods, carefully setting aside inventory for walk-ups can have revenue benefits, just as in the airline industry. Such last minute pricing for day-zero

customers is typically the responsibility of local field managers, and RM systems have to account for the resulting uncertainty in day-zero prices.

### 10.3.2 RM Practice

One significant feature of car-rental RM is the nature of capacity. Capacity is much more flexible than it is in either airline or hotel RM. For example, a rental-car company may operate more than one location in a city or a geographical area (for example, a downtown and an airport location). Inventory at each one of the locations can be pooled (*intrapool*), allowing greater flexibility in adjusting capacity to meet demand. Even if there is only one location in a given area, capacity can usually be increased or decreased by *interpool* moves, by moving cars from nearby cities, and also by controlling the sale of older vehicles and turn-backs to manufacturers. Small adjustments to the fleet size at a location can therefore be made on a weekly basis if need be.

Available capacity is also affected by customers who rent at one location and drop off at another (*migratory inventory,* Carroll and Grimes [100]), creating a network imbalance, or by customers who return the car earlier or later than their planned return date (akin to a hotel guest who understays or overstays). This means the capacity itself is often uncertain.

Free upgrading, in which a customer is given a car of higher rental value for no extra charge, is also an important factor in rental-car RM. Indeed, when demand for a lower car type exceeds the available inventory and the forecasted demand for a higher category car type is low, car-rental companies often plan to give free upgrades. This practice is analogous to planned overbooking over multiple compartments by airlines, where economy passengers who cannot be accommodated in the coach compartment get free upgrades to business-class (see Section 4.5). However, the practice is more prevalent in car-rental RM because there are many more inventory types and the capacities are more evenly balanced across the different car types.

Business customers typically select mid- and full-size vehicles, have insurance protection and gas included in the rate, and rent and return during the week. Leisure customers drive smaller cars or vans and on average rent longer than business customers. As a result, RM product-segmentation restrictions include Saturday-night stay, minimum length of stay, and weekend rates to stimulate midweek rentals. Many rates have blackout periods where they are not available (such as holiday weekends).

Carroll and Grimes [100] describe an implementation of a RM system at Hertz. Although at the core, the system calculates marginal values

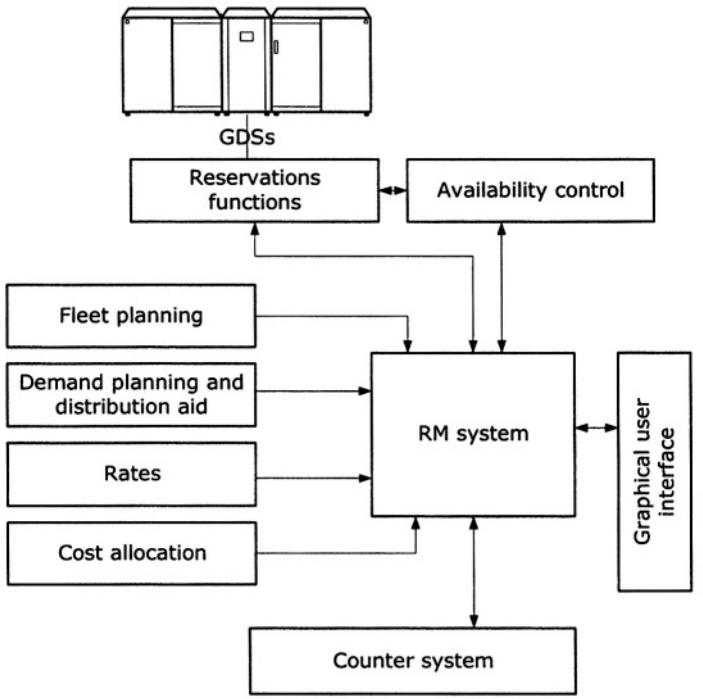


*Figure 10.3.* A rental car RM system implementation.

and uses a bid-price control to make accept/reject decisions for bookings, it differs from airline RM systems in some significant ways. Most notably, RM is very closely integrated with capacity planning—how many cars to purchase, where to deploy them, what products to offer and sell. Figure 10.3 shows the relationship between the RM system and the capacity management systems.

## 10.4 Retailing

RM in retailing is a relatively new but growing practice. Apparel and grocery retailers have to deal with highly perishable and seasonable products. High-tech retailers (PCs, consumer electronics) have similar problems, as their inventory loses value rapidly due to technological obsolescence. These characteristics mean that tactical demand management is important economically for retailers. Recently, a number of specialized software firms have entered the market for providing RM systems to retailers, and several major retailers have adopted or are testing these systems. Retail RM differs from the industries we've discussed thus far in that dynamic pricing, in the form of discounts, markdowns,

*Table 10.3.* World's top 10 retailers, store types, and their revenues for the year 2002.[a]

| | *Country* | *Name* | *Format* | *Retail Sales (US$ mill)* | *Income (Loss) (US$ mill)* |
|---|---|---|---|---|---|
| 1 | U.S. | Wal-Mart | Discount, hypermarket, supermarket, superstore,warehouse | 217,799 | 6,671 |
| 2 | France | Carrefour | Convenience, discount, hypermarket, supermarket | 61,565 | 1,069 |
| 3 | Netherlands | Ahold | Cash and carry, convenience, discount, drug, hypermarket, specialty, supermarket | 57,976 | 1,207 |
| 4 | U.S. | Home Depot | DIY, specialty | 53,553 | 3,044 |
| 5 | U.S. | Kroger | Convenience, discount, specialty, supermarket, warehouse | 50,098 | 1,043 |
| 6 | Germany | Metro | Cash and carry, department, DIY, hypermarket, specialty, superstore | 43,357 | 398 |
| 7 | U.S. | Target | DIY, specialty | 39,455 | 1,368 |
| 8 | U.S. | Albertson's | Drug, supermarket, warehouse | 37,931 | 501 |
| 9 | U.S. | Kmart | DIY, specialty | 36,151 | (2,418) |
| 10 | U.S. | Sears | DIY, specialty | 35,843 | 735 |

[a] *Source:* Deloitte, Touche, and Tohmatsu, "2003 Global Powers of Retailing," Stores, January 2003.

and promotions—rather than capacity controls—are used to manage demand.

### 10.4.1 Customers, Products, and Pricing

Characterizing retailing practices is difficult because retailers sell very different products using a variety of different formats and channels. Broadly, retailers can be classified as either selling durable or nondurable goods. Durable-good sales constitutes between 35 to 45% of total retail sales in the U.S. [485]. Table 10.3 gives a list of the top 10 retailers of the world and their revenues for the year 2002. The revenue of the largest retailer, Walmart, exceeds $200 billion, which gives an idea of the importance of even small incremental gains from RM. Table 10.3 also shows the different categories of stores for each of the firms. Among the

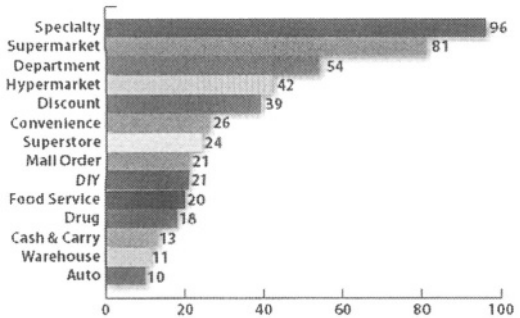


*Figure 10.4.* Store type breakdown for the top 200 retailers (*Source:* Deloitte, Touche, and Tohmatsu, "2003 Global Powers of Retailing," *Stores*, January 2003).

top 200 retailers of the world, the breakdown by store type is shown in Figure 10.4.

Some retailers—such as a grocery stores, department stores, and e-commerce sites like Amazon.com—sell an assortment of products from different manufacturers and suppliers. Others sell only own-brand or private-label merchandize—such as direct-to-consumer firms like Gateway and Dell and private-label retailers like The Gap or Eddie Bauer. There are specialty stores that carry a deep selection of one type of product, and mass merchants and department stores that sell a tremendous range of products. Retailers may sell through physical stores, catalogues, and online—or some combination of all three. Competition is generally considered intense in the retailing industry because consumers typically have many alternatives and can buy through many different retail channels. Profit margins in the retail industry rarely exceed 3%, as can be seen from Table 10.3.

However, customer do vary in terms of their geographical location, their preference for different channels, the importance they place on customer service and the in-store experience, their preference to buy early rather than late in the season, and their willingness to spend time searching products and prices. As a result, time of purchase, sales channel, and location tend to be the major segmentation mechanisms used in retail RM.

Regardless of the format, most retailers have to manage prices for thousands of *stock-keeping units (SKUs)* and control a large number of in-store and out-of-store promotional campaigns. Moreover, prices can vary based on the channel of distribution and by geographical region or country. There are also several ways of implementing price changes—

including coupons, promotions, markdowns, and tie-ins. Thus, the number of prices that need to be managed can be very large indeed.

The challenges of RM vary depending on the type of retail environment. As a sample of these differences, we next look at RM practices in apparel, grocery, and Internet retailing.

#### 10.4.1.1 Apparel Retailing

Apparel has short life cycles and is usually progressively marked down, and at the end of the sales season taken off shelves and sold at clearance prices or through discount outlets. Figure 10.5 shows the magnitude of markdowns over the last 20 years. Indeed in retail management, a firm's markdown dollar budget, defined as the original list price minus the final sale price, is a closely tracked number.

The duration of the apparel sales season may be anywhere from a few months to a year. Most apparel is manufactured overseas (for U.S. and Europe) and has to be ordered well ahead of the sales season. The production and ordering cycle is often too long to reorder during a season, so retailers must precommit to the quantity stocked of each item.[6]

Forecasting is an important and difficult task in apparel retailing. Items have to be ordered by size, color, and style. For a retailing chain, inventory also has to be allocated by store and the retailer may occasionally need to redistribute inventory. As apparel items are often new and unique every season, there may be little historical data available for forecasting. Hence, the judgment of store buyers plays an important role and some RM systems use Bayesian forecasting techniques to merge a buyer's prior beliefs with observed in-season sales data (see Section 9.3.6).

The initial price of items in apparel retailing is generally determined manually (at least for "designer merchandize" [506]) because of the judgment required to evaluate brands, quality, and design attractiveness. In addition, price targets are often part of the initial product planning for an item. Once prices are set, RM systems are used to manage the timing and depth of markdowns based on sales trends (at the store or regional levels), inventory levels, forecasts and managerial targets, and business rules. Promotional events also influence the markdown strategy. RM systems also typically provide "what-if" analysis that allows managers to estimate the impact of markdowns. In addition to markdown decision support, the RM system may provide forecasts, initial buy recom-

[6]The exception is the use of "quick response" supply strategies, which attempt to provide within-season replenishment of apparel, using both fast logistics and domestic manufacturers.

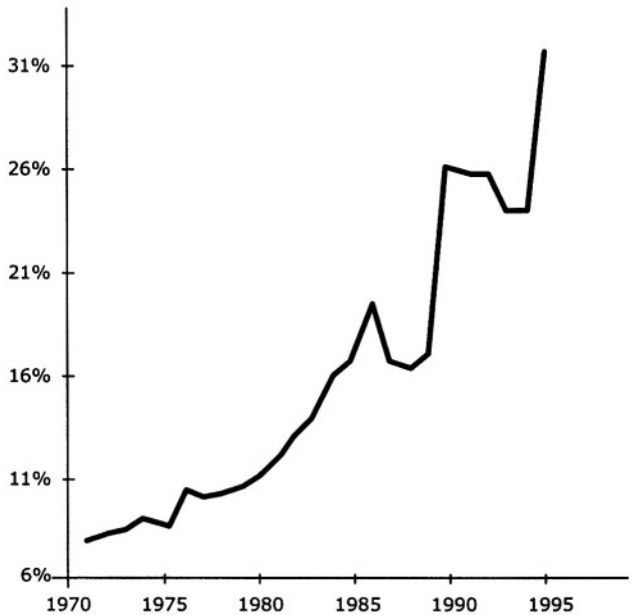


*Figure 10.5.* Growth of department-store markdowns as a percentage of store sales (*Source:* Merchandizing and Operational Results of Department and Speciality Stores, National Retail Federation).

*Table 10.4.* U.S. apparel sales by channel.[a]

| *Category* | *1999 Sales (US$ mill)* | *2000 Sales (US$ mill)* | *2000 Market Share %* |
|---|---|---|---|
| Brick-and-mortar | 167,346 | 169,256 | 92.9 |
| Catalog | 9,428 | 7,177 | 3.9 |
| Online/Internet | 2,904 | 5,873 | 3.2 |
| Total apparel | 179,678 | 182,306 | 100 |

[a] *Source:* NPD Group Inc.

mendations, store-level allocations, size allocations, and replenishment recommendations.

### 10.4.1.2 Grocery

Grocery retailing differs from apparel in several respects. First, most goods are consumables that are purchased repeatedly by consumers over time. In addition, goods are replenished frequently. As a result, inventory constraints and seasonalities are less of an issue in grocery retail RM. However, there are significant substitution effects in grocery re-

*Table 10.5.* U.S. apparel sales by category.[a]

| *Segment* | *Volume (US$ millions)* | *% Change vs. 1999* | *%* |
|---|---|---|---|
| Men's | 63,300 | -0.3 | 34.7 |
| Women's | 96,588 | 2.1 | 53 |
| Boys' | 7,653 | -2.2 | 4.2 |
| Girls' | 7,114 | 1.1 | 3.9 |
| Infants' and toddlers' | 7,651 | 13.1 | 4.2 |
| Total | 182,306 | 1.5 | 100 |

[a] *Source:* NPD Group Inc.

tailing. Consumers have choices of many brands, and brand-switching behavior is common. Consumers also stockpile, buying many units of a product when the price is low, which reduces their future purchases. Therefore, grocers have to consider the value of consumers' purchases over time and plan to attract both current and repeat purchases. Consumers also tend to be more price-sensitive with repeat-purchase products, and in general, there is less differentiation of products and ambience among grocers. All this leads to more direct and intense price competition. Margins in the grocery business are also very low.

Other factors link the RM decisions for related products in grocery retailing. Stores are often more concerned with the profits they generate on a *category* of products than on the profits they generate on any given brand or given product within a category. This has led many stores to adopt a *category management* approach to pricing and inventory decisions.

Additionally, consumers often shop a grocery store for a bundle of goods. As a result, stores may stock and price certain products more for their effect on consumers' store-choice decisions rather than for the profits they generate directly. Also, consumer perceptions on whether the retailer has high or low prices are formed largely through repeat-purchase items (such as milk or bread). Low prices (even at or below cost) on these items can drive traffic to a store and benefit overall sales and customer satisfaction. However, a low-price "loss-leader" strategy is normally applied only to a small subset of products. These so-called *market-basket effects* play an important role in RM in the grocery sector.

Grocery stores also carry a tremendous variety of products. An average grocery store may stock nearly 40,000 SKUs. The product mix consists of both perishables (meat, vegetables and diary products), nonperishables (consumer packaged-goods or dry goods; toilet paper, canned tomatoes, pet food), and frozen and chilled goods, each requiring a different pricing strategy.

Because of the large assortment of products, *menu costs*—the costs of changing prices—is an important consideration for grocery retailers. Electronic devices that are connected to a database and can change prices automatically (electronic shelf labels or ESLs) reduce these costs but are not yet widely deployed. In the vast majority of cases, grocers implement price changes by having clerks manually retag products with new price labels. This process is both expensive and time-consuming. Consequently, prices for many items are relatively stable and change only for competitive reasons or for manufacturer promotions or discounts.

The initial price for fruits and vegetables tends to follow a market price determined by overall supply and demand in wholesale markets. Retail prices are then marked down as the expiration date nears. For nonperishables, the price is influenced strongly by the manufacturer's wholesale pricing. Volume discounts (truckload pricing) is common and may influence a retailers ordering and pricing strategy. Trade promotions at the wholesale level are also a common practice and retailers may or may not pass these trade promotions on in the form of lower retail prices.

Promotions are very common in the grocery industry, and retail RM systems help grocery stores plan and execute promotions optimally. RM models recommend which product in which category to promote, the size of the products to promote, the best advertising strategy (amongst display, local ad or regional ad) and the optimal discounting to meet the store's objectives. RM software may also recommend baseline prices for products, depending on the store positioning (for example, quality products, convenience store, warehouse food market), store location, and local demographics.

#### 10.4.1.3 Internet Retailing

The RM issues faced by Internet retailers are somewhat distinct from those of bricks-and-mortar retailers. For one, an unprecedented level of customization and customer profiling can be performed while the customer is shopping online. The Internet also makes prices more transparent to consumer, which makes price comparison easier; "shopbots" and price-comparison sites gather information from multiple vendors, allowing consumers to compare prices easily and in real time. At the same time, prices can be changed by online retailers at near-zero cost.

These features have led to two early predictions on how the Internet would affect retail pricing practices: first, that Internet prices would be significantly lower than in traditional brick-and-mortar store prices, and prices would vary little from one retailer to another; and second, that retailers would move to real-time dynamic pricing, customizing price based

on supply and demand and their knowledge of the individual customer. However, neither of these predictions has proved to be true. Internet prices show significant variations among retailers—as much, if not more, than the price variations observed among bricks-and-mortar retailers—with the largest retailers not necessarily selling at the lowest price. A survey by McKinsey [126] showed that Internet shoppers rate price as relatively low in importance in their purchase decisions; brand, product information, and customer service rate consistently ahead of price. The same McKinsey survey [126] finds only 8% of Internet shoppers are bargain hunters, who would buy only at the cheapest e-retailer.

To quote Eli Katz, president of e-Commerce for Fragrance Counter and Cosmetics Counter [505], a retailer that does not discount heavily:

> There's always going to be customers who look for price, and there's always going to be customers who look for service, just like some people shop at Saks and some shop at Walmart. That will hold true on the Web as well.

The second prediction, that firms would practice dynamic pricing, has also only partially borne out. To quote Ken Harris, CIO of Gap Inc. [250]:

> I wouldn't rule it [dynamic pricing] out. Right now, I don't think it's quite ready. It's important that consumers understand how pricing is determined and that they feel it's fair.

Stephen Hamlin, VP of operations for iQVC, the Internet arm of the QVC Shopping Network [250] echoes this sentiment:

> One thing we really believe in is unilateral prices. If it's on TV for one price, it's on the website for that same price; if it changes on TV, it changes on the Web.

Moreover, there has also been some high-profile consumer backlash against dynamic pricing online. The most famous such incident occurred in 2000 when Amazon.com was discovered to be offering different prices for the same DVDs to different customers based on their profiles.[7] An incident with one consumer was widely reported in the news media, and Amazon quickly stopped the practice in the wake of this publicity. (See Section 11.5 for further discussion in a RM implementation context.)

While explicit price manipulation has not been well received by consumers, other marketing tactics are practiced very efficiently on the Web. Tools such as *collaborative filtering* (a data-mining technology that infers customer tastes based on "similar" customer purchases) create product

[7] "On the Web, Price Tags Blue," *Washington Post,* September 27, 2000.

recommendations and presentations in real-time based on customer information and current shopping behavior. Volume discounts are offered to encourage customers to buy larger quantities or bundles are created to increase their buy size. Online promotions and coupons are tailored to separate the price-sensitive customer and induce a customer to make a purchase. Such tactics are largely rules-based in current e-CRM applications, though it is likely that models and algorithms will play a more significant role in optimizing these decisions in the future.

Another new use of the Internet for e-tailers is online price testing. Selling at a single price provides very little information about the price sensitivity of customers. Because of the low menu costs for e-tailing, experiments are conducted online to gauge price sensitivity. A few price-optimization vendors provide this capability in their products.

## 10.4.2 RM Practice

There has been significant commercial activity in retail RM in recent years, with several new technology vendors offering software systems targeted at different segments of the retail industry. These retail RM applications focus on improving gross margins by optimizing base prices, markdowns, and promotions.

As mentioned, a key difference between retail RM and traditional airline and hotel RM is that it is price-based rather than quantity-based—that is, market-response models are utilized for dynamic pricing. This requires an ability to estimate the demand effects of short-term price changes.

Another important difference is that historical data is often inadequate for making good demand forecasts, especially for seasonal, fashion and high-tech products. Thus, there is more emphasis on forecasting demand for an item based on its in-season sales and the sale of "comparable" items. Experimenting with price changes at a sample of locations is also a common technique for gauging price sensitivity.

### 10.4.2.1 Features of a Retail RM System

Besides the price-optimization functions, retail RM applications provide important operational and productivity benefits, such as

- Automating routine price changes by location and channel,
- Monitoring profit or sales targets for items and categories,
- Tracking the performance of promotions and advertising campaigns,
- Maintaining consistent pricing and rounding rules,

- Automating price matching based on competitor prices,
- Supporting price-sensitivity experiments, and
- Generating periodic reports and statistics to track pricing performance.

Retail RM systems may also include other nonprice decision support tools for initial store allocation and assortment decisions, and reordering and replenishment of products. Indeed, the current trend is for retail RM to be combined within a SCM system under the label *retail analytics.*

#### 10.4.2.2 Data Sources

The data available for retail RM is very rich indeed. Point-of-sale (POS) scanner data provides detailed and complete transaction data in an electronic format and is available almost instantaneously to retailers (and manufacturers). E-commerce channels add click-stream data, making it possible to monitor shopper browsing behavior and estimate customer responses.

In addition, *panel data* tracking total household purchases for a sample of consumers, available from market-research firms like IRI and Nielsen, allows companies to track and estimate brand-switching and market-share information over time. Other firms, such as AWIS Weather Services and Meteorlogix, supply forecasts of weather by micro-region that can be incorporated into sales-forecasting models for traffic and weather related items. Demographic data (age, income level, housing costs) by micro-region is also sold by many firms.

Finally, most large retailers have inventory-control systems, ERP systems, and SCM systems that link to supplier inventory systems, accounting systems (for cost and labor rates), financials, and inventory-management systems.

Retail RM systems use some or all of these data sources to perform demand forecasting and pricing optimization. They download current data from a store's POS and ERP/SCM systems and combine this with the store's historical data to calibrate forecasting models of demand. The models often require some input from buyers and analysts—for example, to identify a past product that is "similar to" a new product the store is introducing.

## 10.5 Media and Broadcasting

As with retailing, RM in the media and broadcasting industry is a relatively new practice. Indeed, to date, only a few networks and television stations are reported to practice RM. These include the Seven

Network in Australia, NBC in the U.S. [83], and CBC of Canada [184]. Still, the advertising market is large and has many of the characteristics conducive to the practice of RM. The sale of advertising time in broadcasting, though superficially similar to the sale of airline seats or hotel rooms in the sense that it too is a sale of a perishable commodity, has features and practices that make it quite distinct.

## 10.5.1 Customers, Products, and Pricing

Advertising time is normally bought by ad agencies on behalf of clients. The station either sells the space directly or through national sales representatives working on behalf of the television station or network. Advertising agencies also sometimes buy blocks of time in anticipation of demand from clients. Advertisers can be local, regional, or national and are additionally classified by industry (beverage product category, automotive or local dealers, and so on).

Advertisers also vary in their time sensitivity. Some are advertising for specific promotional events, so timing and placement of ads are critical, and they may require this space on very short notice. For others, their ads are for general brand awareness or for public information campaigns, so the exact timing of ads is less important and moreover can be planned well ahead of time.

### 10.5.1.1 Advertising Product

The advertising product is classified based on demographics (such as, adults 18+ or females 13–18) and also the time of the spot (prime-time, late-night). Table 10.6 shows how inventory is specified in television, radio, and print media.

Demographic differences in a show's viewership mean that the value of a particular slot for a particular advertiser can vary, so segmentation of buyers based on demographics is common. The demographics-based requirements of advertisers also give broadcasters the flexibility to substitute times and programs. For example, if it turns out that a particular time slot is oversold, a customer will usually accept a different time slot with similar demographics, though many advertisers have strong preferences for specific programs.

### 10.5.1.2 Sales Process

Advertising space is typically sold in both an upfront (long-term) and scatter (short-term) markets—and also on an opportunistic basis (called *remnant* space for print media). The television market is further divided into national, cable, and local (spot) markets.

*Table 10.6.* Inventory definitions in television, radio, and print media.

| *Media* | *Inventory Description* |
|---|---|
| Television | Day-part (time part into which a broadcast day is divided) (e.g., daytime, early fringe, access, prime, evening news, late fringe)<br>Audience composition (demographics), (e.g., women 25–54<br>Ratings (e.g., guaranteed 53.5)<br>Preemptability |
| Radio | Day-part (e.g., morning drive, mid day, afternoon drive, night<br>Audience composition<br>Ratings |
| Print | Total pages, issue dates, positioning, separation, cancellation options |

*Table 10.7.* A sample advertising purchase plan.

| *Qtr.* | *Purchased* | *Firm* | *Option* | *Option Date* |
|---|---|---|---|---|
| 3Q | \$3 million | \$3 million | \$0 million | – |
| 4Q | \$10 million | \$6 million | \$4 million | 1 Aug. |
| 1Q | \$4 million | \$4 million | \$0 million | – |
| 2Q | \$6 million | \$4 million | \$2 million | 10 Jan. |

Up to 90% of national sales are upfront. Upfront sales are made at least a year in advance of airing, usually during the June and July period. Scatter sales are made each quarter, roughly three to six weeks in advance of airing. Opportunistic sales (similar to airline last minute sales) are the sale of distressed inventory just before airing. The prices for upfront sales tend to be 20% to 40% less than for scatter sales; prices for opportunistic sales can be as low as 50% below those of scatter sales.

Customers can purchase inventory as well as options on additional inventory, with a deadline for exercising the option. The combination is called a *purchase plan.* Table 10.7 shows a sample purchase plan.

### 10.5.1.3 Prices and Ratings

The sale price of an advertising slot is based on its *gross rating points* (GRP)—the percentage of a demographic group in a market viewing a program at a point in time. The GRP is measured after the show goes on air, based on a sample of viewers that keep a meter or a diary record. Therefore, at the time a slot is sold, the exact GRP of the slot is uncertain, and only estimates can be provided. Yet buyers pay for the actual GRP, typically on a *cost per thousand impressions* (CPM) basis. Consequently, if the GRP turns out to be less than the promised

GRP, the station may have to compensate the advertiser—usually by means of free additional time (called *make-goods* in the industry). On the other hand, if the GRP turns out to be more than that specified in the contract, the buyers usually do not have to pay more, and hence the station or network has lost a revenue opportunity. Ratings for new television shows in particular are highly uncertain.

CPM is usually guaranteed for upfront sales, and the advertisers specify the target CPM, demographics, frequency, and any other restrictions that they may have. In the scatter market, ratings are not normally guaranteed, and prices can vary depending on the viewership.

#### 10.5.1.4 Preemption

Preemption of scheduled advertisements is an accepted practice in the broadcast industry. That is, even if the station sells a particular time slot to an advertiser, if a higher offer is subsequently received from another advertiser the station may preempt the original advertiser, offering either to substitute another slot or return their money. This preemption is common in large media markets but less prevalent in smaller markets, where maintaining customer relations takes precedence. Hybrid practices, in which only a certain number of slots are sold as preemptable slots, also exist in the industry.

#### 10.5.1.5 Print Media

The sale of advertising in the print media is similar to broadcasting. The prices are based on readership and demographics, on the size of the advertisement, and on the number of issues that the advertisement will be run. Magazines tend to be much more willing than broadcasters to negotiate prices because their capacity is more flexible. Despite the similarities between print and broadcast media, we know of no reported implementations of RM in the print media, though it remains a promising area for applying RM principles.

### 10.5.2 RM Practice

Broadcasters use a wide variety of pricing structures in an attempt to enhance revenues. For example, the price for a slot may be based on the loyalty of the advertisers (the frequency rate card), whether the advertiser is a local or a national advertiser (the national and regional rate cards), the ratings (the grid rate card), and finally on how rapidly the inventory is being sold. These structures evolved partly to segment customers based on location and access to information, partly to differentiate the product based on demographics, and are also partly rough-cut

attempts at RM (for example, the prices may be raised based on remaining inventory levels). Taking a cue from airlines, some stations are attempting to further segment their customers based on time of purchase and penalties for cancellations.

The actual prices for each category of inventory are determined by competition and historical rates. In addition, many stations raise prices after a certain percentage of inventory is sold or offer last-minute discounts if time is unsold. Again, as mentioned above, it is not unusual to see (at least in major U.S markets) a system of preemption. However, advertisers typically get a lower price if they agree to allow their ads to be preempted. Controlling the use of preemptable and nonpreemptable slots is an important challenge for RM in the industry.

Another important factor in the sale of airtime is that it is rarely sold in units of a single time slot. Rather, a package deal is normally negotiated between the agency and station representatives. For example, the advertising agency may have a target GRP and demographic in mind for its client for a campaign over a certain period of time, and the agency's goal is to buy a package from a range of television stations, programs and time slots to meet that target. This makes it important for the broadcaster to know the value of each of its time slots to negotiate effectively. Therefore, estimates of the marginal opportunity costs of time slots (their bid prices) are useful information to a broadcaster.

This package-deal nature of sales introduces network effects into the evaluation and negotiation process. Just as an itinerary for an airline is a collection of resources, a package for a television or radio station is the sale of capacity for a collection of its shows. A station may therefore decide to accept an entire package even if it is losing money on certain time slots in the package, provided the overall net revenue contribution of the deal is positive.

Finally, a significant obstacle to RM in broadcasting is that sales practices in the industry vary widely, often depending on the traditions of each local market. This makes it difficult to construct a common RM model and system that is appropriate for a large number of media firms.

## 10.6 Natural-Gas Storage and Transmission

The natural-gas industry in the United States has undergone a process of deregulation since the mid-1980s. These structural reforms have led to a number of innovations, including experimentation with RM techniques.

*Table 10.8.* An example of a pipeline delivery contract.

| | |
|---|---|
| Rate schedule | FT-A |
| Service requester name | XYZ PAPER PRODUCTS CO |
| Service requester | 6139711 |
| Service requester proprietary | 70860 |
| Shipper affiliated indicator | N |
| Agent name | ABC ENERGY RESOURCES, L.P. |
| Agent affiliated indicator | N |
| Contract number | 13 |
| Contract effective date | 9/1/93 |
| Contract effective thru date | 4/30/04 23:59 |
| Rollover period | |
| Maximum daily quantity | 3,556 |
| Negotiated rate indicator | N |
| Footnote | |

| *Location Name* | *Location* | *Location Prop* | *Receipt Delivery* | *Location Zone* | *Location Segment* | *Quantity* |
|---|---|---|---|---|---|---|
| AAA PLANT DEHYDRATION | 38535 | 10144 | R | 0 | SU | 3556 |
| BBB STORAGE INJECTION | 125643 | 60018 | D | 4 | S2 | 3556 |

## 10.6.1 Customers, Products, and Pricing

In 1985, *Federal Energy Regulatory Commission* (FERC) of the United States issued Order 436, which required pipelines to provide open access to their facilities, allowing consumers to contract separately for purchases of gas and for transportation services. This encouraged better balancing of supplies of gas among producers and consumers. The *Natural Gas Wellhead Decontrol Act of 1989* required the removal of all price controls on wellhead sales by 1993, allowing natural-gas prices to be freely set in the market. Similar deregulation is in progress in a number of other parts of the world as well.

Because of these reforms, the gas industry has gradually moved away from long-term minimum-purchase contracts between the pipelines and producers toward short-term contracts and spot-markets for buying and selling gas. This has tremendously increased the volatility of both prices and demand for pipeline services.

The gas-industry distribution structure consists of local distribution companies (LDCs), pipeline companies, retail marketing companies, and wholesale marketing companies. The customer base of these firms is diverse, ranging from large industrial users to individual homeowners.

*Table 10.9.* Sample base-line delivery tariffs for interruptible and noninterruptible delivery. The high rates for the non-interruptible service are used only on rare occasions. Normally the rates are calculated from traded natural gas (locational) futures prices on NYMEX (New York Mercantile Exchange) and other commodity exchanges (e.g., The Intercontinental Exchange).

*Interruptible Base Transportation Rates (IT)*
*(Per Dekatherm)*

| | *Delivery Zone* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Receipt Zone* | *0* | *L* | *1* | *2* | *3* | *4* | *5* | *6* |
| 0 | $0.185 | | $0.319 | $0.425 | $0.484 | $0.553 | $0.626 | $0.746 |
| L | | $0.157 | | | | | | |
| 1 | $0.325 | | $0.259 | $0.368 | $0.425 | $0.495 | $0.568 | $0.688 |
| 2 | $0.425 | | $0.368 | $0.177 | $0.235 | $0.315 | $0.377 | $0.497 |
| 3 | $0.484 | | $0.425 | $0.235 | $0.144 | $0.306 | $0.367 | $0.487 |
| 4 | $0.564 | | $0.506 | $0.315 | $0.306 | $0.169 | $0.197 | $0.317 |
| 5 | $0.626 | | $0.568 | $0.377 | $0.367 | $0.197 | $0.176 | $0.278 |
| 6 | $0.746 | | $0.688 | $0.497 | $0.487 | $0.317 | $0.278 | $0.208 |

*Base reservation Firm Transportation Rates (FT-A)*
*(Per Dekatherm)*

| | *Delivery Zone* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Receipt Zone* | *0* | *L* | *1* | *2* | *3* | *4* | *5* | *6* |
| 0 | $3.10 | | $6.45 | $9.06 | $10.53 | $12.22 | $14.09 | $16.59 |
| L | | $2.71 | | | | | | |
| 1 | $6.66 | | $4.92 | $7.62 | $9.08 | $10.77 | $12.64 | $15.15 |
| 2 | $9.06 | | $7.62 | $2.86 | $4.32 | $6.32 | $7.89 | $10.39 |
| 3 | $10.53 | | $9.08 | $4.32 | $2.05 | $6.08 | $7.64 | $10.14 |
| 4 | $12.53 | | $11.08 | $6.32 | $6.08 | $2.71 | $3.38 | $5.89 |
| 5 | $14.09 | | $12.64 | $7.89 | $7.64 | $3.38 | $2.85 | $4.93 |
| 6 | $16.59 | | $15.15 | $10.39 | $10.14 | $5.89 | $4.93 | $3.16 |

LDCs form the end stage of the gas supply chain, delivering gas to customers. They typically have to purchase in spot markets (at least for excess requirements), where prices are volatile, and sell at relatively fixed prices to their consumers. Futures contracts, swaps, and options are extensively used to manage the resulting risk. Retail marketing companies, which do not own physical distribution facilities, handle only the marketing and billing functions and contract with LDCs for delivery.

Wholesalers are one level up in the natural-gas supply chain. They buy from gas producers and deliver to LDCs and large industrial accounts. Their orders are based on forecasts of the demand from large customers as well as aggregate demand from LDCs and retail marketers.

*Table 10.10.* Sample natural gas transportation and storage products.[a]

| *Product Code* | *Description* |
|---|---|
| FT-A | Gas-pipeline's firm transportation service that provides the customer with the highest priority and most reliable transportation service. Customers have the right to nominate at primary, secondary, or tertiary priorities based on zone and leg entitlements. An FT-A shipper may also utilize authorized overrun on receiving advanced approval by the pipeline. Authorized overrun allows firm shippers to schedule volumes in excess of their contractual limits for an additional charge. These nominations are scheduled at a higher priority than interruptible transportation. |
| FT-A (Zone 0L) | A lower-priced firm transportation service restricted to transportation within Zone 0L, a subset of gas pipeline's Zone 01. |
| FT-BH | A lower-priced firm back-haul transportation service restricted to pure displacement nominations from qualified receipt points. Nominations at secondary points are allowed provided they are within the path of the primary route and there is no forward-haul component. Deliveries on laterals constitute forward haul. |
| EDS/ERS | Extended delivery or receipt service enables FT-A shippers to nominate deliveries in zones downstream or receipts in zones upstream of their FT-A contractual rights for an incremental charge plus additional fuel. |
| IT | Gas pipeline's interruptible transportation service. |
| FS | Firm storage service from facilities located in the production area or the market area. This service has a space charge, injection limit, injection charge, withdrawal limit, and withdrawal charge associated with it. |
| IS | Interruptible storage service from facilities located in the production area or the market area. This service provides customers flexibility in supply and market options. |
| SA | Gas pipeline's pooling service that provides shippers with free supply aggregation throughout the system. Pool-to-pool transactions and imbalance trades are free of charge provided the pooling areas are the same. Between different pooling areas, these transactions require transportation and an associated charge. |
| LMS | Gas pipeline's load-management service that provides balancing to customers at receipt or delivery points, including pipeline customers customers Gas Pipeline Company cashes out imbalances on a monthly basis. Cost of imbalance, assuming no penalty situation, is established based on pipeline position, location, and type of imbalance, and the arithmetic average price of gas published in Natural Gas Week's *Gas Price Report.* |

[a] *Source:* Tennessee Gas Pipeline website.

Wholesalers purchase delivery services from pipeline companies, who route gas from the source (wellhead) to the end market. As part of deregulation in the U.S., pipeline companies were required to unbundle purchase and delivery of natural gas (FERC Order 636, April 1992). Thus, pipeline companies generally are restricted only to transmitting or storing gas.

Besides these traditional firms in the industry, new intermediaries have entered as a result of deregulation. Some of these firms are simply asset management companies who hedge risks and make profits through trading energy-related contracts. Some are market makers who create packages and contracts from different pipeline vendors and suppliers and become "virtual suppliers" themselves. Internet market places, such as Intercontinental Exchange (ICE) and (the now defunct) EnronOnline (EOL), were started to facilitate trading of these new instruments.

### 10.6.2 RM Practice

For pipeline companies, in particular, the unbundling of transportation and purchases of gas has increased their dependence on transportation revenue, which is now estimated to constitute nearly 93% of their total revenue. These changes and the increased uncertainty in demand has made revenue managing pipeline capacity sales all the more critical.

Pipelines are essentially involved in the sale of space—the capacity for transmission or storage. Indeed, pipeline RM is somewhat similar to airline RM in that demand is for transport over a network with many interconnection points and routings. Pipelines have to price their space based on future demand forecasts as well as available capacity. Demand is realized in the form of forward contracts (essentially reservations) with various forms of options (analogous to airline cancellations and no-shows).

To give an example of a RM problem in the industry, consider the pipeline in Figure 10.6 connecting cities A, B, C, and D. For a certain date the residual capacities of the network are as shown in the figure. Consider the following bids for future capacity (Dth=Dekatherms):

**A-B** 2,000 Dth at 0.15$/Dth

**A-C** 5,000 Dth at 0.20$/Dth

**B-C** 3,000 Dth at 0.12$/Dth

Selling A-C would fetch the highest revenue, but it would exhaust capacity on B-C and prevent future sales. If the bids are indivisible, the firm may be better off rejecting the A-C bid. If bids are divisible, a

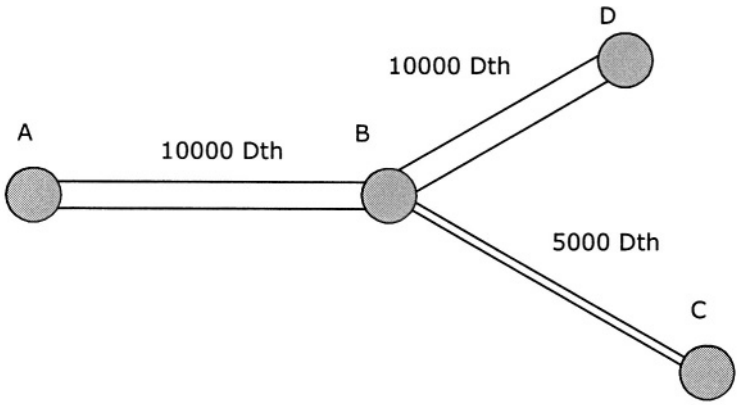


*Figure 10.6.* Residual capacity (in dekatherms) on a gas pipeline network for a specific date.

maximum-revenue network-optimization problem gives the optimal allocation. For a future date, a RM system would make a forecast of all future bids (volume and price, by origin and destination) for capacity on this network and use one of the network methods of Chapter 3 to determine which bids should be accepted now for this future date.

In addition to the capacity optimization illustrated above, current RM systems for gas storage and transmission include the following features [524]:

- Storage and park-and-loan service optimization, in which the pipeline company stores a producer's gas at its storage locations. A *park-and-loan service* is where the provider puts in gas for later use (parking) or takes out gas to meet a temporary imbalance, to be returned within a specified period (loaning). Using park-and-loan, shippers can generally avoid buying at high spot prices.
- Firm transportation revenue optimization, in which delivery is provided at the guaranteed delivery tariffs.
- Dynamic pricing of interruptible transportation tariffs (Table 10.9).
- Capacity contract optimization.

## 10.7 Electricity Generation and Transmission

The electricity industry has seen significant deregulation in the mid-1990s in the United States and many European Union countries. While in principle RM fits in nicely with these newly deregulated markets for electricity—and there has been considerable speculation on how RM

could be applied in the industry [4]—to date we know of no electricity RM implementations per se, in the sense of market segmentation and capacity controls.

Still, the electricity industry has many characteristics that make it well suited to RM methods. Demand for energy is highly variable, varying by time of day, day of week, temperature, and season, yet generation and transmission capacity is relatively inflexible. Firms use a mix of generation technologies (hydro, nuclear, coal, and gas) in an attempt to respond to demand variations, but generating capacity has limits, and near-peak-capacity wholesale prices can rise to nearly 300 times the average price [426]—even in regions with 20% reserve capacity [125]. Finally, the industry has long used risk and demand management and sophisticated trading technologies, so it has the scientific and software culture to adapt RM.

### 10.7.1 Industry Structure

Much of the deregulation in the electricity industry has focused on separating the generation and transmission (distribution) functions, creating competitive wholesale markets for generators to sell to distributors and competitive retail markets for distributors to sell to end consumers. Figure 10.7 shows the four main models of electricity competition (Hunt and Shuttleworth [261]). In the complete monopoly model (10.7(i)), a single monopoly controls generation, transmission, and retail sales. In the purchasing-agency model, (10.7(ii)), there is competition in generation between the IPPs (independent power producers), but a single monopolist controls buying and distributing the electricity. In the wholesale competition model (10.7(iii)), there is competition in generation and among distribution companies (Distcos). In the model of retail competition, there is competition in the generation, wholesale, and retail markets for the final consumers (10.7(iv)). Models (i) and (ii) are generally followed by the traditional—usually state-owned or regulated—utility companies, while models (iii) and (iv) are a result of deregulation.

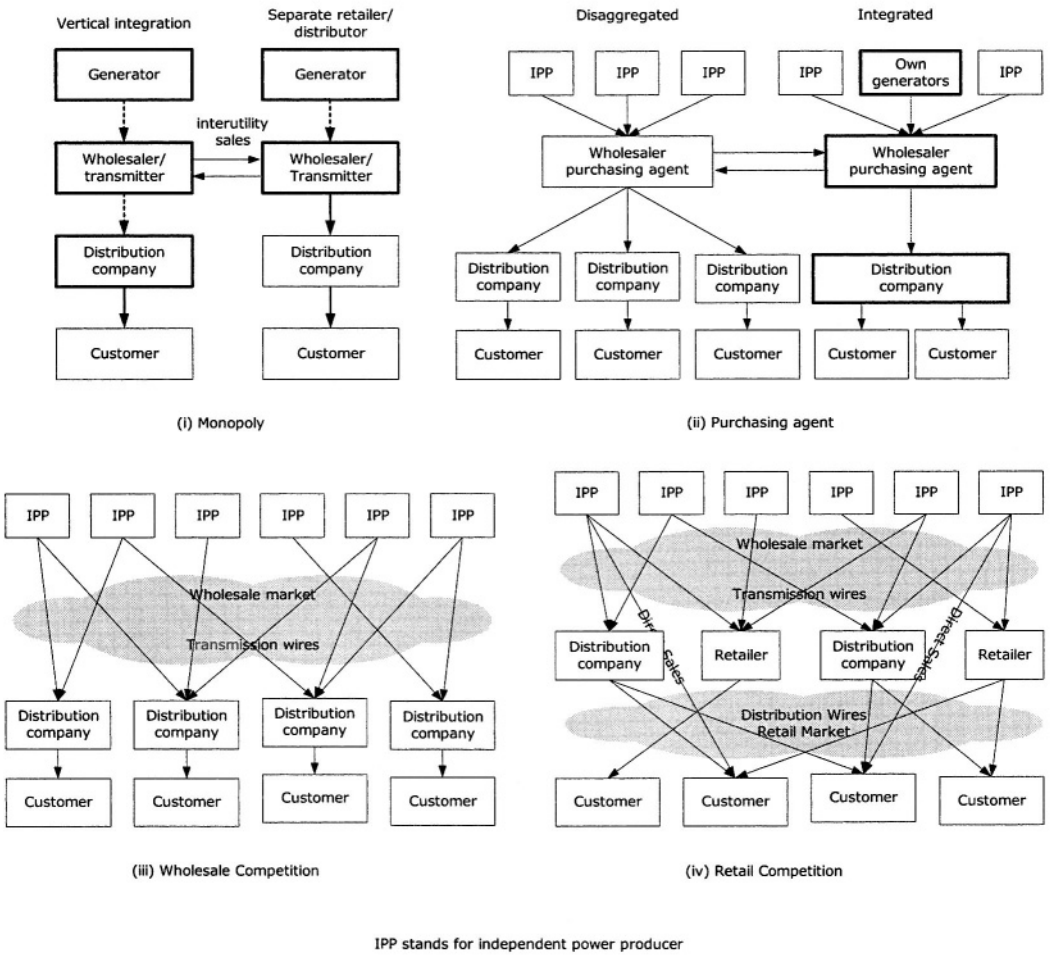


*Figure 10.7.* Four models of electricity industry structures and competition (*Source:* Hunt and Shuttleworth [261]).

### 10.7.2 Customers, Products, and Pricing

The pricing structures and the management of prices have also changed significantly in the wake of deregulation. Wholesale markets have moved toward dynamic, market-based pricing, while retail prices have, to a large extent, remained fixed (or have been capped by regulators). This has created often devastating problems for distributors that have to buy in wholesale markets and sell in retail markets.[8] Risk-management techniques are widely used by energy-sector companies in an attempt to manage such risks, but many of these problems are structural.

Wholesale markets in electricity are organized at various regional levels: state, country, pan-Europe, and global exchanges, such as the Amsterdam Power Exchange. The organization of these wholesale markets varies considerably from market to market. For example, trade may be through a central compulsory pool market or consist of bilateral trades between generators and consumers; prices may be set by bid/ask mechanisms, market makers, or auctions; the products traded may be electricity dispatch contracts, options or derivatives; settlement may be based on ex ante or ex post pricing; time of bid submission varies (real-time, 5 minutes ahead, 30-minute blocks) as do scheduling and dispatch rules; start-up costs and incumbent adjustments (price adjustments to account for the incumbents' sunk costs during the regulated period) may be factored in as well. Regardless of the exact form and rules of each market, the overall goal is to allow supply and demand to determine prices—often in real-time—and encourage efficient utilization and allocation of energy resources.

### 10.7.3 RM Practice

The electricity industry is making some preliminary attempts to implement dynamic pricing for end consumers—at least for larger industrial clients [545, 181]. Indeed, industrial customers have long paid differential prices depending on the quantity (nonlinear tariffs) and time (peak-load pricing) of their energy usage. However, such schemes require new technologies, such as time-of-usage meters, to enable real-time monitoring and accurate billing.

These same meters can, in principle, be used for individual households and small businesses. Radio control of the meters give utilities the capability to shut off large appliances (such as air-conditioners and swimming

[8]For example, only a few years after the deregulation of California's energy markets, one of the state's largest distributors, Pacific Gas and Electric, filed for Chapter 11 bankruptcy protection with accumulated debts of over $8.9 billion due to soaring wholesale power costs.

pool pumps) during periods of peak loads in exchange for lowered rates on electricity. Such practices have been reported in trials (see [545]) and exhorted by consultants (see [125] and [254]), but applications of such technologies and pricing schemes is not common yet.

The RM challenges in the electricity industry will undoubtedly be distinct from traditional RM industries. RM systems will need to determine the value of futures and long-term contracts for generators, evaluate complex contract conditions (such as preemptability) and handle new forecasting requirements (weather, economic condition, price sensitivity, market-price predictions).

Fortunately, the data available in the electricity industry is quite detailed and accurate. Historical hourly demand and price information by market is often publicly available. For example, the Electric Power Research Institute (EPRI) in California sells a database (StatsBank) of observed load responses to various types of risk-managed prices in the United States and United Kingdom. EPRI also has many ongoing projects on customer behavior and responses to electricity pricing. Load forecasting is also based on weather forecasts, which are commonly available. Publicly available macroeconomic factors (aggregate inventories, GDP, income data) can also be used for long-term energy forecasting.

Though traditional RM methods are not yet common in electricity markets, there is research on applying scientific methods to optimize the market pricing decisions of electric generators and distributors. For example, Anderson and Philpott [14] describe a body of work on optimizing "offer stacks" (price-quantity bids) in electricity pool markets. (See also Day et al. [149] and Neame et al. [274].) Researchers have also looked at how to optimally release power from hydroelectric dams (see Pritchard and Zakeri [430]) in response to dynamic, uncertain market prices. This work is very much in the spirit of RM, both in terms of the technical methods employed (such as large-scale stochastic optimization) and its philosophy of using scientific, model-based approaches to quantity and price-setting decisions.

## 10.8 Tour Operators

Tour operators sell packages of air and ground travel, cruises, and board. Some tour operators run their own charter air services, though most contract some amount of capacity from third-party suppliers. Tour operators share some of the same RM problems encountered by airlines and hotels. Yet their RM challenges are unique as they have to manage flexible capacity and multiple types of capacity with different costs and ownership.

### 10.8.1 Customers, Products, and Pricing

Tour operators almost exclusively target leisure and vacation customers. Sometimes a package is organized around a group—schools, businesses, associations, etc.—but many packages are unaccompanied, aimed at individuals and families, with the tour operator selling only a package of air travel, rental car, and hotel. Packages are published in catalogs or on the Internet and are offered for repeated dates for a season or a year. Distribution is through an operator's own retail offices, via the Internet, and through travel agencies.

To the leisure traveler, buying a package offers convenience (low search costs) and a low overall price for a trip, at the expense of some loss of flexibility. For the suppliers—airlines, car rental companies, and hotels – that sell their capacity to tour operators, tour operators offer them a chance to reach a very well targeted segment of demand.

A tour operator's product is therefore a complex mix of capacities of different types, and tour operators offer a large number of such products. The products are put together by negotiations with the airlines, ground transport operators, hotels, and rental-car companies. To price a product and plan its sales operations, tour operators either purchase blocks of capacity from their suppliers at fixed prices, or they negotiate just the rates and let their suppliers control the availability of capacity.

The planning and process for the tour operator consists of three stages: (1) capacity planning, where routes and capacities are fixed tentatively; (2) a pricing and purchasing stage, where capacity is purchased from various sources and prices for the packages are fixed; and (3) a RM stage, where discounts and promotions are used to stimulate demand during the booking period.

RM for tour operators—as in the rental car industry, which also has somewhat flexible capacity—is closely integrated with capacity management, which we describe briefly next.

### 10.8.2 Capacity Management and Base-Price Setting

As we mentioned, large tour operators use a mix of their own fleets and third-party carriers. The goal of capacity planning is to optimize the balance between own-fleet utilization and third-party purchases. Figure 10.8 shows an example of a capacity planning exercise of a tour operator.

Setting base prices by and large is guided by expected load factors, margins, competition, costs, and the previous year's prices. Figure 10.9 gives good insight into the price-setting process at a tour operator. It is

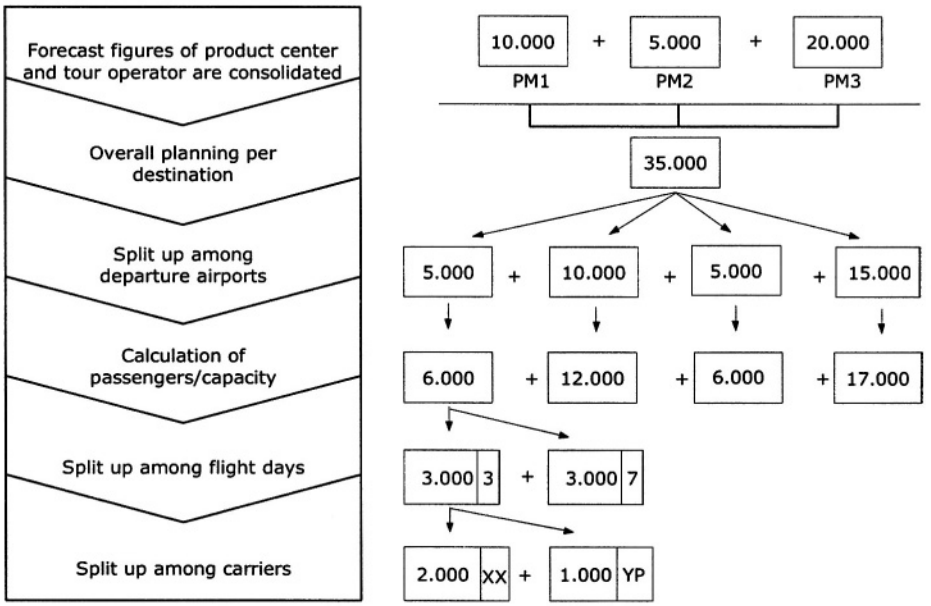


*Figure 10.8.* An example of capacity planning at a tour operator.

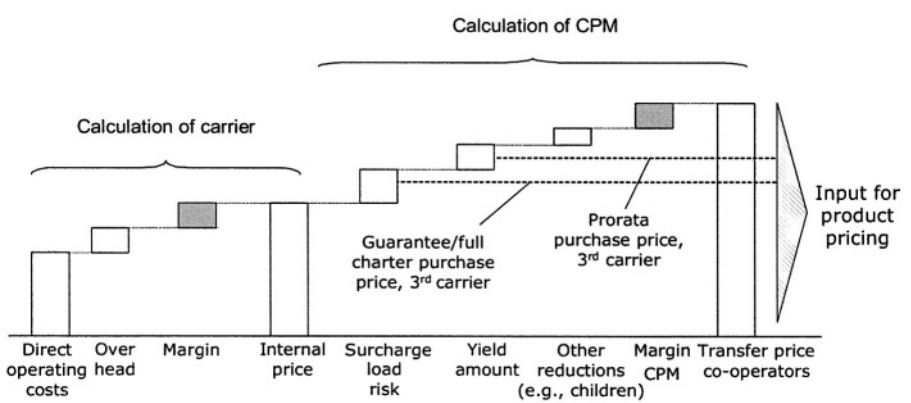


*Figure 10.9.* Purchase plan and price setting at a tour operator (*Source*: Modified from Remmers [439]).

essentially cost-based pricing allowing for margins and risks (load-factors as well as price-dilution risks). The planning process (purchases and price setting) is finalized around six weeks prior to the first departure. In the final five to six weeks of the booking period, a combination of

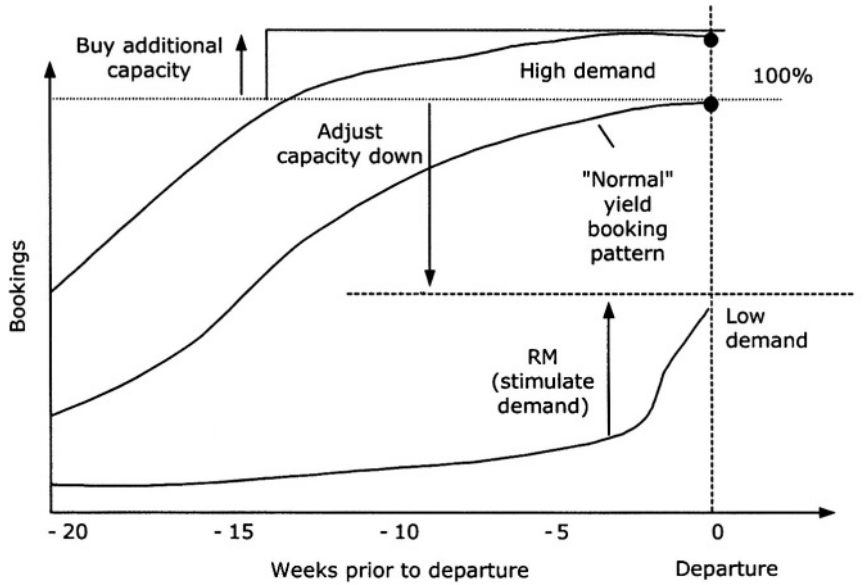


*Figure 10.10.* RM process for a tour operator [439].

capacity adjustments and RM is used to manage sales, which we describe next.

### 10.8.3 RM Practice

A tour operator can increase its revenue by (1) segmentation of its customer base (family holiday, weekend packages, exotic tours, back-packers tours, organized tours, school trips, cruise packages) marketing special packages to each segment; (2) allocating scarce capacity to more profitable packages by using capacity controls that make low-profit packages available only on unconstrained dates; and (3) using price-sensitivity estimation and dynamic pricing tools to adjust prices to stimulate demand.

Industry presentations indicate that to date only a few tour operators have implemented some form of RM [439, 557, 579, 264]. Current usage appears limited to long-term sales forecasting, booking-trends forecasting, and statistical reporting for package sales. Little optimization and control of availability appears to be used at present. The role of RM is to monitor demand during the booking period, and if demand exceeds the planned load factors, increase, or shift capacity from low-demand products, and if demand is below the planned load factors, advertise and run promotions to stimulate demand (Figure 10.10).

Part of the difficulty in implementing multiclass quantity-based RM in the tour industry is that there are no standard reservation systems for automating distribution and sales. Some industry standards are being developed specifically for the tour industry [518] by the EDI standards body Travel Technology Initiative (TTI) using XML, but these standards are not yet in widespread use.

## 10.9 Casinos

RM is applicable in casinos in two areas: renting out the casino's hotel rooms and managing capacity and pricing in the gaming area. We look at each in turn.

### 10.9.1 Customers, Products, and Pricing

The core business of a casino is gambling; renting rooms and meeting space is a secondary line of business in most casinos, whose main purpose is to attract gambling revenues. Two popular edicts in the industry are that gamers play more when they stay, and gamers play where they stay. The average daily gambling revenue from the different gamer types can range from $20 to $20,000 [422], so it is understandable that the revenue from rooms is not the highest priority for a casino. Indeed, many casinos give rooms away free to their top, "high-roller" customers.

### 10.9.2 RM Practice

The RM problem in casinos, therefore, is one of controlling availability based on a combination of room revenues and the amount a customer is expected to spend on the casino's gambling floor. To facilitate the latter, many casinos have instituted special loyalty-card programs for their repeat customers that are a cross between the debit cards of banks and the frequent flyer cards of airlines. These cards track how much the customer has spent on the floor. Hence, when a customer calls in to make a booking and gives his card number, the casino can assess how much revenue the customer will potentially bring in and the RM system quotes availability and price based on this information.

RM systems implement this customer value assessment through a *gaming value function.* The software recognizes and ranks repeat guests by their gambling history. Harrah's, a large U.S. casino, reports a modification in which its RM system was customized to work with their Total Rewards Player (TRP) program [92]. Guests in this program are ranked in tiers. High-rollers are identified and receive the lowest room rates, while first-time guests and nongamblers get the rack room rate. When a customer calls Harrah's for a reservation, the system automatically

generates a customized room rate based on the customer segment of the caller. Harrah's has up to 64 segments and each segment has a code (such as AEP for avid experienced player [361]).

Another potential use of RM in casinos, mentioned in industry talks but not implemented yet, is to control capacity on the gaming floor itself—to determine the minimum bets at each table, and to adjust the number of tables of each game which are opened.

## 10.10 Cruise Ships and Ferry Lines

Even though both cruise and ferry lines have superficially similar operations (they transport people by ship), there are considerable differences between the two businesses when it comes to RM practices.

### 10.10.1 Customers, Products, and Prices

Cruise lines can vary from small harbor cruise boats to large international operators offering long multiport itineraries. Ferry lines operate regular scheduled transportation service to move both people and cargo. There are further subdivisions called *fast-ferry* and *cruise/ferry.*

Cruise ships are essentially floating hotels. There are a wide variety of cabin types and a large spread of fares, some of which are sold with advance-purchase restrictions. Sales are made either directly by the cruise company or through tour operators and travel agencies.

Unlike airlines and hotels, however, cruise customers are almost exclusively discretionary travelers. This has historically created some difficulties in maintaining price discipline in the industry. For example, there is a significant market for people willing to take a cruise on short notice at very low prices. Cruise lines facing an underutilized vessel are frequently tempted to lower prices and offer last minute bargain rates on some sailings. However, customers have, over time, learned of this practice and as a result are often unwilling to buy advance-purchase products.

Ferries, in contrast, have commercial, commuter, and leisure segments. Ferry traffic has more in common with the airlines or passenger railways than it does with hotels. They segment based on volume of purchases (monthly commuter passes), one-way and return purchase, peak and off-peak times, and customer type (student, child, senior citizen). Long-haul ferries also offer advance-purchase fares, and some offer private-cabin service.

### 10.10.2 RM Practice

Cruise lines have some special characteristics that distinguish their RM practices from hotels. First, all stays are of the same length; though some multiport cruises let customers join and leave at different ports. Also, overbooking for the ship as a whole is generally not practiced, as it is difficult to "walk" a cruise passenger; overbooking at a cabin-type level is more common.

Cruise operators also have to coordinate with airlines to bring customers to and from their various ports of departure. Cruise operators may purchase a block of seats from an airline and must therefore manage the air-travel capacity along with the ship capacity, similar to the problem faced by tour operators.

Finally, even if the cruise is all-inclusive, customers have many shopping opportunities on board, and the cruise lines consider shopping revenue in assessing the overall net revenue contribution of the different customer segments.

Ferry operators also face some unique RM challenges. For example, ferry lines have to manage passenger space and vehicle space jointly. Combination cruise/ferry lines have to manage inventories of cabins, passenger space, and vehicle space. Thus, they too are faced with multiple-resource RM problems.

Most large cruise lines, such as Norwegian Cruise Lines and Royal Caribbean, practice some form of RM for controlling sales on their ships. Smaller river and harbor cruise companies, like New York Cruise Lines, are also known to use GDSs and practice some simple RM. Ferry line RM implementation is more sporadic and less known, but there are a few firms, such as Transmediterranea, that are reported to have RM systems.

## 10.11 Passenger Railways

Passenger railroad RM is similar to airline or hotel RM, albeit with some differences.

### 10.11.1 Customers, Products, and Pricing

A large passenger railway company can have over 2,000 trains daily. Because many railways are nationalized, it is common to have only one passenger railway operating in a market. Consequently, they do not face direct price competition and have greater flexibility in pricing than do airlines or even hotels. Nevertheless, railways compete with the other modes of transportation such as airlines, automobiles, ferries, or buses,

*Table 10.11.* Amtrak accommodation and fare types.

| *Accommodation type* | *Fare Type* |
|---|---|
| Superliner standard bedroom | Adult |
| Viewliner standard bedroom | Senior |
| Deluxe bedrooms | AAA adult |
| Family bedrooms | NARP |
| Viewliner accessible bedroom | Student Advantage |
| Superliner accessible bedroom | Veteran's Advantage |

and hence pricing is influenced by the prices and availability of these transportation alternatives.

In addition to the prices of competing travel alternatives, pricing for trains also depends on the speed of the train, the time of operation, and the distance of travel. High-speed trains (such as the TGV in France) offer service that is comparable or better than airlines in terms of travel-time between city centers and on-board amenities and consequently are priced higher than ordinary trains.

The passenger mix varies depending on whether the route is a short-haul or long-haul and on the time of day. For example, a Washington-Philadelphia train at 6:00 PM will have a large number of business passengers, while a Washington-Chicago train carries primarily discretionary travelers. As a result, one sees multiple fares more often in short-haul markets. However, the number of fares offered by railways is typically small—two or three—with advance-purchase restrictions of five or fourteen days. For instance, Rail Canada sells seats in four classes Y, B, Q, and V with progressive advance-purchase discounts.

Long-haul trips rely more on product differentiation (type of accommodation) and identifiable customer types than on booking characteristics. Further segmentation and discounts are based on youth rail-passes, senior-citizen passes, and family packages with discounts for a family traveling together. Cancellation fees and other penalties normally apply for discount fares. Table 10.11 shows the product types and fare types for Amtrak's long-distance (overnight) train service. Prices for the accommodation part of the tariff range from $347 to $1,067 (standard versus deluxe bedroom going from Chicago to Emeryville). Dynamic pricing in the form of weekly promotions, which usually carry some sort of advance-purchase and cancellation restrictions, is becoming more prevalent.

### 10.11.2 RM Practice

AmTrak in the U.S, VIA Rail Canada, and Eurostar and Société Nationale des Chemins de Fer Francais (SNCF) in France are a few large passenger railways that are known to actively use RM techniques. The network structure for a railway is a cross between that of hotels and airlines. A single railway line resembles the length-of-stay network of a hotel; however, there are many connection points where passengers can switch trains, making it a more complicated network. Amtrak is reported to use five fare buckets, opening and closing them depending on demand to come (Johnston [271]), with the capacity decisions made jointly between the train or corridor manager and the central RM department.

## 10.12 Air Cargo

RM is a nearly universal mission-critical tool for passenger airlines, so cargo would seem a logical area for airlines to apply their RM skills. However, the use of RM in airline cargo at present is rather sporadic.

### 10.12.1 Customers, Products, and Pricing

Most passenger airlines accept cargo to fill the empty holds of their passenger aircraft. The bulk of the space is sold under long-term contracts to a small number of shippers, normally through a bidding process conducted only once or twice a year.

Still, the larger carriers have partially segmented their market and sell both premium (fast) and regular (slow) shipping. Ad-hoc requests and long-term contracts are some other segmentation criteria used. Restrictions or advance-purchase requirements are not prevalent at present. Pricing is primarily distance-based and the typical tariff structure does not segment the market significantly, though the potential exists to segment based on factors such as the quantity shipped and day of week.

### 10.12.2 RM Practice

Airline cargo RM is more complex than passenger airline RM. For one, the hold space of the carrier is limited both by the weight and volume it can carry, so shipments have to be controlled based both on their weight and volume. Also, the weight constraint of the aircraft depends on both the number of passengers carried and the cargo. Thus, the decisions for both passenger and cargo are interrelated and ideally should be coordinated by a single RM system.

The long-term nature of customer relationships also makes capacity control difficult. Air cargo carriers rarely—if ever—reject a shipment

when they have available space. Long-term customer relations take priority because unlike passenger sales, which are anonymous and numerous, air cargo carriers work closely with a few important customers who ship large volumes. Still, there are occasional small-volume shippers in addition to large shippers, and some segmentation between the large, contract shippers and the smaller, "spot-market" shippers is possible.

To date, only the largest carriers practice some form of cargo RM, and even in these cases, the systems are not comparable in sophistication to the airline's passenger RM systems. Many cargo RM systems in operation do mostly simple reporting, overbooking, and aggregate forecasting. Unlike passenger systems, few make automated accept/reject or block allocation decisions.

The few airlines that have implemented or are currently implementing cargo RM are also cautious when evaluating the success of their systems. Edward R. O'Meara, senior director of cargo RM for Continental Airlines, cites the complexity of implementing RM in air cargo as one factor [483]:

> It's been a success story but it's not been a slam dunk either. It's a very difficult process because you're changing a lot of roles. I see it as an extra tool you don't use blindly. You always have to keep the customer in mind and that's the thing with RM: you don't want to do something stupid that hurts your customer.

According United Airline's Lung, the low status of air cargo in the industry is another factor [483]:

> Cargo is not as glamorous and is viewed more as a byproduct or an afterthought. Typically you have lots of investment opportunities within the airline and cargo is not viewed as your core business.

Another obstacle is data. Historical data is often collected only by weight or volume (usually weight), so many airlines don't have adequate data to implement a RM system. Legacy systems to manage cargo are also a significant barrier to implementing RM.

## 10.13 Freight

Shipping, trucking, railway, and intermodal companies transport billions of dollars worth of cargo every year. The emergence of global supply chains and just-in-time (JIT) manufacturing have increased the strategic importance of logistics, and companies are often willing to pay a premium to have reliable, fast deliveries. Freight transport is subject to significant capacity and time constraints. Together, these factors make freight transport a natural candidate for RM methods.

*Table 10.12.* Sample freight product differentiation.[a]

| | |
|---|---|
| Exact Express™ | Expedited, time-definite air and ground service with same-day, next-day and any-day service, featuring proactive notification. |
| Definite Delivery™ | Guaranteed service with constant monitoring and proactive notification for standard transit time shipments. |
| Standard Ground™ | Ground service. |
| Cross-Border™ | Door-to-door transportation solutions between Canada, United States and Mexico |
| Global™ | International via air, ocean, and land. |

[a] *Source:* Yellow Freight, for year 2003.

### 10.13.1 Customers, Products, and Pricing

Most commercial freight today is moved in containers over one or more transport modes (ship, rail, and truck). (If the transportation involves more than one form of transport, it is called *intermodal shipping*.) Intermodal shipping offers a high level of service at a relatively low cost. It is often cheaper than moving a shipment entirely by truck, while offering comparable flexibility in routing and timing. Standard containerization also reduces transfer and handling costs considerably, as most rail yards and shipping docks today have specialized facilities for handling containerized freight.

Freight customers can have different service level requirements. For instance, package delivery companies and the U.S. Postal Service require strict service commitments and schedules tightly integrated with their own operations. Often a carrier has dedicated trucks and trains assigned to these customers. Other customers, such as *less-than-truckload (LTL) shippers* and freight forwarders, are less sensitive to delivery time and willing to accept longer delivery times and less reliable service for lower shipping charges. These time-price sensitivity differences provides a natural means for segmenting customers in the industry; a sample portfolio is shown in Table 10.12. Rates are also segmented based on the type of good being shipped, as well as by the weight and volume of each shipment. Many shippers purchase freight services through long-term contracts. The contracts require the freight company to guarantee capacity on demand. However, shippers have little obligation to use the services they contract for—or even to pay the prices agreed to in the contract. Indeed, if spot prices are cheaper, shippers commonly bypass their contract carriers and ship using the cheaper spot carriers [426]. These practices make it difficult for carriers to maintain pricing discipline.

Long-term contracts also make customer relations extremely important and—as shippers are reluctant to renegotiate long-term contracts—make RM type innovations hard to introduce. However, there is signifi-

cant business from low-volume, smaller shippers, with whom the freight companies have some degree of pricing flexibility.

Tariffs for terminal-to-terminal shipping are usually different for wholesale agreement customers and retail customers and whether the shipping is domestic or international. Intermodal and rail pricing plans also differ considerably. For ocean carriers, the freight rate is normally a percentage of the value of the cargo. Ocean carriers can also be members of a conference that controls both the capacity members can introduce into the market, as well as monitors tariffs—but as the revenues depend on the cargo value, there is nothing to prevent the carrier from using RM-type controls to manage the cargo mix [360].

### 10.13.2 RM Practice

A few large freight companies, including Sea-Land [213] (Sea-Land is now integrated into CSX Intermodal), have implemented RM systems. However, RM is not yet widely practiced in freight, although the potential is significant. For example, low-value demand often fills up the weight limits of a ship or truck well before the volume limit is reached, forcing the carrier to reject low-volume/weight, high-value demand. Indeed, Maragos [360] reports that in the shipping industry, low-value customer demand tends to appear before the high value demand, creating conditions similar to those in the airlines.

Structurally, the RM problem in freight is similar to airline or hotel network problems, in that carriers provide a network of routes and scheduled service with capacity constraints on each link. In addition, orders are taken over a period of time, and there is a mix of customer types, ranging from high-value, low-weight items (PC components) to low-value, heavy-weight or large-volume items (raw materials). Internet websites (such as Rezl and nacsfirst) are facilitating freight reservations.

Capacity conditions are somewhat different, however. For example, in the case of rail freight, there is considerable flexibility in adding or removing capacity to a train because the cars or car blocks are easy to add and remove. The capacity of the locomotive at some point prevents such additions, but the range is significant. Thus, at present it is rare for a railroad to reject a shipment because of capacity constraints. Trucking firms are also able to adjust capacity on routes by reallocating tractors and drivers. Ships, in contrast, have more of a hard capacity constraint, analogous to an airline flight.

## 10.14 Theaters and Sporting Events

Theaters and sporting events have many characteristics that seem well suited to RM methods. Indeed, the existence of "scalpers"—and the often exorbitant prices they charge for tickets for popular shows and events—is evidence of the demand management potential in this industry. Also, many firms are experimenting with auctions and dynamic pricing, driven mainly by the Internet.

### 10.14.1 Customers, Products, and Pricing

Tickets for events are purchased in advance or on location at the time of the event. There are many different customer segments—corporations, annual subscription customers, families, tourists—each with varying usage patterns and willingness to pay. There are few regulations on the prices that event sponsors can charge or on the sale conditions, with the exception of some local municipal laws against scalping.

Ticket prices for theaters and sporting events depend on factors such as the location relative to the stage, the expected demand for the event, group affiliation of customers, seasonalities, bulk-sales terms and advance-purchase restrictions—besides the draw of the performance itself. Table 10.13 gives an example of the different rate categories for a Broadway show [340].

Demand can be highly variable for events, and while historical data is sometimes available to make forecasts, there is often considerable uncertainty about the popularity of a new show or a particular sports event. For example, the success of a local sports team or the presence of a star player has a significant impact on attendance. For instance, A.T. Kearney [23] reports an Atlanta Hawks game with an overflow of 20,772 one day, and an attendance of 8,772 two days later—Michael Jordan played the first day; both days had the same prices with no capacity controls, a clear inefficiency in pricing.

The number of seats in the venue, of course, strictly limits capacity. However, there are different categories of seats based on location in the venue. In terms of the sales process, prices are sometimes published a year ahead (as in the case of opera or concert halls).

### 10.14.2 Ticket Scalping and Distribution

Unlike airline or hotel products, event tickets are almost always transferable (even many subscription tickets for opera/sports events can be passed on to others). A scalper ticket market shows both a missed opportunity to increase revenues for event sponsors as well as a potential

*Table 10.13.* An example of ticket categories for a broadway show *Seven Guitars.*[a]

| *Full-Price Sales* | |
|---|---|
| Orchestra (543 seats) | The best seats in the house are located in the orchestra. By convention, for all Broadway shows, all full-price ; orchestra seats in a given theater have the same price, although different theaters may have different prices. This category is always the highest price category, and the price varies with the time of the week that the performance is held. Note however that many discount-price buyers will in fact be seated in the orchestra. |
| Front mezzanine (196 seats) | The best seats in the front mezzanine are preferable to some orchestra seats. For *Seven Guitars*, the front mezzanine is priced identically to the orchestra. |
| Rear mezzanine (126 seats) | For the first 16 weeks of performances, no distinction is made between the front and rear mezzanine. After week 16, the rear mezzanine price was lower than the front mezzanine price, which remained at the previous level. |
| Balcony (66 seats) | This is the least favorable seating in the house and also the cheapest, cheaper even than standing room. |
| Boxes (16 seats) | While the boxes are priced identically to the orchestra, the relative average seat quality of the boxes is unclear. |
| Standing room | The highest number of attendances, in a single performance, in this category is 13. It is possible that individuals purchase these tickets and then sit in vacant orchestra seats. |

[a] *Source*: Leslie [340].

impediment to the practice of RM. We examine both aspects in this section, beginning with a brief look at the legality of ticket scalping.

### 10.14.2.1 Scalping Laws

Somewhat surprisingly, most legislation against scalping is at the state or municipal level, so there are many variations in the law. In the United States around half of the states have either no laws or give jurisdiction to municipalities; the other half have strict antiscalping laws. Most of the states that limit ticket resales (either a blanket law, or by type of event) specify that tickets cannot be resold above face value or face value plus a small amount.[9]

[9] *Source:* eBay Event Tickets Resale Policy.

*Table 10.13 (continued)*
An example of ticket categories for a broadway show *Seven Guitars.*[a]

| *Discount-Price Sales* | |
|---|---|
| 10% off | A catch-all category for 10% discounts given for an array of small-scale marketing initiatives. |
| Two-fer-one | Two tickets for the price of one. This is a marketing initiative during two disjoint time-periods. Coupons are available from locations such as dry cleaners and student cafeterias. |
| TKTS | 50% discount for day of performance sales, with a $2.50 service charge to the buyer. Roughly 90% of TKTS sales are through the Times Square booth, where buyers must wait in an outdoor line to make their purchase. |
| MTC | The Manhattan Theater Club (MTC) is a subscriber organization that reached an agreement with the producer of *Seven Guitars* to give a discount to MTC members if they saw the show before the end of week 13. |
| AENY | Arts Entertainment of New York (AENY) is an organization that specializes in obtaining high-quality seats for various forms of live entertainment for its members. The producer of *Seven Guitars* gave AENY a 10% discount, but this is not passed on to the members who purchase the tickets. This category was only available during the final 7 weeks and never accounted for more than about 1% of the attendance in any given performance. |
| Direct mail | There were three direct-mail periods that are distinguished by pricing and the mailing list used. |
| Group | The group discount varies with the size of the group and is generally at least 10%. |
| Student | Approximately 50% discount for students. |
| TDF | The Theater Development Fund, a nonprofit company that also operates the TKTS booth, purchases tickets at a large discount operates (often around 70%) for use in various programs with an educational or audience-development emphasis. |
| Wheelchair | Approximately 50% discount for individuals in a wheelchair. |
| COMPL | Tickets given away for free. |

[a] *Source*: Leslie [340].

The public reaction to scalping is generally not against individuals selling their tickets (on eBay or in newspaper ads) but against professional scalpers buying up large blocks of seats in anticipation of a popular event and also the nuisance caused by the presence of scalpers in front of event venues. To prevent scalping, many events in fact restrict the number of tickets they sell to each individual, though this is not always enforceable.

From an economics point of view, there is no reason to prevent a spot market just before the event time. There is also no reason to believe that scalpers will always charge a premium, as they do take a risk in buying up tickets ex ante. Indeed, Happel and Jennings [236] report the case of the Phoenix City Council, which allowed scalping by law but restricted scalpers to selling in a centralized lot in front of the Phoenix Suns stadium. The prices obtained for tickets went down as the event time approached, similar to markdown dynamic pricing. An econometric study by Williams [567] found that NFL teams in states with anti-scalping laws charged lower prices. His explanation is that secondary markets provide valuable information to event organizers if the event is underpriced (if it is overpriced, they know it themselves), allowing them to raise prices. So antiscalping laws may in fact hurt more than help event sponsors.

#### 10.14.2.2 Primary Sales and Ticket Distribution

In contrast to ticket resales, there are few restrictions on the primary sale of tickets. (Primary sales are sales by the artist, team, promoter, or organizer of the event.) So in theory, there is little to prevent event organizers themselves from conducting auctions or using dynamic pricing if the public finds this acceptable.

At present most primary ticket sales in the United States are sold either by subscription, through an event website or box office, or through one of the electronic ticketing agents like TicketMaster (which bought up an earlier rival Ticketron). There are many Internet-only sellers such as Tickets.com and Ticketmall.com.

In addition, there are the ticket brokers. The U.S. National Association of Ticket Brokers, which boasts over 150 member firms, defines their role as to (1) provide tickets to events that are sold out through the primary market, (2) provide premium upfront seats which are the most desirable, and (3) to provide ticket holders a place to sell their unwanted or extra tickets.

There are a few auction marketplaces for event tickets currently, but as distribution moves increasingly to the Internet they are likely to gain in popularity. For instance, on a recent day eBay listed over 30,000 items in their Tickets category (including both primary and secondary sales). While this number is minuscule compared to what Ticketmaster sells on a given day (they recently *sold* more than a million tickets on a single day), it is growing. A recent *New York Times* article [157] reports that Ticketmaster is experimenting with online auctions and used them recently for a boxing match. Another online ticketing firm, StubHub,

works with artists and entertainers to auction off front-row seats for charity.

#### 10.14.2.3 Secondary Markets

Why don't event organizers create their own resale markets and extract the money that is now going to the scalpers? Some have. *USA Today* reports [251] that eight Major League Baseball teams have started online programs to facilitate the resale of seats, though the websites are only to facilitate sales, and they do not yet conduct auctions. In these systems, the holder of the ticket posts it for sale at a virtual exchange window. When he finds a buyer, the original ticket's bar code is invalidated and a ticket with a new bar code is created. This removes one of the main consumer risks in the scalper market—fraud.

The biggest impediment to dynamic pricing seems to be the fear of negative consumer reactions—the fear that along with the scalper's money, event organizers may also acquire the scalper's reputation. There is a concern that this could cause long-run damage that more than offsets any short-run boost in revenues. Indeed, in many cases, the ticket revenue for a single event is a small fraction of the total lifetime value of a customer. A performing artist, for instance, normally makes more money from album sales than from ticket sales, and a loss of fan goodwill could jeopardize future album sales. Sold out concerts also generate good publicity. Similarly, opera houses form long-term relationships with their clients and do not want to risk losing that patronage. For many sports teams, secondary spending in the arena is as important as the ticket revenue, so they would rather make sure *someone* gets in by facilitating the exchange of unused tickets than make money on the transaction per se. According to a survey on Fan Cost Index [440], an average major league baseball ticket costs $18.69, but a family of four spends an average of $148.66 for a single game, on souvenirs, snacks, drinks, and program. Yet none of this precludes some innovative applications of RM, as we discuss next.

### 10.14.3 RM Practice

Many microeconomic text books cite movie-ticket discounts for students and seniors as examples of third-degree price discrimination and discounts for midweek shows and matinees as examples of peak-load pricing. As can be seen from Table 10.13, for this Broadway event there are many rate categories with different prices even for the same inventory type (akin to airline fare classes in a cabin) and a price structure in the form of discounts off the top rate for the seating area (akin to percentage off the rack rate for hotels). Notice however that most of the

rate categories in Table 10.13 are based on identifiable customer characteristics (third-degree price discrimination), so there is a fundamental difference between the segmentation as practiced in event ticketing and traditional airline RM.

Nevertheless, whenever the demand exceeds capacity for an event space, there is a need to manage the capacity intelligently. Not many venues manage their discounted demand in any systematic, scientific way. So although at first glance this seems like an industry tailor-made for RM, there are relatively few reported implementations in event ticketing. The few implementations include opera houses (San Francisco Opera [479], Washington Opera [137]), Internet event sellers (Tickets.com, [338]), sports teams (Mariners [22], Mets [454])—and RM has been proposed for movies [409]. However, even these reports point to somewhat tentative and limited implementations in this sector. Fear of negative customer reactions and consequent loss of customer goodwill are the main reasons firms seem to be avoiding bolder demand management strategies.

The Washington Opera is one of the pioneers of RM in the opera business. In 1994–1995 it initiated a rate plan consisting of nine categories based on the location of the seats (Table 10.14 shows the 2003–2004 season prices). Figure 10.11 shows the physical layout of the various categories. In addition, specially priced tickets and group tickets are also sold, the former at reduced prices, and the latter at normal prices. Subscription tickets are sold the earliest, with those subscribing to more shows given first priority. Next come group sales, around three months prior to the season beginning. After groups are booked, the box office opens for individual sales. Finally, excess demand is sold on the day of the performance at student or senior discounts or standing-only. Rather than lowering prices for low-demand shows (thereby upsetting the subscription customers), the preferred tactic is bundling where individual tickets to popular shows are sold only bundled with low-demand shows. So even though prices are fixed *and* there are no capacity controls, there is demand management going on—giving preference to customers who bring high value (lifetime value of the customer) and creating and pricing ticket bundles to smooth out demand and increase sales.

In baseball, the Mets pricing plan, shown in Table 10.15, varies prices by game rather than by segmenting customers and controlling capacity for each game. So it is more in the spirit of peak-load pricing than tactical RM. Other baseball teams, such as the Cubs, Yankees, and Giants have also implemented similar schemes, in which prices vary by game. Notice that significant efficiencies are lost, as prices are set ex ante, once, for the whole season, and there is little scope for demand management

*Table 10.14.* Washington Opera Kennedy Center pricing (2003–2004 season).

| | *Weeknights* | *Fri. and Sat. Evening, Sun. Matinee* |
|---|---|---|
| Box | $260 | $285 |
| Premium orchestra | $160 | $185 |
| Prime orchestra | $135 | $165 |
| Orchestra | $117 | $123 |
| Rear orchestra | $90 | $95 |
| 1st tier prime | $135 | $165 |
| 1st tier | $93 | $98 |
| 2nd tier 1 | $65 | $68 |
| 2nd tier 2 | $41 | $42 |

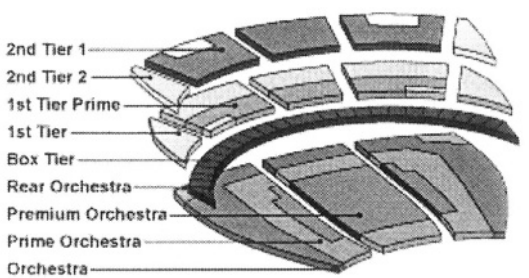


*Figure 10.11.* Washington Opera Kennedy Center layout.

on per-game basis. This can be considered a preliminary, experimental, step toward a full-fledged RM, and is a significant improvement over uniform pricing. However, the Mets' management ruled out, for now, the possibility of raising and lowering prices for individual games based on their popularity [454]. Theater and sporting events present some unique challenges for RM. For example, as mentioned, the popularity of an event or the success of a sports team must be factored into the forecasts of demand, which makes for a challenging forecasting. Also, seating in theaters suffers from bin-packing effects; having isolated empty seats in different locations is not appealing to couples or groups that want to sit together, so sales often drop off as a venue fills even though there are nominally many available seats. Assigning groups to seats and managing the configuration of available blocks of seats therefore becomes an important issue.

*Table 10.15.* The Mets four-tier pricing plan (year 2002).[a]

| | |
|---|---|
| Gold Plan | Covers 17 dates, including opening day against the Chicago Cubs, weekend series against Atlanta, Seattle, the Yankees, and St. Louis, and a midweek series against San Francisco and Barry Bonds. The peak ticket price of \$53, for inner-field boxes, is \$10 more than it was in the previous season. The cheap seats rise to \$16 from \$12. |
| Silver Plan | For 21 games. Includes weekend series against Arizona, Philadelphia, Cincinnati, and Colorado and two midweek series against Atlanta. The top price rises \$5 to \$48, and the lowest price goes up \$2 to \$14. |
| Bronze Plan | For 27 dates, preserves the most expensive seat at \$43 and the cheapest one at \$12, for midweek games against Chicago, Los Angeles, Florida, Montreal, and Milwaukee and weekend games against Montreal and San Diego. |
| Value Plan | For 16 games, discounts the top seat to \$38 and the least expensive one to \$8, for midweek series against Houston, Philadelphia, Milwaukee, Florida, and Pittsburgh. |

[a] *Source:* Sandomir [454].

## 10.15 Manufacturing

There is significant interest in applying RM in manufacturing. However, it is fair to say that to date there have been relatively few implementations. But manufacturing is clearly a vast sector of the economy and many SCM and ERP technology vendors are starting to offer pricing-optimization systems for manufacturers. It therefore warrants careful attention.

### 10.15.1 Customers, Products, and Pricing

Manufacturing spans a vast and diverse set of firms, so our discussion here is, of necessity, somewhat generic. A make-to-stock (MTS) manufacturer produce standardized products, typically in large volumes, based on forecasts of future demand. Most consumer goods (autos, electronics, food products, apparel) fall in this category. A key challenge in MTS manufacturers is to balance the need to meet demand, which is often variable and uncertain, against inventory and production costs. For most MTS manufacturers, pricing tends to be an aggregate decision and dynamic pricing is not routinely used to manage supply and demand. However, end-of-life-cycle discounting is a common practice in many sectors (such as automotive manufacturer rebates at the end of the model year). Also, trade promotions—discounts given by manufacturers to retailers and distributors—are a long-established practice among many MTS manufacturers. We mentioned one implementation of promotion and incentive optimization at Ford Motor Company earlier in Section 5.1.2 [135].

A make-to-order (MTO) manufacturer generally produces in smaller lots based on specific orders from end customers, who are often other manufacturers. MTO firms typically have to price a continuous stream of bids and request for quotes (RFQ). Most of these pricing decisions are made manually based on tactical factors, such as estimated costs, as well as strategic factors, such as the value of a long-term relationship with a buyer. Cost calculations are critical in MTO manufacturing. Such calculations are based on estimates of material costs, machine time, and labor rates, most often provided by a management accounting system. A variety of methods, such as activities-based costing (ABC), are used to arrive at these cost estimates. The volume of such request is high; a pricing department at a large manufacturing company may have to respond to over 250,000 RFQs every year.

Once a bid is accepted, the order is then scheduled into the firm's production planning and SCM system. SCM systems optimize the scheduling of current and new orders. Traditionally, they do not consider price explicitly as a mechanism to regulate orders, nor do they use price incentives to shift customer demand away from peak-load periods. Meeting the delivery deadlines at the lowest possible cost is the core objective of most SCM systems today. However, as mentioned above, many SCM vendors are currently working on incorporating price-optimization and demand-management functions into their systems, and some already offer pricing-optimization products. (See, for example, [262].)

### 10.15.2 RM Practice

Because variable costs and production planning are so important in manufacturing, manufacturing RM systems must coordinate their data and decisions with ERP, SCM, and management-accounting systems. Revenue has to be balanced with cost considerations in determining the profitability of accepting bids or adjusting prices. The interdependence of SCM and RM decisions is well recognized as the main reason why SCM vendors are leading the development of RM methods in the manufacturing sector.

Manufacturing RM differs from service RM in other important ways as well. For example, although idle capacity can be considered a perishable item, physical inventory of parts and raw materials can be stored for future use. This gives manufacturers more production flexibility. On the other hand, in high-tech manufacturing raw materials and parts lose valuable rapidly, so there is some degree of perishability. Another difference is that a manufacturing order need not be rejected outright; rather, it can be delayed, much as a bumped passenger on an overbooked flight can be flown on a later flight. As a result, RM can potentially be

used for demand smoothing, delaying production of low-value demand to off-peak times, while ensuring prompt production and delivery of high-value demand during peak times.

The dynamic pricing tactic of choice for MTS manufacturers has been trade promotions. This is when the distributors and retailers are given a discount (which may or may not be passed on to consumers) if they buy a certain quantity or if they run a promotion special.

Applications of RM among MTO manufacturers are growing, with several vendors specializing in the area. Product configuration software tools (such as the ones used to order a PC online) incorporate pricing information and perform some segmentation (large business, small business, government, and so on), though most of the technology is rules-based. A form of RM where discounts are given based on advance purchase, lead-time, and delivery-time flexibility have been proposed in the literature, but we know of no major implementations at this stage. Applications of configuration-based pricing are reported in the trade literature, but few details have been published.

Finally, dynamic pricing, in the form of Internet auctions, has also had a significant impact in manufacturing recently. Excess inventory is now routinely auctioned off on the Internet, and procurement departments often source supplies (at least in-direct materials) from B2B exchanges. RM systems are likely to play a role in managing these surplus inventory auctions in the future.

## 10.16 Notes and Sources

The main source for the airline pricing description are a variety of ATPCO Rules and Footnotes documents. The discussion on airline operations draws on Barnhart and Talluri [28].

For a description of hotel operations, see Kimes [299, 300], Hanks, Cross and Noland [234], Orkin [411], Varini et al. [532], Burns [96], and Bitran and Mondschein [72]. Hadjinicola and Panayi [233] is one of the few papers that explicitly touches on hotel overbooking and tour-operator agreements. Pinchuk [422] gives a description of RM strategy for casinos, and Ladany and Arbel [319] for cruise lines.

Fellman [184] and Kuyumcu and Higbie [317] discuss media RM implementations. Our discussion of the television ad markets comes from Rust [451]. Bollapragada et al. [83] describe RM implementation at NBC.

Kasilingam [295] and Kasilingam and Hendricks [294] discuss cargo models and an implementation of cargo RM at American Airlines. The thesis of Maragos [360] advocates RM for ocean carriers, Campbell [97]

for intermodal, and a McKinsey article by Pompeo [426] argues the case for the freight industry in general.

In addition to the sources mentioned in the text on event pricing, Courty [133] provides a good survey of ticket pricing in the entertainment industry.

The two main sources for our description of rental car RM practice comes from Geraghty and Johnson [208], and Carroll and Grimes [100], describing RM implementations at National and Hertz respectively.

Passenger railway RM descriptions can be found in Kraft and Srikar [312], Di Pillo, Lucidi, and Palagi [158] and Ciancimino, Inzerillo, Lucidi, and Palagi [118].

Retail RM system information has been culled from vendor literature and also from Girard [214], Johnson [270] and Mantrala and Rao [359]. For background on the industry, see Leamon [333], Standard and Poor industry surveys [485], Subrahmanyan and Shoemaker [493] and Hechings, Gallego, and van Ryzin [247].

For the natural-gas industry and RM descriptions, we have consulted Homes [255], Valkov and Secomandi [525] (the example comes from there), and Anthony and Harrington [20], and the tariff examples come from the Tennessee Gas Pipeline published tariffs for 2003. We consulted Hunt and Shuttleworth [261] and Wilson [569] for the electricity industry competition structure. See also Simth [481], Hirst [254], Wald [545], Colledge, Hicks, Robb, and Wagle [125] and Denton [153].

Harris and Pinder [238] describe an application of variable pricing in manufacturing at a repair facility, and Kay [297] describes dynamic pricing at Boise Cascade Office Products (retail) and Campbell Soups (manufacturing). The operations research literature has concentrated on models for joint inventory and pricing in manufacturing. (See the references at the end of Chapter 5.) Elimam and Dodin [176] and Kalyan [284] give examples of segmentation and RM applications from a ready-mix concrete plant and high-tech component procurement. See also Gray [219] for the potential of RM in manufacturing.

In addition to the industries mentioned in this chapter, RM applications have also been mentioned (although we are not aware of many implementations) in the following industries: bandwidth (Martin [363]), restaurants (Kimes, Barrash, and Alexander [298], and Bertsimas and Shioda [62]), golf courses (Kimes [303]), health care at the Duke University Diet and Fitness Center (DFC) (Chapman [106]), the nonprofit sector (Metters and Vargas [380]), and ISPs (Nair, Bapna and Brine [401]).