Revenue Management in the Railway Industry in Japan and Portugal: A Stakeholder Approach

by

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B.E., Mechano-Informatics, the University of Tokyo, 1999

Submitted to the Engineering Systems Division
in Partial Fulfillment of the Requirements for the Degree of

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ABSTRACT

Revenue Management (RM) is the process of managing the sales of perishable assets by controlling price and inventory so as to maximize profit. It was developed in the late 1970s after the deregulation of the US airline industry, and has enabled the US airline industry to increase its revenue by offering dynamic prices associated with demand. Many academic articles have understandably focused on applications to the airline industry.

This thesis deals with the application of RM to the railway industry. The railway is considered the most energy-efficient mode of transportation, and its role has become increasingly important around the world with ever growing concerns about the global energy crisis and climate change. Implementing an RM strategy for railways is expected to contribute to a significant lessening of this environmental burden by making better use of the existing railway infrastructure. Furthermore, it is not only advantageous for the railway operators, but also for the passengers who can benefit from discounted tickets. In fact, several countries have already introduced RM to their railway systems. However, the results have not always turned out as desired and the goals set out by the policy makers have not always been achieved.

Most research looking at the issue of how RM should be applied to the railway industry has employed a quantitative approach. While the development of mathematical models is clearly valuable, what is equally needed from the viewpoint of policy makers and railway practitioners is social consideration to better implement RM strategies. In order to bridge the gaps between quantitative research and policy implementation, this thesis 1) explores how RM has been implemented to the railway industry by showcasing several empirical examples, 2) proposes a new framework which is used to define an approach for implementing RM, and 3) applies the framework to new national settings, Japan and Portugal. This thesis focuses on qualitative analysis to implement RM practice to the railway industry. Specifically, it analyzes who is the salient stakeholder, and how they are treated by applying stakeholder theory.

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Chapter 1 *Introduction*

Revenue Management (RM) emerged when the US airline industry was deregulated in the late 1970s and can be defined as the process of managing the sales of perishable assets by controlling price and inventory so as to maximize profit. Many researchers have understandably focused on its applications to the airline industry. As a result, the US airline industry successfully provides a variety of fare tickets and meets the needs of a diverse range of customers by offering dynamic prices associated with demand. In 1992 American Airlines estimated that it had achieved the quantifiable benefit of $1.4 billion over the previous three years thanks to RM and expected an annual revenue contribution of over $500 million to continue into the future. (Smith, Leimkuhler, and Darrow 1992, 8-31) Belobaba also reported that individual airlines may increase revenues five percent or more after adopting RM techniques. (Belobaba 1987, 63-73) To date, most of the world's major air carriers and many smaller airlines have some level of RM capabilities. Other small airlines and international airlines in newly deregulated markets are beginning the development process. (McGill and Van Ryzin, Garrett J. 1999, 233-256)

Considering the success of RM practice in the airline industry, the managers within other industries have begun to pose the question: "Would RM be also applicable for my concerns?" Since the service industries, particularly those in the travel and transportation markets, often possess the similar characteristics as airlines and need to satisfy the same conditions, it should also be possible to apply this methodology to other industries. In fact, several industries such as hotels, theaters, ferries, and car rentals have already introduced RM techniques successfully (see *Figure 1-1*). Since most businesses are subject to some sort of supply or production inflexibility, such industries are potential candidates. Furthermore, thanks largely to the recent wave of enterprise software and e-commerce innovations, many firms have now automated their business processes. All of these factors bode well for the future of RM.

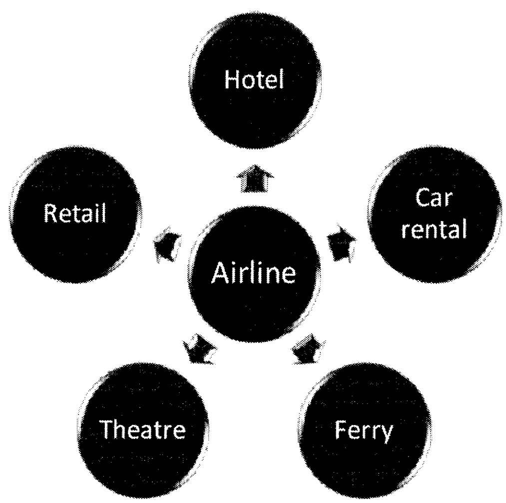

Figure 1-1 Adopters of RM Practices beyond Airlines

1.1 *Motivation*

The railway is considered the most energy-efficient mode of transportation, and its role has become more and more important around the world with ever increasing concerns about energy crisis and global climate change. While few would deny that the development of the railway systems is desirable for any sustainable society, there are some particular conditions where the railway can be advantageous. For example, *Figure 1-2* shows the share of transportation modes among airlines, railways, and automobiles as a function of the travel distance in Japan in 2002. (Ministry of Land, Infrastructure and Transport Japan 2003, 12-14) Generally, railways can be most advantageous with a travel distance of between 300km to 700 km. This is especially true if railways operate in a highly populated area. Thus, selecting the appropriate area to serve is critical for railways to be profitable when deciding new infrastructure investment.

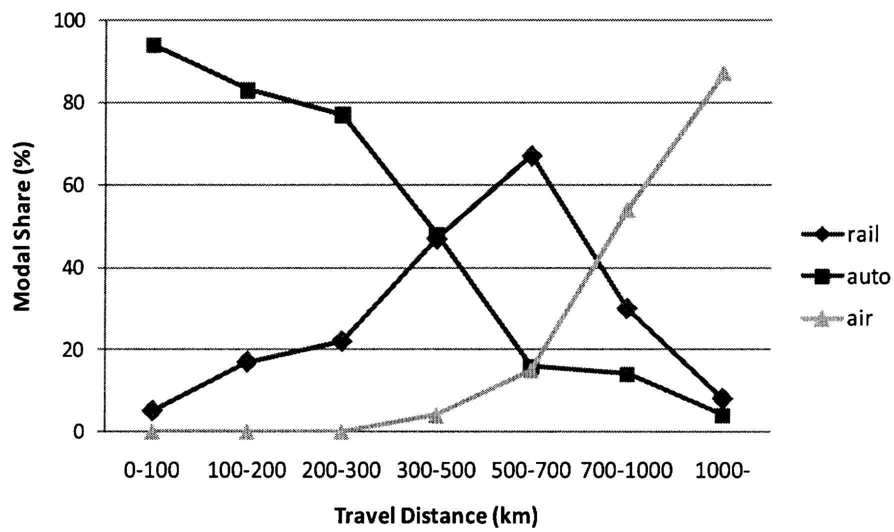

Figure 1-2 Mode Share in Japan

Source: Ministry of Land, Infrastructure and Transport Japan 2003, 12-14

There is still some room for improvement in mode share, however, even after the construction of the railways. While trains are often congested during peak times, there are many trains that do not fully utilize their capacity especially during off-peak periods. Under such circumstances, it is important to make better use of the existing infrastructure and rolling stocks by increasing the average load factor. Furthermore, if travelers who usually use their automobiles switch to the railway, such a shift will surely contribute to a significant lessening of the environmental and congestion burden.

Implementing an RM strategy for railways offers one solution to this issue. As we discuss in Chapter 2, it is advantageous for both the railway operator and the consumer. For the operator, incremental revenue is generated by discount fare passengers who otherwise would not use railways at a standard fare. The discount passengers, on the other hand, who otherwise would not use the railway at the single fare level benefit from the practice. In fact, research to apply RM practices to the railway industry has become active, and there are several countries which have introduced RM to their railway systems as discussed in Chapter 4.

However, as we see in Chapter 4 again, the results do not necessarily turn out to be desirable and do not always achieve the initial goal that policy makers intended. For example, a new fare system with RM techniques called PEP was introduced in Germany in 2002. (Link 2004, 50-55) Even though most managers in charge of the RM Department in the railway operator came from the US airline industry, the system initially provoked strong protest among the general public and it had to be greatly simplified. This example clearly shows that RM research techniques alone are not enough for successful implementation.

Most research looking at the issue of how RM should be applied to the railway industry has employed a quantitative approach. While such research methodologies and development of mathematical models are clearly valuable, what is equally needed from the viewpoint of railway practitioners and decision makers is social consideration to better implement RM strategies. It is very important to bridge the gaps between RM researchers who predict the bright estimates, and policy makers who struggle with RM implementation. This thesis is intended to be such a bridge, as described in detail in the next section (see *Figure 1-3*).

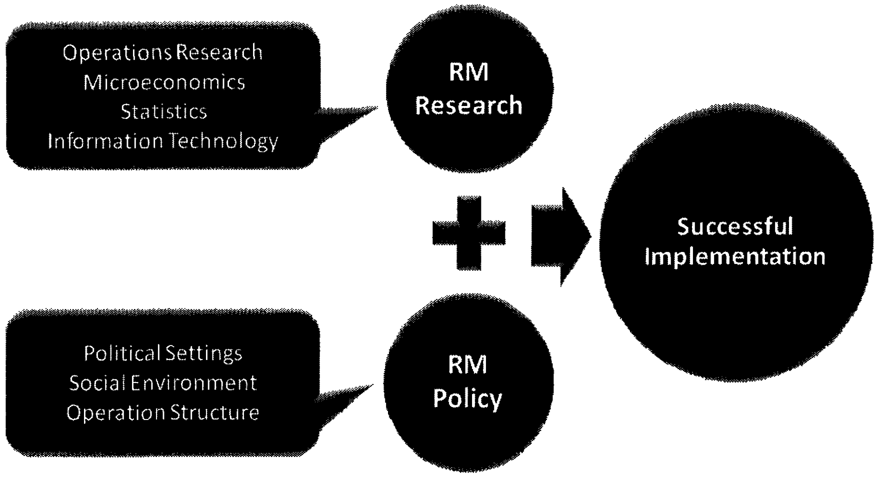

Figure 1-3 Components for Successful RM Implementations

1.2 *Purpose of This Thesis*

This thesis aims to achieve three goals (see *Figure 1-4*). **First**, it explores how RM has been implemented in the railway industry so far, and analyzes why each country has developed a different system. France, Germany, the UK, Canada, and the US have introduced RM techniques to the railway, and considerable differences can be observed depending on the country's circumstances. **Second**, it proposes a general framework which is used to define a new approach for implementing RM as a function of several determinants. This involves a framework from stakeholder theory which determines the salient stakeholders in society. Additionally, several practitioners have proposed a 'revenue management applicability framework,' which is used to analyze the characteristics of the railway industry. By utilizing their findings and my findings above, a general proposition concerning how RM can be implemented to each country is presented. **Third**, it applies the new framework to other countries as an example. Specifically, we will apply it to Japan, where the railway system is more advanced and complicated than any other country, and Portugal, where an active research partnership between the Portuguese government and MIT has been established and the construction of a new high-speed railway system can be expected. (Ministry of Science, Technology and Higher Education Portugal 2006, 1-22)

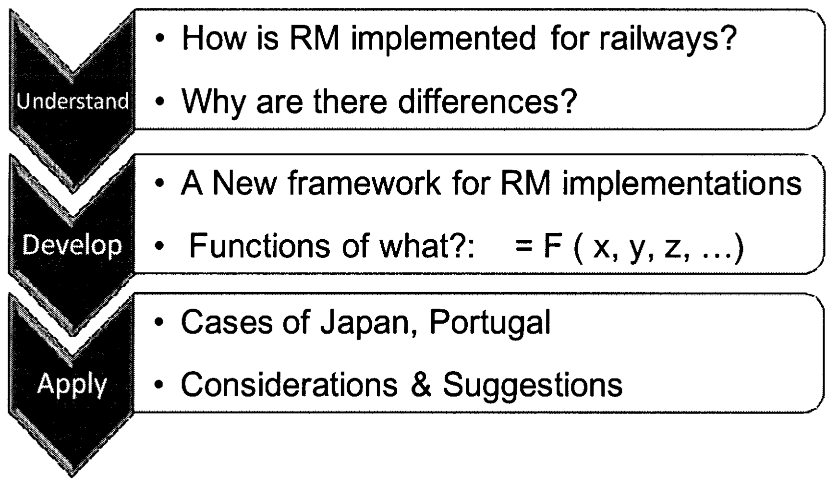

Figure 1-4 Purpose of This Thesis

1.3 *Scope of This Thesis*

This thesis focuses on qualitative analysis to implement RM practice to the railway industry. Specifically, it analyzes who will be the salient stakeholders, and how they are treated. This analysis is made possible by utilizing an existing framework from stakeholder theory. As a next step, this thesis combines several empirical cases from five countries with the existing framework to produce a newly adjusted framework for RM.

This thesis does not intensively deal with mathematical models used to predict numerical estimates of revenue, load factor, etc. However, theoretical development of RM is explained in Chapter 2 to understand the underlying concepts of RM. As Lieberman, who is a consultant in the hospitality practice and studies the application of RM to the hotel industry, writes, "The root concepts (of RM) are the same (with the airline industry), but the applications and the techniques used to implement the concepts (for the hotel industry) differ widely. Unfortunately, RM is often discussed in the context of the applications and techniques, not the root concepts." (Lieberman 1993, 34-41) Such misunderstandings in part cause unsuccessful implementations of RM to the hotel industry. The same rule is applied to the railway industry. Thus, understanding the conceptual history and basic theoretical development is imperative in order to implement RM practices. Moreover, characteristic differences between airlines and railways for RM, and the algorithmic considerations associated with such differences so as to create numerical models are briefly discussed in Chapter 3.

Finally, this thesis assumes high-speed railways as the first target of RM. While there have been several attempts to implement RM practices within urban public transportation systems, the fact that railways possess many similar traits to airlines, both aiming to serve long-distance, inter-city passengers, should make it easier to implement RM practices. In fact, all the empirical examples in five countries in Chapter 4 deal with high-speed railways.

1.4 *Thesis Structure*

Figure 1-5 shows a graphic illustration of the thesis structure.

The remainder of this thesis is divided into seven chapters. Following this introductory Chapter 1, the overview, history, and development of RM are described in Chapter 2. We will focus on both concepts and theories of RM, and introduce current RM practices in the airline industry to have a good understanding from an operational viewpoint, too.

Chapter 3 then moves on to illustrate RM techniques, with the focus on the differences between airlines and railways. Algorithmic considerations associated with those differences are also described. Furthermore, as far as we have surveyed, there is not much research which deals with a RM applicability to railways from a qualitative approach. An example of such an approach will be showcased.

After discussing the general characteristics of RM for railways, five case studies of how RM has been implemented in the railway industry are presented in Chapter 4. Such countries include France, UK, Germany, Canada, and US.

Parallel to the above discussion, 'Stakeholder Theory' is introduced in Chapter 5 to prepare for the discussion about the new framework as one of the thesis goals. Topics include the origin and literature review of the theory, the specific model we use for the basis of our discussion, and stakeholders from the viewpoint of railway operators.

Based on the findings in Chapter 4 and Chapter 5, we analyze why each country has developed RM in a different way in Chapter 6. A new framework that is used to define an approach for implementing RM in various national circumstances is the final product in this chapter.

Then Chapter 7 presents the case studies in which the new framework is applied to other countries, namely Japan and Portugal. Even though these countries have not implemented RM practices on railways, they have sophisticated railway systems and can be good candidates for the next implementation.

Finally, the discussion is summarized in Chapter 8, which describes the thesis conclusions with the focus on some suggestions for further research.

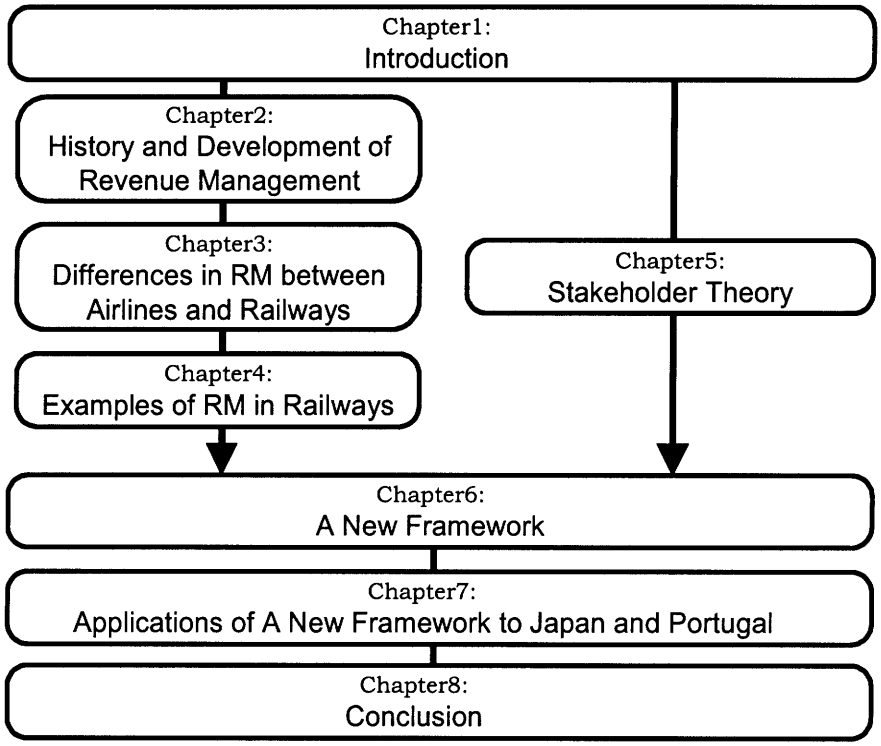

Figure 1-5 Thesis Structure

Chapter 2 *History and Development of Revenue Management*

This chapter describes the history and development of Revenue Management (RM) in the airline industry of the USA, with the focus on both concepts and theories, followed by explanations of current RM research fields. We then move on to discuss the highly sophisticated computerized system which is required to deal with RM strategies. Finally, general conditions of the applicability of RM to the other industries are outlined.

This chapter will be the basis for the discussion on applications of RM to the railway industry in the following chapter. Specifically, what the characteristic differences between airlines and railways are, and how RM should be applied to the railway industry will be described in Chapter 3.

2.1 *Conceptual History of Revenue Management*

The problems of RM are not new in terms of theory at a broad level. The forces of supply and demand and the resulting process of price formation – the "invisible hand" of Adam Smith – lie at the heart of our current understanding of market economics. Thus, *what* is new about RM is not so much demand-management decisions, but rather *how* these decisions are made. Quoting from Talluri and Van Ryzin, "the new approach has been driven by two complementary forces. (Talluri and Van Ryzin, Garrett J. 2004, 715) First, scientific advances in economics, statistics, and operations research now make it possible to model demand and economic conditions, quantify the uncertainties faced by decision-makers, estimate and forecast market responses, and compute optimal solutions to complex decision problems. Second, advances in information technology now provide the capability to automate transactions, capture and store vast amounts of data, quickly execute complex algorithms, and then implement and manage highly detailed demand-management decisions." First component including fundamental techniques is described in section 2.2 and 2.3, and second component such as system designs is illustrated in section 2.4.

The starting point for RM was the Airline Deregulation Act of 1978. With this act, the U.S. Civil Aviation Board (CAB) loosened control of airline prices, which had been strictly regulated based on standardized price and profitability targets. Facing the freedom of price settings, many airlines started to offer a wide range of fares for an identical Economy seat in a single city-pair market as they attempted to fill empty seats and realize as much revenue as possible from each seat sold. In terms of the theory of microeconomics, "price discrimination" – the practice of charging different prices for the same products that have the same costs of production based solely on different consumers' "willingness to pay" (WTP) – is advantageous for both the airline and the consumer. For the airline, offering various fares instead of a single fare allows it to increase total flight revenues with little impact on total operating costs. Incremental revenue will clearly be generated by discount fare passengers who otherwise would not fly at a single standard fare.

Consumers can also benefit from the airlines' use of differential pricing. Obviously, the discount passengers who otherwise would not fly at the single fare level benefit from the practice. In fact, without low fare passengers to contribute incremental revenue to the operating costs of the airline, high fare passengers would have to pay even higher fares and/or have a reduced set of flight departure options.

In *Figure 2-1*, a price-demand curve with and without price discrimination for an O-D market is illustrated. If the airline serving this market were to adopt a single-price strategy, the revenue that it would realize equals to P_0*Q_0. Now, if the airline were to offer a second lower fare at P_2, and increase the standard ticket at P_1 to capture the demand with high WTP, the revenue can be expected to increase to $P_1Q_1+P_2(Q_2-Q_1)$. The same principle would be applied to more price discriminations as shown in *Figure 2-1*(bottom), where the airline is offering six different prices. Obviously, revenue can be increased by capturing more WTP (or consumer surplus) as the number of fare products goes up. Thus, the airline's ability to identify different demand groups or segments is extremely important since total revenue is theoretically maximized when each customer pays a different price equal to his WTP. In practice, such segmentation is clearly impossible to achieve. Instead, airlines identify segments with similar characteristics in terms of purpose, price sensitivity and time sensitivity. Business and leisure travelers are the two traditional segments. Several restrictions are usually applied to the discount tickets such as advance purchase, minimum stay requirements, and cancellation and change fees. These restrictions are meant to be the primary mechanism used by airlines to prevent "diversion" – the ability of consumers with higher WTP (who were expected to buy the higher fare products) to buy the lower fare products, given that they were planning to fly anyway and that they are well aware of the lower-priced options.

Having adopted this approach, the airlines soon began to realize that differential pricing alone was not enough to maximize airline revenue. Both leisure (discount) and business (full fare) consumers typically prefer to travel at the same times, and compete for seats on the same flights. Without booking limits on discount fare seats, it is likely that leisure travelers who tend to book earlier than business travelers will displace high-revenue business passengers on peak demand flights. Thus, it is also extremely important to protect seats for later-booking, high-fare business passengers by forecasting the expected future booking demand for the higher fare class, and by performing mathematical optimization to determine the number of seats that should not be sold to the lower fare classes. In other words, RM was developed to capture the airline's last chance to maximize revenue, given scheduled flights, capacities, and prices.

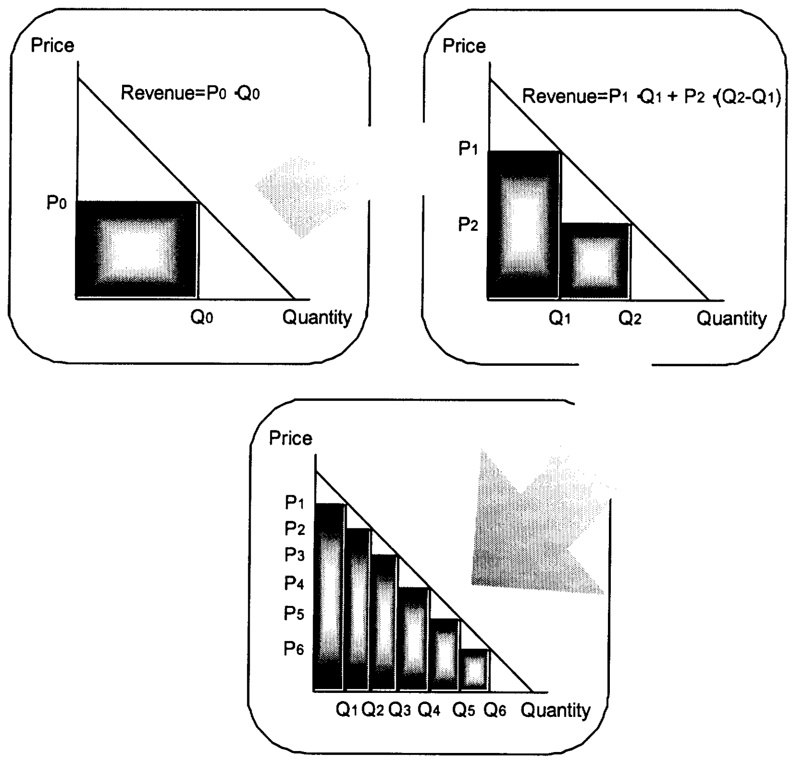

Figure 2-1 Price-Demand Curve and Price Discrimination

However, this practice has not been necessarily welcomed by all passengers. First of all, it has become increasingly familiar that two types of air travelers, one who paid full fare and the other who purchased a deeply discount ticket, ends up sitting next to each other. Paying different prices for the same economy seats might be considered unfair because it violates the "law of indifference." Secondly, the airplane becomes more and more crowded. *Figure 2-2* shows the historical data from 1986 to 2005 of the average load factor in the US domestic market. (Belobaba 2005) It continuously goes up. Although the high load factor is desirable for airline firms, air travelers naturally prefer less crowded planes.

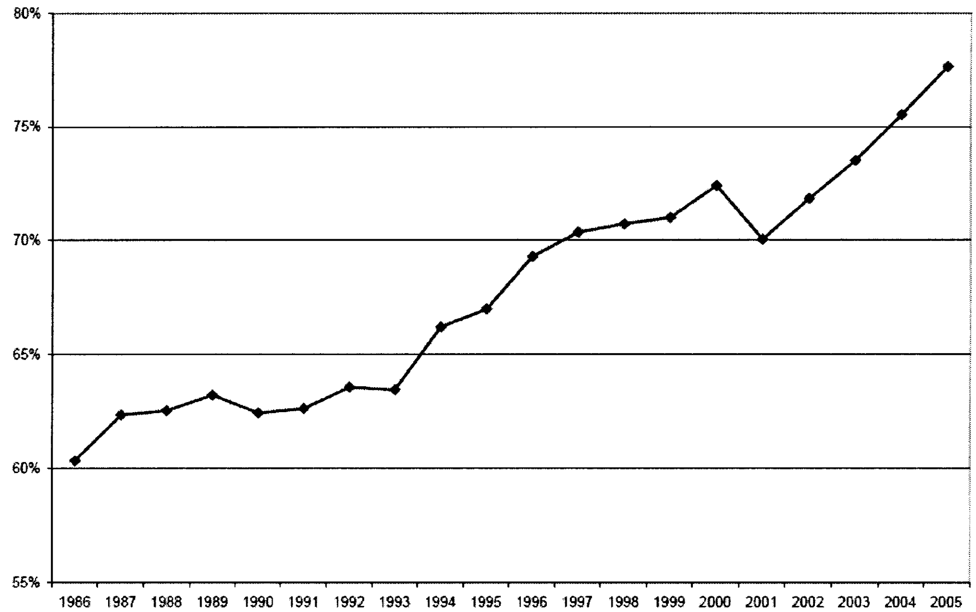

Figure 2-2 The Average Load Factor for the US Domestic Market

Source: Belobaba 2005

2.2 *Theoretical Development of Revenue Management*

Having understood the conceptual history of RM, we then move on to discuss the theoretical development based on ideas in the above section. Most early research assumed all of the following simplifying assumptions: 1) sequential booking classes (the assumption that requests for bookings in particular classes are not interleaved); 2) low-before-high fare booking arrival pattern; 3) statistical independence of demands between booking classes; 4) no cancellations, no no-shows and no overbooking; 5) single flight leg with no consideration of network effects; and 6) no batch booking.

2.2.1 *Littlewood's Model*

The beginning of what was then called yield management and later RM was marked by Littlewood of BOAC (now British Airways). (Littlewood 1972) It was evident that effective control of discount seats was essential, and he created a simple two-class fare model, proposing that low fare passengers who pay a mean revenue of r should be accepted on a flight as long as:

$$r \geq P \cdot R$$

where R is the higher yield revenue and P the maximum risk that acceptance of a low fare passenger will result in the subsequent rejection of a higher yield passenger. In other words, total flight revenue will be maximized by accepting low yield passengers up to the point where the probability of selling all remaining seats to high yield passengers is equal to the ratio of the mean revenue of low yield and high yield passengers, r/R.

2.2.2 *EMSR Model*

Belobaba extends Littlewood's model to multiple fare classes and introduces the term EMSR – Expected Marginal Seat Revenue – for the general approach. (Belobaba 1987) EMSR is a probabilistic revenue optimization model which can be used to set and revise fare class booking limits for a future flight leg departure. The EMSR model determines the number of seats which should be authorized for sale in each fare class by using historical demand data, average fares, and current bookings. Seats for a given fare class are protected over lower fare classes by equating the expected marginal revenue of protecting an additional seat in the higher fare class with the expected marginal revenue of not protecting the seat and selling it in the lower fare class.

The model assumes that the demand has a normal distribution. In this case, the probability density function, *p(r)*, for the total number of requests, *r*, received by an airline, and the demand for a given fare class, is a normal curve as shown in *Figure 2-3*. The average expected future demand, μ, and the standard deviation of the expected demand for the flight, σ, are derived from a sample of historical data of similar flights.

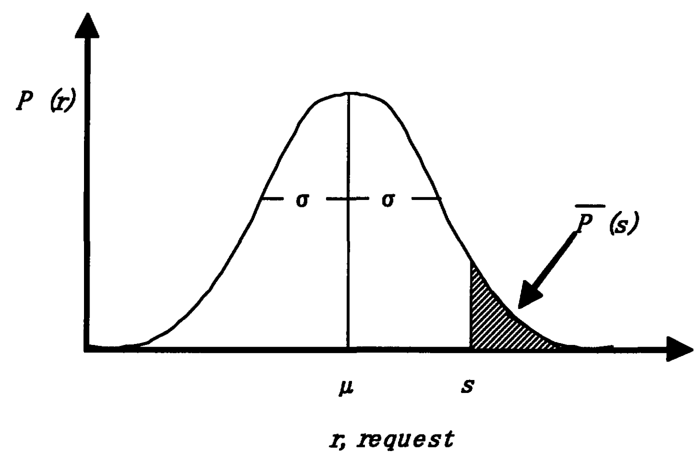

Figure 2-3 Normal Probability Density Function of Demand

Source: Belobaba 1987

The probability of selling the S*th* seat, *P(S)*, is the probability of having *S* or more requests, $\overline{P}(S) = 1 - P(S)$, as shown in *Figure 2-3*. The probability of selling the first seat in a particular fare class is approximately equal to 1. As the number of seats increases, the probability of selling them decreases, and eventually goes down to 0. This decreasing probability function curve is shown in *Figure 2-4*(left).

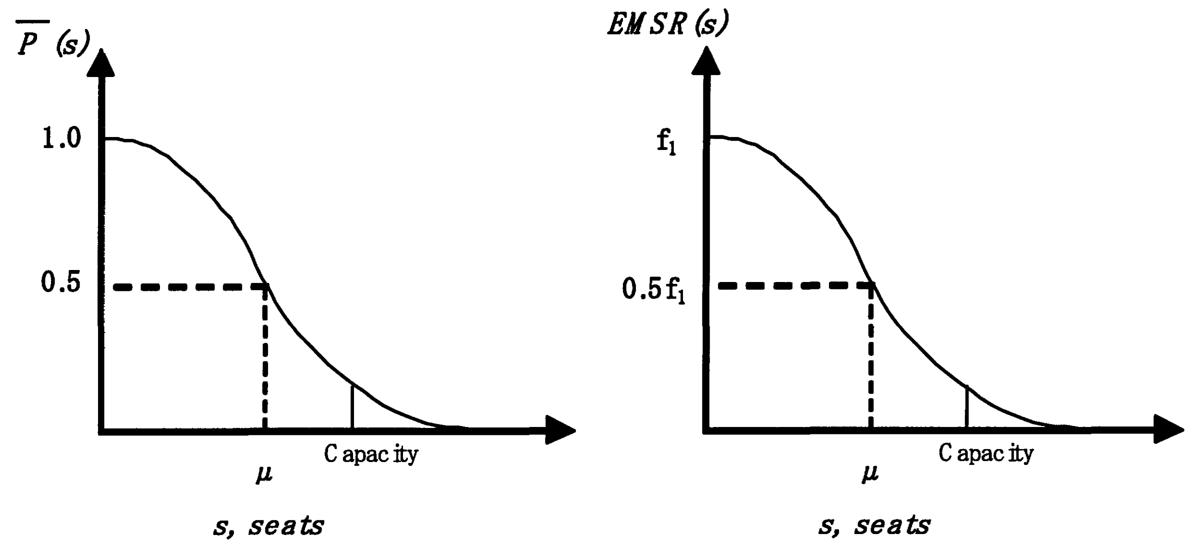

Figure 2-4 Probability Distribution of Selling the Sth seat (left) and Expected Marginal Seat Revenue (right)

Source: Belobaba 1987

The expected marginal revenue of the seat is simply: $EMSR(S) = f \times \overline{P}(S)$. Thus, the expected marginal revenue curve has the same shape, but the curve is scaled up by the constant *f*, the fare as illustrated in *Figure 2-4*(right).

Suppose that there are only two classes; class 1 as a higher fare class, and class 2 as a lower fare class, and S_2^1 denotes the number of seats which should be protected for class 1 over class 2. S_2^1 is found by equating the expected marginal revenue of the $S_2^1 th$ seat in class 1 with the expected marginal revenue of the first seat made available in class 2,

$$EMSR_1(S_2^1) = EMSR_2(1)$$

The expected marginal revenue of selling the first seat in class 2 is simply f_2, because the probability of selling the first seat in a particular fare class is approximately equal to 1. Thus,

$$f_1 \times \overline{P}_1(S_2^1) = f_2$$

This is illustrated graphically in *Figure 2-5*. In this way, S_2^1 is the booking limit for class 1.

Note that this model explicitly assumes that requests for a lower fare class always come first.

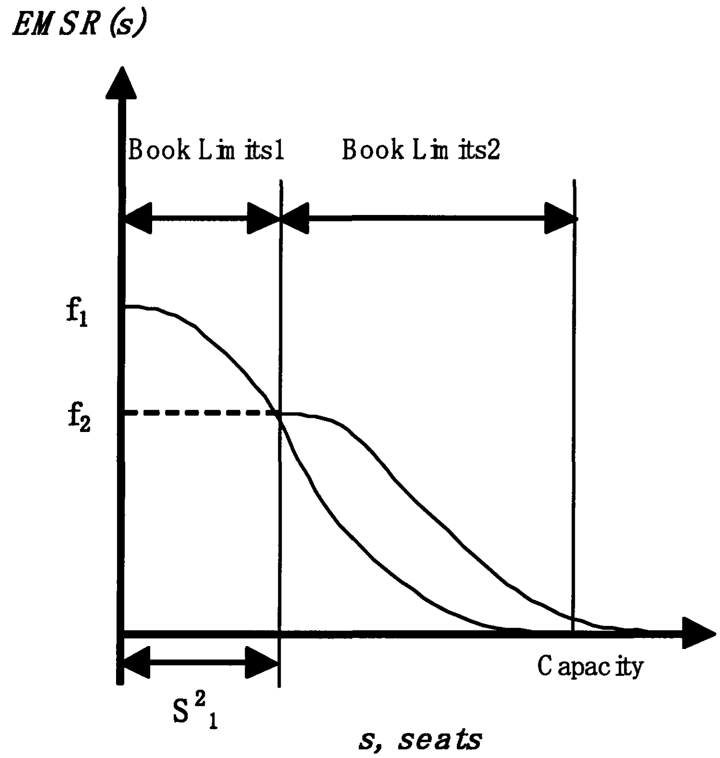

Figure 2-5 EMSR Protection Level for Two Classes

Source: Belobaba 1987

As opposed to the optimal controls such as Littlewood's model, EMSR is a heuristic approach. But the EMSR approach is widely used nowadays because it is simpler to code, quicker to run, and generate revenues that in many way cases are close to optimal.

2.2.3 *Network Control*

Network effects in RM have become increasingly significant because the development of hub-and-spoke networks has greatly increased the number of passenger itineraries that have connections to different flights (see *Figure 2-6*). When products are sold as such bundles, the lack of availability of only one leg limits the whole sale. This situation creates interdependence among legs. What we call network RM is required. Some of the approaches to respond such needs are 'Virtual Nesting' and 'Bid-Price Methods.'

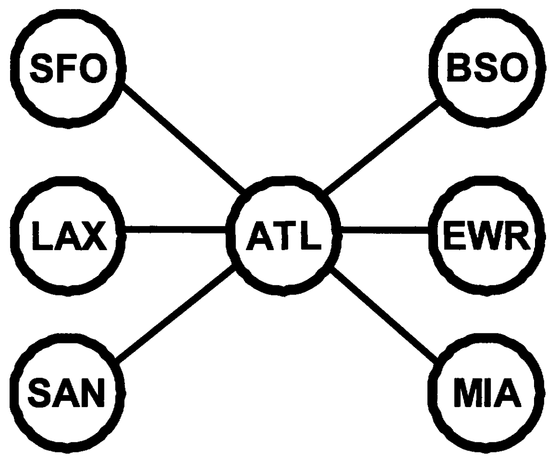

Figure 2-6 A Hub-and-Spoke Network for the US airline market

2.2.4 *Virtual Nesting*

In fully nested booking systems, seats that are available for sale to a particular booking class are also available to bookings in any higher fare booking class, but not the reverse. In other words, inventories are nested so that more desirable request will not be denied as long as there are seats available. For example, in a four fare class structure (Y, B, H, and V – with Y being the full fare class and V being the lowest discounted fare class) as shown in *Figure 2-7*(left), if there were 20 seats allocated to Y class, 30 to B, 15 to H, and 35 to V, there would be 100 seats made available to Y class requests, while V class availability would remain at the 35 seats. A nested fare structure is more realistic assumption than a distinct fare structure which is shown in *Figure 2-7*(right), thus it is widely used. However, a nested structure for a single leg control cannot be translated to that for a network control easily due to the size and complexity of a method which determines a network solution.

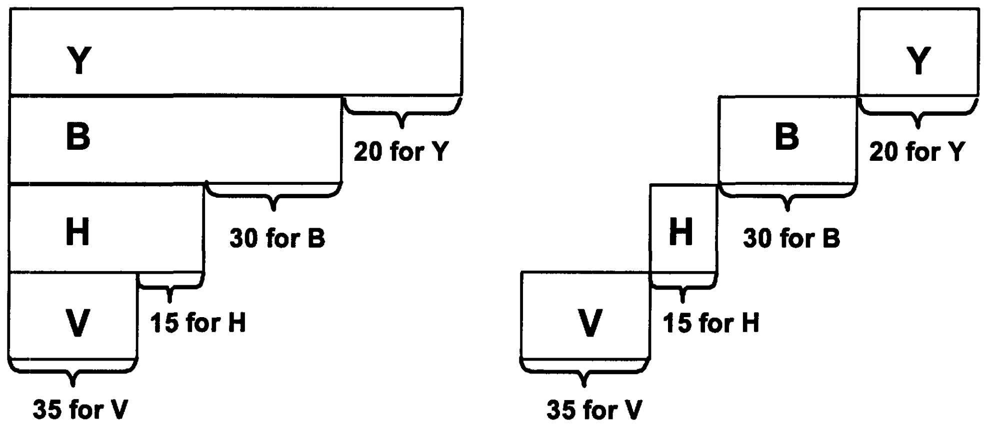

Figure 2-7 Nested (left) and Distinct (right) Fare Structures

Source: Author

Virtual nesting control is a hybrid of network and single-leg controls, and provides one solution. (Smith and Penn 1988) It uses single-leg nested-allocation controls for each leg in the network. However, the classes used in these nested allocations are virtual classes, which group together sets of products that use a given leg. A variety of options are possible for the clustering process such as assignment by total value, or by estimated leg value. In order to decide on a request for a network product, the system checks for availability of its corresponding virtual classes on each leg. If all the virtual classes are available, the request is accepted.

Booking limits are determined and expected revenue is maximized by individual flight leg, but seat allocations are controlled on the basis of fare class and passenger itinerary. This is not an optimal system-wide solution, but is considered a sophisticated approach to seat inventory controls.

2.2.5 *Bid-Price Methods*

Bid-price methods are revenue-based controls rather than class-based controls. Specifically, a bid-price control sets a threshold price, and a request is accepted if its revenue exceeds the threshold price and rejected if its revenue is less than the threshold price. (Simpson 1985) Bid-price controls are simpler than booking-limit controls because they require only recording a single threshold value, instead of a set of capacity numbers for each class. However, bid-prices must be updated after each sale to be effective. *Figure 2-8* illustrates how bid-prices can be used to achieve the same nested allocation results as booking limits. The bid-price is plotted as a function of the remaining seats. In this example, when there are more than 65 seats available, the bid-price is below $100, so all four classes are accepted. With 50 to 65 seats remaining, the bid-price is over $100 but less than $200, so only class Y, B, and H are accepted. The same rule can be kept applying. Eventually, when there are 20 or fewer seats available, the bid-price is over 300 but less than $500, so only class Y is accepted. Bid-price is usually interpreted as an estimate of the marginal cost to the leg of consuming the next incremental unit of the capacity.

While nested allocations in section 2.2.4 are difficult to extend directly to network RM control, a network bid-price method is a relatively simple extension of the single-leg version. When a request comes in, the revenue of the request is compared with the sum of the bid-prices of the legs. If the revenue exceeds the sum of the bid-prices, the request is accepted. Thus, the structure of controls remains simple even in a network setting. Only a single value for each leg needs to be specified, so the number of variables is small.

Furthermore, evaluating a request requires only a simple comparison of revenue to the sum of bid-prices, so the transaction is quick. However, if the bid-prices are not updated, it could be possible to sell an unlimited amount of capacity to any class whose revenues exceed the bid price threshold. Thus, frequent updating is critical.

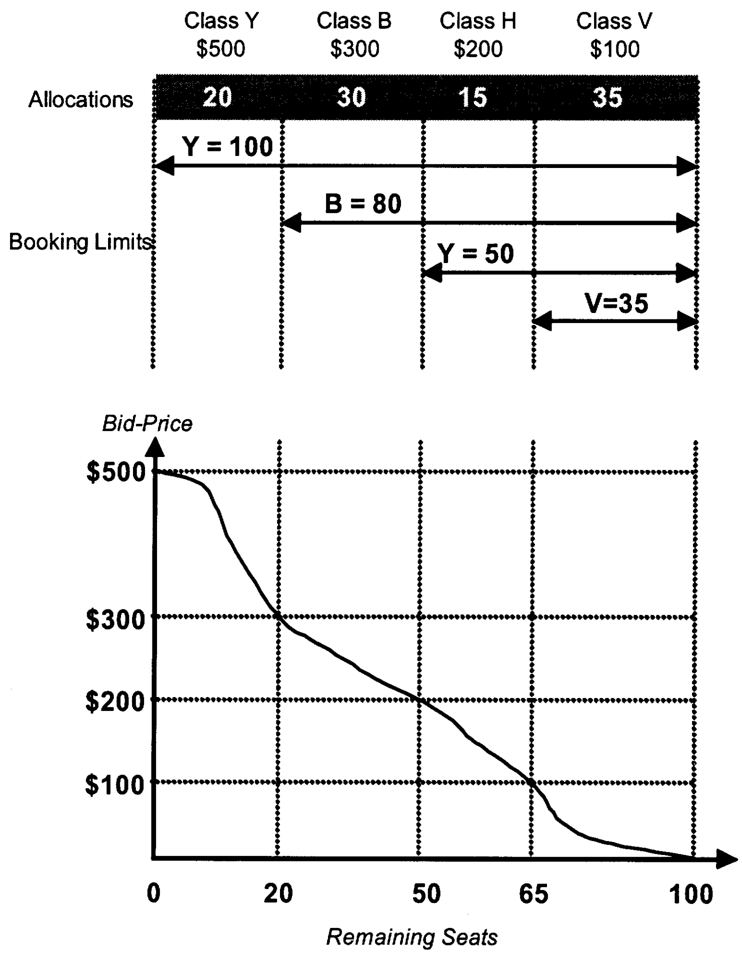

Figure 2-8 The Relationship between Booking Limits and Bid-Price

Source: Author

2.3 *Current Research areas of Revenue Management*

McGill and Van Ryzin describe how research into RM falls into four key areas: forecasting, overbooking, seat inventory control and pricing. (McGill and Van Ryzin, Garrett

J. 1999, 233-256) We will briefly explain all of four areas, with the focus on the relevance to RM systems.

- **Forecasting**

Forecasting is particularly critical in RM within any industry because of the direct influence forecasts have on the booking limits that determine profits. As illustrated later in section 2.4.2, the outputs of the forecasting module are fed to the optimization module in current RM systems. The forecasting module includes the demand data (both censored and uncensored), booking curve (the way reservations for different customer types arrive during the booking period), cancellation and no-show probabilities, revenue values, and price sensitivity. Forecasts can be made at different levels of aggregation. Concerning aggregate forecasting, Sa concludes that the use of regression techniques can improve the performance of RM systems when compared to time series analysis or historical averages. (Sa 1987) The disaggregate forecasting is extremely difficult, but there has been significant research activity in many disciplines on discrete choice behavior modeling which uses logit estimations. (Ben-Akiva and Lerman 1985; Hopperstad 1994; Lee 1990) Practitioners favor the use of short-term booking information such as the same flights in earlier weeks to forecast a given flight. Most systems use time series methods so far, which use historical data to project the future

- **Overbooking**

Overbooking has the longest research history, and achieves the best financial contribution of these four components. The objective of most of the early technical research on airline overbooking was to control the probability of denied boardings within limits set by airline management or external regulating bodies, but none of these studies did not take into account the dynamics of the passenger cancellation and reservation process after the overbooking decision. Since then, however, a number of researchers have developed dynamic optimization approaches to the overbooking problem. The objective is to determine a booking limit for each time period before departure that maximizes revenue, where allowance is made for the dynamics of cancellations and reservations.

- **Seat inventory control**

As described in section 2.2, early inventory control research is for single flight legs with various assumptions including low-before-high fare booking arrival patterns, statistical independence of demands between booking classes, and no overbooking. Belobaba introduces the term EMSR (Expected Marginal Seat Revenue) method. (Belobaba 1987) Seats are protected over lower fare classes by equating the expected marginal revenue of protecting an additional seat in the higher class with the expected marginal revenue of not protecting the seat and selling it in the lower fare class (see 2.2.2). However, since the expansion of hub-and-spoke networks, various approaches have been presented for a network (multi-leg) model such as mathematical programming, virtual nesting (see 2.2.4), and bid-price methods (see 2.2.5).

The focus of research, however, has shifted since the advent of Low Cost Carriers (LCCs). Because LCCs do not rely on the traditional pricing model with many restrictions to make a profit, the recent trend toward "less restricted" and "simplified" fare structure is spreading to an increasing number of air travel markets around the world. New methods to accommodate those changes are needed, and being developed.

➢ **Pricing**

While there is extensive literature on pricing from an economic perspective, most of the research deals with pricing and price competition at an industry level rather than the operational RM decision model. (Borenstein and Rose 1994, 653-683; Dana 1996; Dana 1998, 395-422; Kretsch 1995, 477-482) There has been very little published research on joint capacity/pricing decisions in the RM context. However, since price is generally the most important determinant of passenger demand behavior, it is natural to view pricing as part of the RM process these days.

2.4 *Computerized Revenue Management System*

2.4.1 Hardware Requirements

RM is a computationally intensive process because huge amounts of data have to be collected and stored in databases, then executed through several modules. While hardware requirements for RM systems can be immense, not every firm needs expensive supercomputers to run RM software. In fact, some of the smaller, simpler applications can be run on a PC. A multiprocessor database server and a powerful workstation for forecasting and optimization are usually sufficient for most RM systems. Current RM systems run on a variety of platforms from stand-alone PCs to mainframes. Reliability, redundancy, and good back-up procedures are important because, if a RM system is down, critical controls are not set properly, which could result in a significant revenue loss.

2.4.2 RM System Flow

Figure 2-9 shows the process flow in a RM system. (Talluri and Van Ryzin, Garrett J. 2004, 715) Due to the huge volume of data that has to be dealt with in RM practice, a highly sophisticated computer reservation system (CRS) is usually implemented. It manages the inventory of available seats by using mathematical models and a computer database to address three different problems: Discount allocation, Overbooking, and Network control. According to Talluri and Van Ryzin, a CRS generally follows four steps: Data collection, Estimation and forecasting, Optimization, and Control. (Talluri and Van Ryzin, Garrett J. 2004, 715) The RM process typically involves cycling through these four steps at repeated intervals.

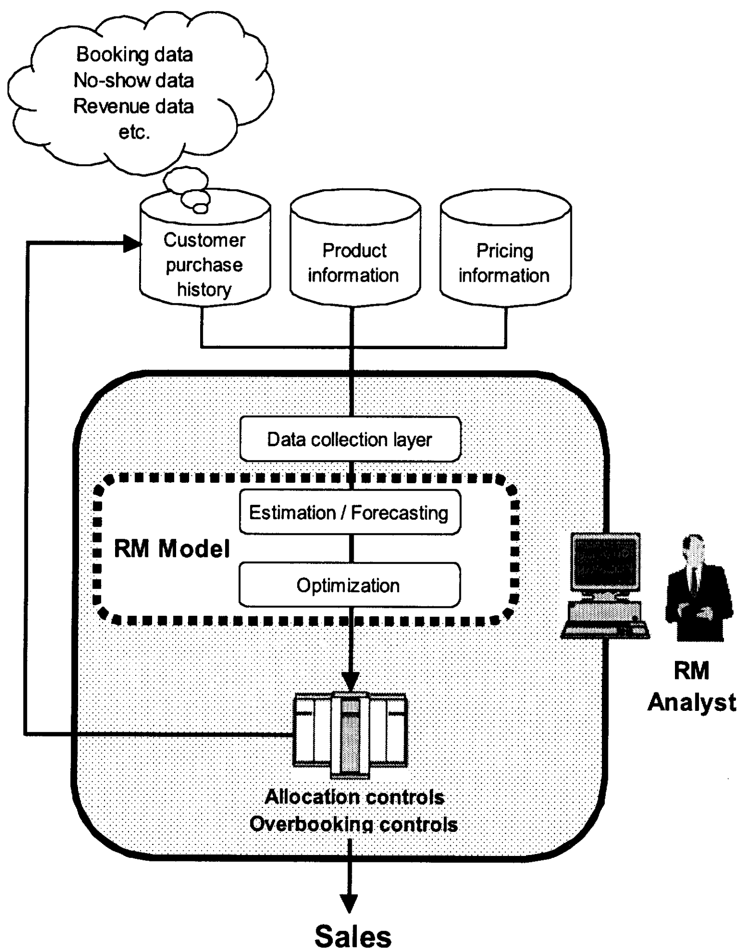

Figure 2-9 RM System Flow

Source: Talluri and Van Ryzin, Garrett J. 2004, 715

- **Data collection:** Collect and store relevant historical data (prices, demand, causal factors).
- **Estimation and forecasting:** Estimate the parameters of the demand model; forecast demand based on these parameters; forecast other relevant quantities like no-show and cancellation rates, based on transaction data.
- **Optimization:** Find the optimal set of controls (allocations, prices, markdowns, discounts, and overbooking limits) to apply until the next re-optimization.
- **Control:** Control the sale of inventory using optimized control. This is done either through the firm's own transaction-processing systems or through shared distribution systems (such as Global Distribution Systems).

The user interface is an important component of a RM system, since RM is a man-machine process, with systems automating most of the routine decisions but under the supervision of analysts who intervene as necessary to respond to unusual market conditions or system errors. *Figure 2-10* shows the flow of a nightly batch process and daily activity between systems and analysts. (Talluri and Van Ryzin, Garrett J. 2004, 715)

It is considered that human analysts can make a better judgment than algorithms about forecasting demand due to the deep knowledge of markets or special conditions. For example, when there is a special event on certain city which could stimulate tremendous demand, human analysts can forecast such demand more precisely than computer algorithms can do. To the contrary, it is also assumed that human analysts can rarely set controls better than optimization algorithms. This means that computer algorithms can calculate the seat allocation better than human analysts can do. Thus, overriding by analysts is typically made between a forecasting process and an optimization process. In fact, RM analysts are not usually permitted to change capacity controls directly but can change them only indirectly by manipulating the forecast inputs.

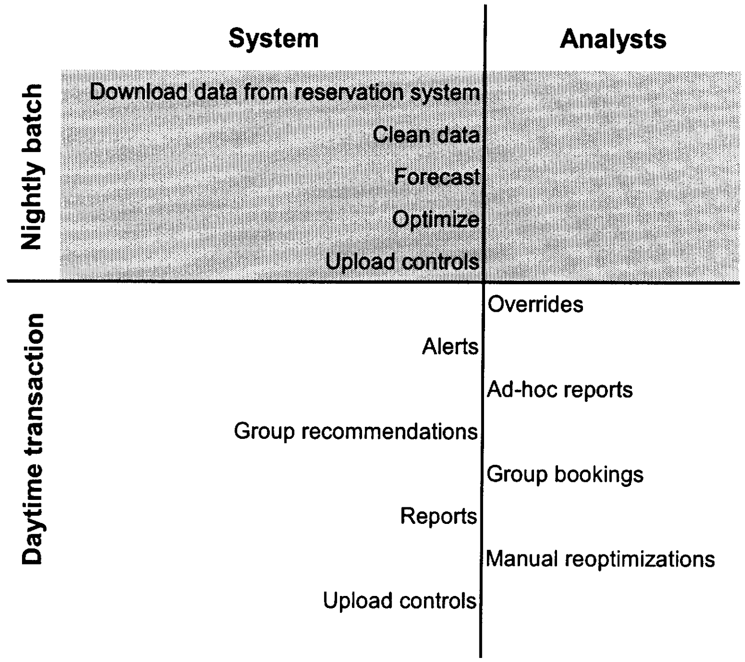

Figure 2-10 Nightly Batch and Daily Transaction Flow between RM Systems and Analysts

Source: Talluri and Van Ryzin, Garrett J. 2004, 715

2.4.3 Organizational Charts

How analysts are organized is also an important issue when implementing RM practices. Even though there is no perfect solution, there are some tendencies depending on the industries. For example, analysts are normally assigned collections of flights to manage in airline companies, though how flights are grouped varies. The flights might be related by geographical markets or by passenger types such as leisure or business travelers. *Figure 2-11* shows a typical organizational chart in the airline firm.

As discussed in the following section, several industries have introduced RM practices, including the retail industry and the hotel industry. In the retail industry, they are typically organized by product categories such as casual wear and business suits. Hotels are usually managed on an individual property basis. Car-rental analysts are most often organized on a regional basis.

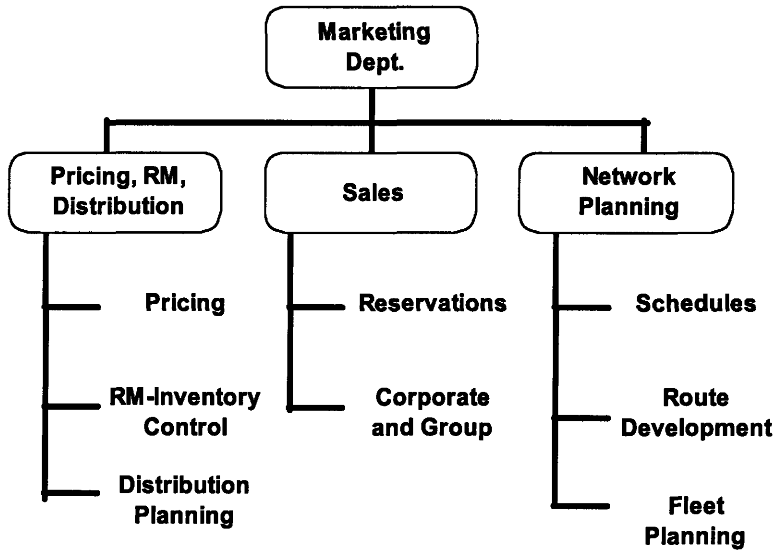

Figure 2-11 A Typical Organization Chart for Airline RM Departments

Source: Talluri and Van Ryzin, Garrett J. 2004, 715

2.5 *Revenue Management in the other industries*

Having seen the great success of RM practice in the airline industry, managers in other industries began to wonder whether they could implement the same techniques in their own concerns. In fact, Kimes claims that RM can potentially be applied to any operation constrained by capacity such as the hotel, car rental, delivery service, and cruise line industries. (Kimes 1989, 348-363) He states that RM techniques are useful if the following six conditions are met:

- **Relatively fixed capacity**

Since the focus of RM is efficient allocation of shared fixed capacity, it is only appropriate for firms which cannot quickly adapt available capacity to available demand. It is not necessary to be entirely fixed, although it is common in many industries where RM is applied. This means either a high cost of adding a capacity or a time lag before capacity can be added.

- **Ability to segment markets**

In order for RM to be effective, the firm must segment its market into different types of customers. The business must know which customers are most likely to use variously-priced classes of service, and must develop different marketing strategies for each market segment.

While the market is segmented into business and pleasure travelers in the airline industry, companies may have different marketing plans such as different services, which distinguish the different segments. The time of purchase is also used to distinguish the service. In either case, arbitrary price discrimination is not allowed, so the product or service should have some characteristic that distinguishes the product in different markets. For example, the time of delivery of a product may differentiate it.

- **Perishable inventory**

One of the key factors distinguishing service firms from manufacturing firms is that the inventory is perishable. Historically, RM techniques have been applied to services or products that perish after a specific date. For example, seats unsold on an airplane represent spoiled or wasted inventory. This situation assumes that if the product or service does not perish, traditional inventory management approaches can be used. Some examples of industries with perishable inventories are provided in Weatherford and Bodily such as seats for the theater or event, space on any means of transportation or in lodging, electricity and other utilities, and traffic on fiber optic lines, etc. (Weatherford and Bodily 1992, 831-844)

- **Product sold in advance**

  As described before, time of purchase is a characteristic often used to differentiate products or services. One of the capacity management tools is a reservation system in which units of inventory are sold in advance of actual use. While this provides the firm with some measure of security, the manager is also faced with uncertainty in that they have to decide whether to accept an early request which is often at a lower price.

- **Fluctuating demand**

  In applicable industries, demand should have variability. It may vary seasonally, weekly, daily, etc. RM can be used to temper some of the demand fluctuations by increasing utilization during slow demand times, and by increasing revenue during times of high demand.

- **Low marginal costs**

  For a RM system to be effective, the cost of selling another unit of available capacity is relatively inexpensive while providing additional capacity is a very expensive proposition.

Orkin suggests that hotels can benefit from adopting RM systems. (Orkin 1988, 52-56) In particular, he claims that Hyatt Regency's average rate for all reservations increased after the adoption of RM techniques. He also states that many Hilton hotels have set revenue records since instituting RM. Geraghty and Johnson credit RM techniques with saving National Car Rnetal from liquidation. They state that the initial implementation moved

National Car Rental into the black, and a cutting-edge RM system increased revenue $56 million in the first year of operation. (Geraghty and Johnson 1997, 107-127)

2.6 *Summary*

In this chapter, we have observed the conceptual history and theoretical development of RM. RM has been developed from the US airline industry, and current Computer Reservation Systems which implemented RM techniques have been described with the example of typical airline companies from an operational viewpoint. Furthermore, six criteria have been presented to apply RM practices to other industries. Even though it is implied, from these criteria, that the railway industry can also implement RM, we need to pay attention to the differences between two industries. In the next chapter, we will discuss several issues to consider when implementing RM for railways.

Chapter 3 *Differences in Revenue Management between Airlines and Railways*

Following the general descriptions of Revenue Management (RM) in Chapter 2, we now move on to discuss the characteristic differences between airlines and railways, and how RM should be applied to the railway industry. Furthermore, we will propose some basic strategies for implementing RM on railways. Actual examples in various countries are presented in the following chapter.

3.1 *The differences of RM between Airlines and Railways*

Having seen the six criteria for RM applicability in section 2.5, we can naturally assume that models of RM systems for airlines could be applied to railway transportation. However, Kraft explores the critical differences between the two industries, as well as common characteristics. (Kraft, Srikar, and Phillips 2000, 157-176) Campbell also concluded that railway RM systems should not be simple adaptations of the airline systems. (Campbell and Morlok 1994, 529-548) We will now present several issues that are particular to the railway industry compared to the airline industry. Algorithmic considerations associated with such differences will be described, too.

- **More network oriented**

Perhaps the most significant difference is that railways are inherently more multi-leg than airlines due to the large number of intermediate station stops typically made by trains. Each pair of adjacent station stops defines a "leg" for which the opportunity cost and/or capacity allocations by fare class must be determined. Because of this added complexity, it is no longer feasible to follow the early models for airlines by dealing with each leg separately. The system should take into consideration more profitable allocation of discounted fares and more effective limits on sales of shorter rides for the entire itineraries, not by each single leg.

For example, *Figure 3-1* (the left figure repeated from section 2.2.3) illustrates the differences mentioned above. While there are only two or three connections at most in airlines, it is common for railways to have more than 20 stops. The Sunset Limited operated by Amtrak from Los Angeles to Orlando has as many as 40 stops. Furthermore, Amtrak would limit sales of reserved seats from Washington D.C. to Philadelphia if the system predicted, based on demand forecasting associated with past ridership, that the railway could fill those seats with riders traveling all the way to Boston. (Kraft, Srikar, and Phillips 2000, 157-176)

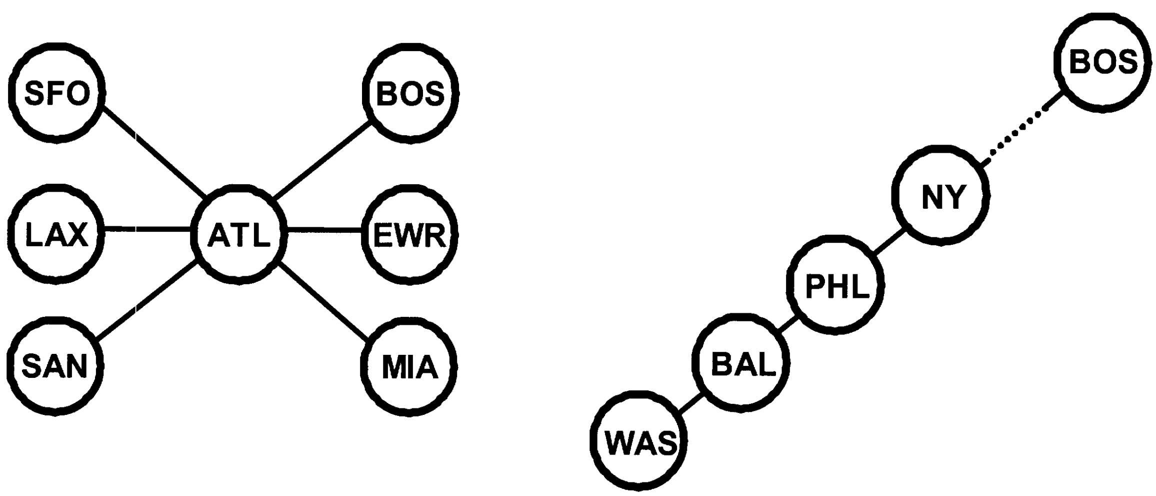

Figure 3-1 Number of Legs for Airlines and Railways

While Ciancimino et al. proposed a mathematical programming formulation such as deterministic linear programming (DLP) and probabilistic nonlinear programming

(PNLP), Amtrak and SNCF use EMSR method with virtual nesting (see section 2.2.4), presumably because of system constraints. (Ciancimino and others 1999, 168-181) Kraft insisted that a bid-price approach (see section 2.2.5) is highly attractive for long distance passenger trains because of the large number of legs traversed by the average intercity passenger, as well as the high number of interconnecting trips between trains. (Kraft, Srikar, and Phillips 2000, 157-176)

There are sometimes many connection points where passengers can switch trains, and such a condition makes it a more complicated network. Many models assume that each train is treated separately, without considering network connecting traffic. This assumption looks restrictive, but it can often be justified by the fact that only the most valuable trains are considered for a RM strategy.

- **Fewer fare product differentiation (less price discrimination)**

While there are usually six to eight fare products with various restrictions for the same economy seats in airlines, the number of fares offered by railways is typically small, two or three. This characteristic can be explained by the relative homogeneity of the pasenger markets served by each train service. For example, nearly all the ridership of Amtrak's long distance passenger trains are leisure class travelers. By contrast, the premium fare Metroliner service is primarily targeted at time sensitive business travelers – most leisure class customers are accommodated on lower fare Northeast Direct trains. While one sees multiple fares more often in short distance markets, such a situation does not allow much of an opportunity to improve revenue through price discrimination.
However, in terms of the market segmentation which is one of the criteria for RM discussed in section 2.5, it is possible for railways to apply other differentiations. For example, there are several types of trains from Washington D.C. to New York including

the Metroliner and Acela Express. In this case, the service is differentiated by the travel time. Additionally, group discounts are also a common technique used in RM. Amtrak noticed from the booking records that most travelers from Boston to New York on Acela Express bought their tickets alone. By temporarily offering discounts for additional ticket, the ridership was reported to have increased substantially. (Amtrak 2006) In this case, Amtrak was successfully able to attract passengers who otherwise would use automobiles or buses. These examples show the importance of the market segmentation.

- **Booking arrival patterns independent of fare classes**

Models for the airline industry explicitly assume that bookings occur in reverse fare order – passengers with the highest willingness to pay usually book last due to price insensitivity. *Figure 3-2* shows the typical arrival pattern for the US domestic airline market.

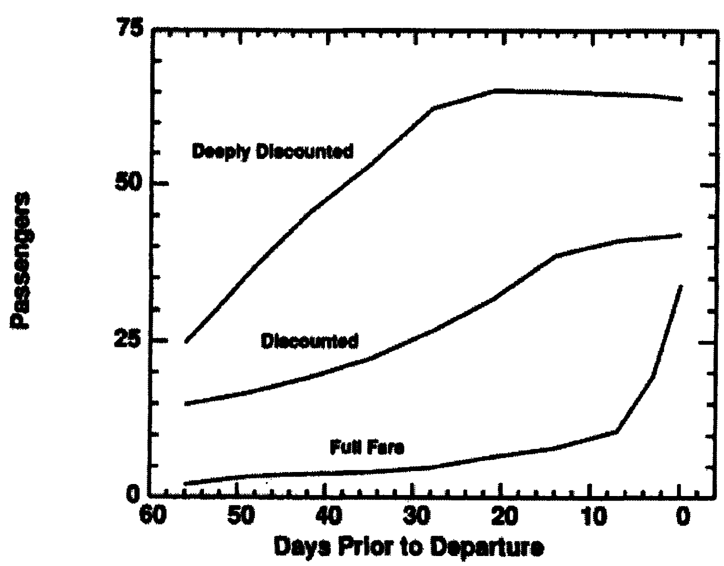

Figure 3-2 Examples of the Booking Arrival Pattern for Airlines

Source: Williamson 1992

However, in industries other than airlines, the basic paradigm of "highest fare books last" is not a good assumption. A more realistic assumption for most industries should be that bookings over time reflect a mixture of high-value and low-value customers, with the balance possibly shifting over time. Since the EMSR method (see section 2.2.2) also assumes "highest fare books last," it is well known that it tends to overprotect allocations, or set aside too much capacity for only the highest fares. The cost of this overprotection depends on how frequently the allocations are updated.

- **Very short booking lead times**

It is very common for people who use trains to buy their tickets on the day of departure. *Table 3-1* shows the historical data by Amtrak which explain the average lead days, percentage of depart day reservations and percentage of depart day cancellations. It shows that over 40% of demand for the Metroliner #119 from New York to Washington D.C. does not materialize until the day of departure on some trains. While long distance trains are usually reserved with a long lead time, Amtrak's high speed corridor services experience short booking curves and higher cancellation/rebooking rates. This is because the latter service is oriented mainly towards time-sensitive business travelers. The load factor in trains – typically lower than in airlines – accelerates this trend, too. In such a case where there are many "show-up and go" passengers, daily updating of allocation levels is just not frequent enough. In the case of Amtrak, the Metroliners were removed from discount allocation and traffic mix control optimization because of system limitations and other marketing considerations. (Kraft, Srikar, and Phillips 2000, 157-176)

Trains	Avg. Lead Days	% Depart Day Res.	% Depart Day Cancel
Sunset Limited ORL-LAX	115	5.9%	24.2%
Cardinal WAS-CHI	100	4.0%	16.4%
Californial Zephyr CHI-OAK	146	8.0%	16.3%
Silver Meteor NYP-MIA	93	10.5%	26.9%
Metroliner #101 NYP-WAS (AM	5.6	19.5%	11.7%
Metroliner #119 NYP-WAS (PM	6.6	43.4%	25.7%
Northeast Direct #95 BOX-NPN	41	20.6%	19.6%

Table 3-1 Booking Lead Times for Selected Amtrak Trains

Source: Kraft, Srikar, and Phillips 2000, 157-176

➢ Flexibility in pricing

Since the price is considered "given" in the airline industry, especially in highly competitive markets, the main focus is put on seat inventory controls. When it comes to railways, however, 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. Nevertheless, railways compete with the other modes of transportation such as airlines and automobiles; hence pricing is influenced by the prices and availability of these transportation alternatives.

If price is viewed as a variable that can be controlled on a continuous basis, a booking class can be shut down by raising the price sufficiently high. When there are many booking classes available, shutting down a booking class can be viewed as changing the price structure faced by the customer. RM consists of both inventory management and pricing. It might not be realistic to change fares on a frequent basis in the railway industry because such changes would confuse passengers who are not familiar with the dynamic pricing in railways. However, techniques which can better integrate pricing into RM decision-making would be desirable.

Table 3-2 summarizes the discussion above.

No.	Issues	Railway characteristics	Algorithmic considerations
1	Network oriented	Inherently multi-leg	Network RM model, or leg-base model with nesting.
2	Less price discrimination	Typically two or three classes	other segmentation methods
3	Booking arrival patterns	mixture of high-value and low-value customers	Bid-price method
4	Short booking lead times	Many "show-up and go" customers on the day of departure	Frequent update of allocation levels, or remove trains with extremely short lead times from systems.
5	Fexibility in pricing	Some freedom of pricing	Price can be viewed as a variable.

Table 3-2 Differences of RM between airlines and railways

Source: Author

3.2 *RM Applicability for Railways*

Combining the general criteria discussed in section 2.5 with railway characteristics for Netherlands, Li, van Heck, and Vervest created what they call "Yield Management Applicability Framework" for Netherlands, which is partly cited in *Table 3-3*. (Li, Van Heck, and Vervest) They believed that RM is applicable for the railway industry when their criteria in *Table 3-3* are satisfied, which will be true in some countries.

Criteria	Railway characteristics
Inflexible capacity	● Physical capacity could be measured by the number of rolling stocks and the number of seats per train unit.
	● There is a relatively fixed capacity in short to medium term, and expanding the capacity are usually planned for the long run.
Variable and uncertain demand	● The demand is different depending on the time-of-day, day-of-week, origin-destination pairs, and travel purpose (home-to-work and leisure travel).
	● The demand has high reliance on weather, holiday, event, reliability, crowdedness, etc., which causes the unpredictability in demand.
Perishable inventory	● The unoccupied seat cannot be inventoried, and the revenue of that inventory is missed.
	● measuring yield per available time-based inventory unit would be essential, not the traditional measure of sales per customer.
Appropriate cost and pricing structure	● Low marginal cost and high production cost.
Heterogeneous customer	● Railways could be able to segment leisure markets from the home-to-work travel according to a range of variables, typically by time of travel, weekdays and weekend, and single and return.
	● In contrast to airlines, railways have not used multiple segments effectively, and more opportunities could be expected by age, affinity, place of origin, purpose and independent/group travel, etc.
	● There is a limited ability to segment according to time of utilization given generalized nature of demand in time.
Data and inforamtion system	● Customer information is largely collected through manual process (e.g., on-vehicle counting, travel survey), which is time-consuming and expensive.
	● The lack of reservation system in the domestic railways implies little relationship beween demand and capacity.
	● More advanced infrastructure is necessary to collect and store the demand data and automate the decisions.

Table 3-3 A RM Applicability Table for Railways in Netherlands

Source: Li, Van Heck, and Vervest

They also called for special attention to the specific features of the railways, and explained that these features include, but are not limited to, the lack of registration system, no overbooking and cancellation, and the simple tariff structure.

3.3 *Proposed Strategies*

In section 2.3, the current research areas of RM have been described. After the discussion about the unique characteristics of RM for railways, it is expected that forecasting, network inventory controls, and pricing will be the main focus of RM for railways. Furthermore, combining RM practices with those research areas, we can also infer that there are several strategies to implement RM in the railway industry. *Figure 3-3* illustrates two distinctive strategies which can be considered by railway operators depending on the load factor.

When the load factor is low, we can stimulate demand by offering discount tickets. In this case, it is important to forecast how much demand will be created by discount tickets. Furthermore, estimating the relationship between the level of discounts and the stimulated demand is also critical for railway companies. (Model 1) As the load factor goes up, however, effective seat allocation becomes more imperative to maximize revenue. In this case, network seat inventory controls will play an important role in addition to forecasting and pricing. (Model 2) Finally, when the load factor is close to 100 %, inventory control and demand forecasting, rather than discount pricing, are the two major issues to increase revenue. (Model 3) Thus, different models should be used to study RM implementations as illustrated.

In order to deal with the network inventory controls, a bid-price method seems to be effective. In fact, several recently implemented hotel and rental-car RM systems utilize bid-prices as their main control methodology. Kraft explains the advantages of a bid-price method. (Kraft, Srikar, and Phillips 2000, 157-176) First, as discussed in section 2.2.5, it can handle network controls easily. Second, the operational characteristic to be designed to update the bid-price frequently makes it well suited to deal with the railway's short booking curves. In addition to these claims, Belobaba found that the effect of nesting decreases and eventually disappears entirely as the frequency of updates approaches real time. (Belobaba 1989, 183-197) Thus, it is not necessary to include nesting in the mathematical modeling.

However, there are several disadvantages to this method. For example, frequent updates require both reoptimization and reforecasting, which could lead to the burden for systems. In addition, a bid-price method is inherently incremental. It cannot deal with multiple (group) booking requests, so some modifications to systems are required.

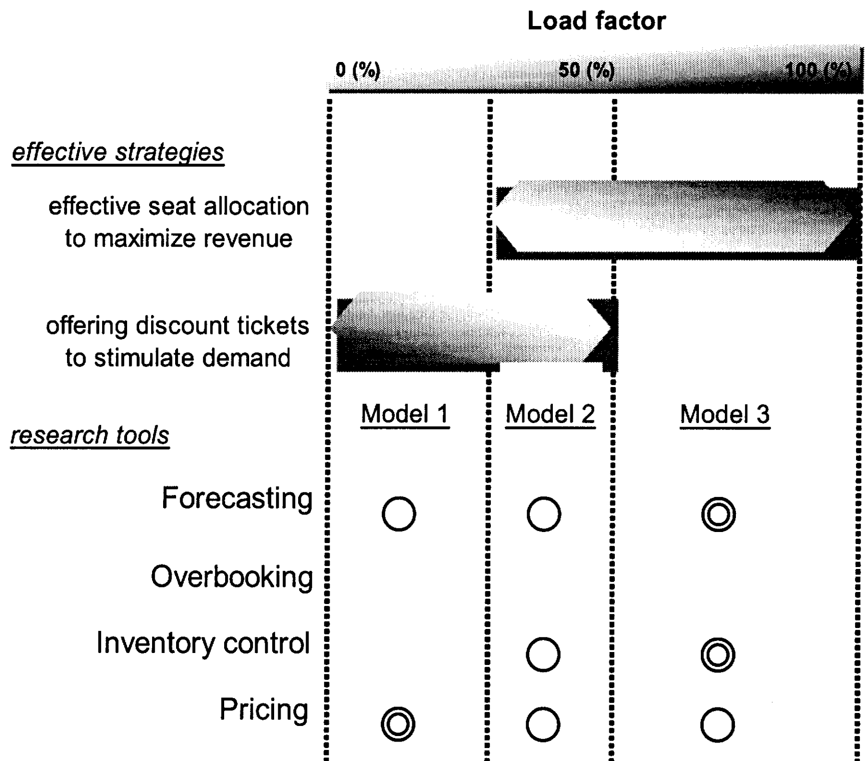

Figure 3-3 RM Strategies for Railways and Related Research Tools

Source: Author

3.4 *Summary*

In this chapter, we have seen the differences in RM between airlines and railways, and discussed algorithmic considerations and suggestions regarding further research. It seems that a bid-price method is appropriate as RM for railways in spite of several drawbacks. Moreover, from an operational viewpoint, the ability to segment the market more effectively, in addition to the traditional leisure and business travelers in the airline industry, will be the key issue for the RM practices.

In Chapter 4, we will examine several examples of the RM implementation to railways based on the findings in this chapter.

Chapter 4 *Examples of Revenue Management in the Railway Industry*

Several countries have already introduced Revenue Management (RM) techniques to their railways. This includes France, Germany, the UK, Canada, the US, Denmark, Norway, and Austria. In this thesis, the following five countries are investigated in detail due to the relatively abundant availability of literature: France, the UK, Germany, Canada, and the US. In addition, since European countries have been influenced by the recent railway deregulation as a result of Directive 91/440/EEC (29th July, 1991), it is worth reviewing the significant changes that the directive has caused before discussing each country in detail.

4.1 ***Passenger Railway Reform in Europe***

Traditionally, railways have been organized nationally as state monopolies responsible for both infrastructure and operation. However, recent years have seen a move away from this model. The main organizational directive for railways is 91/440/EEC. It specifies the restructuring of railways and the public budget contributions permitted for reducing the indebtedness of railways. The objective of this directive is to reduce deficits, put railway companies on a viable financial footing and maintain financial sustainability. More notably, infrastructure and train operations are organizationally separated, and there have also been initiatives regarding deregulation, internationalization and privatization. Additionally, Directive 0221/12/EC further separates freight from passenger accounts. In the meantime, airline deregulation is driving travel fares down and customer expectations up. The railway industry, especially in its growing high-speed component, has been directly affected by all these changes in the travel environment.

The extent and form of deregulations varies among the countries in Europe with some countries having progressed significantly such as Sweden and the UK, while other countries have only put forward limited deregulation initiatives or none at all such as France. *Figure 4-1* shows the general chronology.

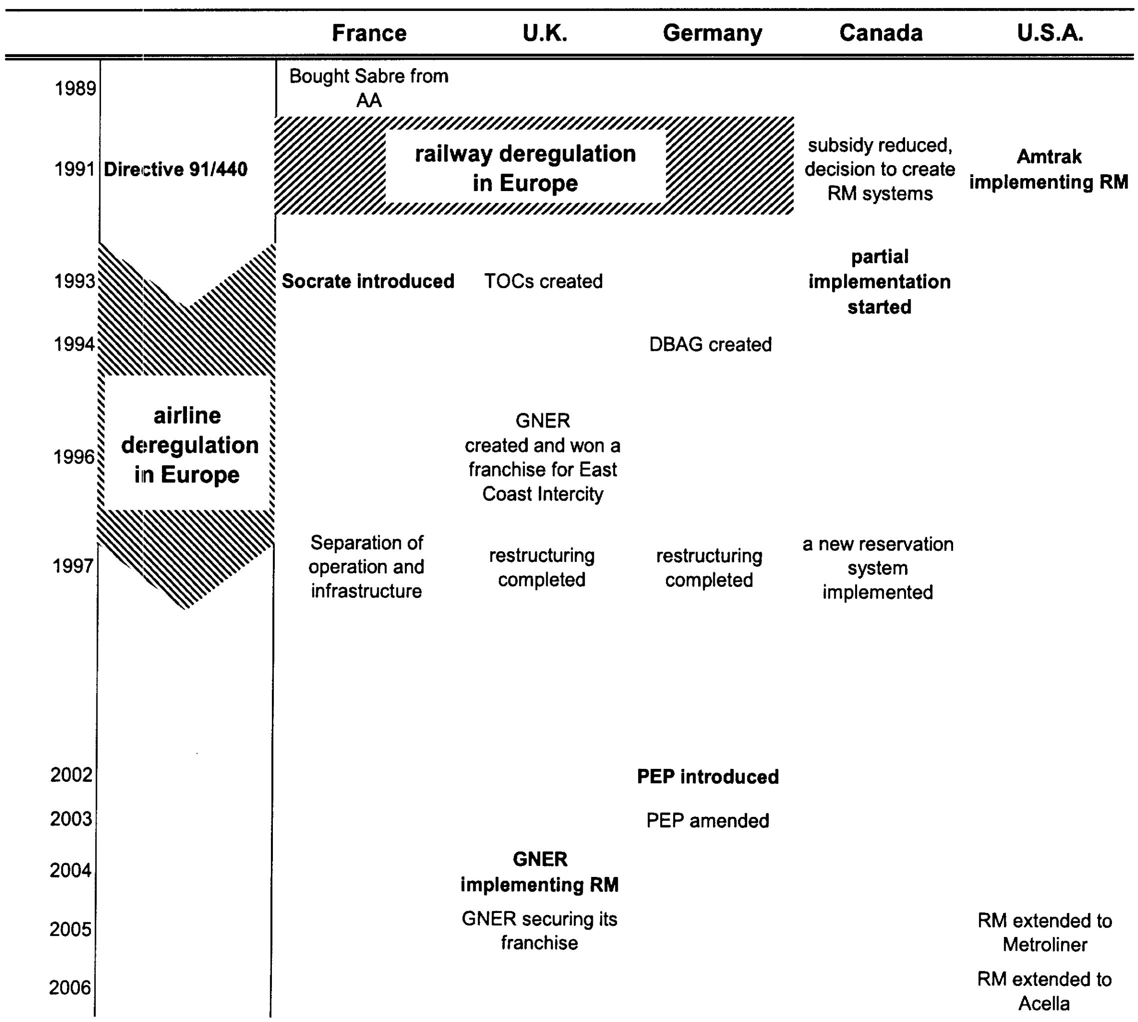

Figure 4-1 Chronology of the RM History in Railways

Source: Carlucci ; Eisenkopf ; Hatano 2003; Holvad, Preston, and Huang ; Li, Van Heck, and Vervest ; Link 2004, 50-55; Mitev 1999, 215-225; Monami 2000, 91-112; Preston 1999

4.2 *France*

4.2.1 *Background*

SNCF and the French government have been, and still are to some degree, hostile to liberalization of European rail transport on the grounds that the national rail network would be weakened if split, and that deregulation ignores the cultural and public service differences between countries. Nevertheless, since the early 1980s, SNCF has had to respond to competition and increase its profitability. Following the Directive 440/91, the first stage in terms of separation took place in 1995, when SNCF was required to produce separate accounts for infrastructure and operation. It was not until 1997 that the network and the granting of access rights were actually entrusted to a separate public enterprise: RFF. (Mitev 1996, 8-18)

In terms of RM strategy, SNCF started introducing price differentiation in the early 1980s by modifying fares according to the time of travel. Price differentiation was initially quite limited since pricing according to the number of kilometers traveled has the advantage of being totally understandable to customers who can work out the cost of a specific journey. Modulation was added to this basic pricing principle, when special discounts, only available in somewhat busy periods so as to fill trains, were devised (family cards, old people passes, youth cards, etc). This price differentiation was quite rigid. For example, daily variations (the time of the day), as opposed to weekly variations (the day of the week), were not included. This is particularly important since daily variations occurring on profitable lines have the potential of bringing in higher profits through further price differentiation. Gathering data on daily variations requires much more sophisticated computer systems. Simultaneously, the previous computerized reservation system (CRS) was reaching saturation point (50 million reservations a year). It was projected that there would be a need for 130 million reservations a year as soon as 1995. (Ben-Khedher and others 1998, 6-23) Therefore, SNCF decided in 1988 to completely change its CRS. Important decisions about pricing strategies were also taken in parallel, which turned out to cause tremendous difficulties.

SNCF had started experimenting with further price differentiation on the TGV network Paris-Lyon in the 80s, then Paris-Bordeaux in the early 90s, through compulsory and chargeable reservation, as well as discount tickets according to the time and day of travel. The objective was not only to fill empty trains but also to increase profits on busy routes and compete with air, which proved successful on the Paris-Lyon route. It can be seen that in SNCF's experience, TGV technology and differentiated pricing became strongly associated and successfully so. The price became more related to the type of train and the time and day of travel rather than the distance traveled.

4.2.2 System Architecture

SNCF implemented a sophisticated rail reservation and distribution system and a comprehensive suite of peripheral decision support systems, which was customized from Sabre. The system, Socrate, consists of schedule planning (RailPlus) and capacity management (RailCap) systems. (Ben-Khedher and others 1998, 6-23) When SNCF's long term "RailPlus" and short term "RailCap" schedule development and capacity optimization systems were developed, revenue management systems were integrated to support intermediate stage planning for both marketing and operations. This produced a fully integrated railway decision support system for the planning of train schedules, equipment allocation, pricing and revenue management of TGV train services. The relationship between RailCap and the RM system is shown in *Figure 4-2*.

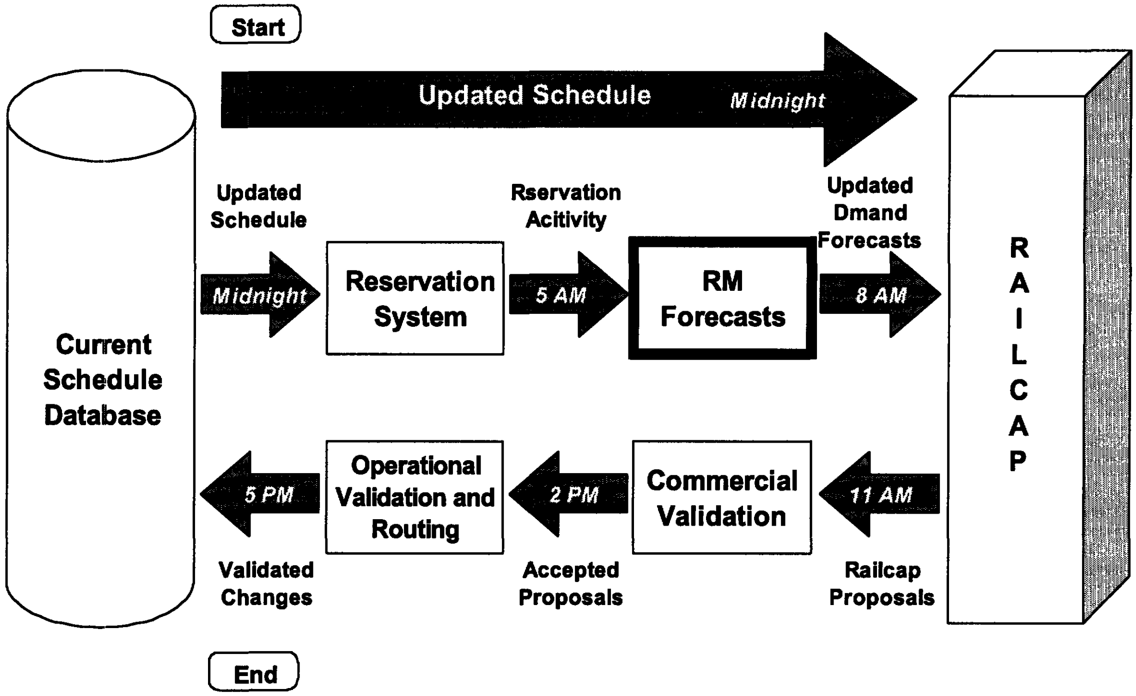

Figure 4-2Relationship beween Railcap and RM Systems in SNCF

Source: Ben-Khedher and others 1998, 6-23

SNCF operates extra or substitutes higher or lower capacity train sets, depending on demand. That is, SNCF uses approximately 85% of the available TGV train sets for a base schedule which is adjusted for peak holiday periods, and then uses the remaining 15% to augment regularly scheduled services during periods of peak passenger activity. The major responsibilities of RailCap are to monitor the reservation activity for all trains and proactively to add capacity (train sets) to the schedule before trains are closed to reservations. The RM system sends RailCap the latest forecasts, which are constantly updated based on long-term trends and short-term booking activity.

As a token of its commitment to both RailCap and RailPlus, SNCF has made organizational changes. It formed the Center of Operations of TGV (COTGV) in the spring of 1994 mainly to perform revenue management and capacity adjustment activities. More than 30 commercial analysts proactively control sales, manage fares, and modify schedules, relying heavily on the RM and RailCap decision support tools. (Ben-Khedher and others 1998, 6-23)

4.2.3 Outcome

The initial implementation of this software, Socrate, in 1993, was a disaster. The inadequate database information on timetables and routes of trains, inaccurate tariff information, and unavailability of ticket exchange capabilities caused major problems. Impossible reservations on some trains, inappropriate tariffs and wrong train connections led to large queues of irate customers in all major stations and to a major public outcry in France. Online reservations available through the public network failed, booked tickets were for non-existent trains while other trains ran empty, railway unions went on strike, and passengers' associations sued SNCF. While the new complex fare structure introduced in imitation of air travel was confusing and proved unacceptable to customers, SNCF sales staff also rejected this new technical tool and its underlying ticketing, pricing and selling policies. Staff training was inadequate and did not prepare the staff to face real-life problems. They had to answer ticket inquiries from customers without knowing how the price was calculated. Also, public relations failed to prepare the public for such a dramatic change. It is reported that the revenue decreased substantially in 1993. (Mitev 1996, 8-18)

After the initial technical difficulties, Socrate system bugs were corrected at a rate of 800 per day during the following months, and the system was fully implemented on the new TGV Nord route, as planned, and on the Channel tunnel Eurostar service. (Mitev 1998) On the rest of the SNCF network, the system was heavily modified: many changes were made to simplify and clarify the ticket and the pricing tactics in order to respond to public pressure. For example, the number of price levels was reduced from four to two, therefore making parts of the Socrate software redundant. Public relations were drastically improved and SNCF now consults widely and consistently with passengers' associations and the general public. However, RM software is still in use, even if it is not fully applied yet. SNCF estimates that the system now provides 17 million Euros in incremental revenue per year and substantially reduces operating costs. (Ben-Khedher and others 1998, 6-23) In addition, the system has become the foundation for the operations of the TGV.

4.3 *U.K.*

4.3.1 Background

Following the Directive 440/91, the UK government decided to restructure British Rail (BR) into various companies in 1993. The 1993 Railway Act established the creation of a track authority (Railtrack), 25 passenger train operating companies (TOCs), and three rolling stock leasing companies (ROSCOs), with the franchising completed by March 1997. (Preston 1999) This reform was intended to increase the productivity by focusing more on each regional environment.

The UK railway has a reputation for a complex fare structure with little transparency for passengers. Historically, fares were based simply on miles traveled, but in 1968 it was decided to adopt a market-based approach that would give more pricing flexibility. While the authority increased fares in line with inflation or market forces, it also offered a range of fares such as discount tickets for students, and advance purchase tickets. After privatizing, each TOC can set a range of fares according to its own business environment within the regulation, resulting in a variety of tickets which are often perceived as confusing by passengers. (Hatano 2003)

Great North Eastern Railway (GNER) is one of the TOCs, which operates high-speed intercity services between England and Scotland along a route of almost 1,000 miles of the most heavily traveled passenger networks in the UK. Established in 1996, it was originally awarded a franchise to operate East Coast Intercity until 2005. In March 2005, GNER successfully won the highly competitive bid to retain its franchise for an additional 10 years. This section exclusively describes GNER. (GNER 2006)

4.3.2 System Architecture

As soon as GNER started its business in 1996, the management team set out to implement information technology such as automatic ticketing and Internet ticket sales. Also, it undertook a transformation initiative called 'Project IRIS' in 2002 to optimize revenue across its network. A railway revenue optimization solution from Manugistic, USA, was chosen to improve its revenue from advance purchase tickets. (Manugistics 2004)

Since the system was purchased from a commercial software vendor, detailed information about its RM system is not easily available. Manugistics is the leading global provider of supply chain management and pricing and revenue optimization (PRO) solutions.

4.3.3 Outcome

It is reported that GNER enjoyed an annual increase in revenue of £16.6 million since the RM system went live in June 2004. (Manugistics 2004) The management has made it clear that the system was instrumental in helping the company keep its franchise in 2005. GNER must now pay the government £1.3 billion over the life of the new franchise, so increasing revenue is therefore a critical priority. However, the company is now facing direct competition from road transport and increasingly from domestic airlines. TOCs are moving further toward the airline ticketing method, with new automated systems allowing more dynamic adjustments to changes in passenger demand than in the past. GNER tracks airline prices and terms and conditions very closely, and then makes sure that its railway fares are comparable, resulting in them offering as many as 14 kinds of tickets between London and Edinburgh. (House of Commons, Transport Committee 2006) Many issues are still the subject of heated debate, not only over whether such high fares are acceptable for a public transportation service, but also over the confusing fare structure.

4.4 *Germany*

4.4.1 Background

Following the Directive 440/91, a new order for the railway system in Germany came into effect in 1994. DBAG, which was newly established as a joint-stock company with the government owning all shares, includes separate business units for both long- and short-distance passenger railway operations and infrastructure management. While all long-distance rail passenger services were classified as profitable, making them ineligible for explicit subsidies, all regional services were classified as non-profitable and therefore eligible for subsidies.

As a consequence of this classification, fare approval is handled differently for long-distance and regional services; since the latter are subsidized, the structure and level of fares must be approved by the local government where the railway operator is registered. In contrast, DBAG has full freedom to decide the level and structure of fares on its long-distance passenger services. Since the end of the 1990s, DBAG had been ambitiously working on developing a new fare system, and therefore created the new "Department for Revenue and Yield Management" in its organization. In fact, most of the managers responsible for the Department were recruited from the airline industry. (Seidel and others 2004)

Another factor that affects the railway industry in Germany is the liberalization of the airline industry. Since its complete deregulation in 1997, DBAG regularly argues that long-distance passenger traffic is very sensitive to the airline traffic, especially Low Cost Carriers (LCCs). (Eisenkopf)

4.4.2 System Architecture

While details of the system architecture have not been made available so far, the key elements of the new fare system (the so-called PEP) were as follows: 1) The principle of a fixed price per mile was abandoned. DBAG intended to adjust the price with regard to intra-modal competition from other railway companies (in the future), and inter-modal competition from low cost airlines. 2) The former BahnCard 50, a bonus card which offered a 50% discount on the standard price, was abolished and replaced by the BahnCard 25, which only offers a 25% discount. 3) Passengers could obtain further discounts if they booked in advance and specified a particular train. While there were three types of discounts depending on the time remaining until the journey began, only a certain amount of tickets was available for each train. 4) A cancellation fee of 45 Euros was payable if someone wanted to use a different train than the one specified in the advance booking. This cancellation fee was also applicable when someone missed his or her train and wanted to take the next one. (Seidel and others 2004)

4.4.3 Outcome

As soon as the DBAG management presented the new fare system in October 2002 with all the details and final prices, several different interest groups carried out various protest campaigns supported by the media. Even though the new fare system was launched as scheduled, the public saw the system as opaque, complex, and unfriendly. Additionally, the fact that several convenient discount tickets were abolished, such as BahnCard 50, made the new system very unpopular among passengers. The financial outcome was also a disaster, as opposed to DBAG had anticipated that the introduction of PEP would lead to a 3% increase in turnover in 2003. In actual fact, the passenger-kms on long-distance trains fell by 7% compared to the same period in 2002. (Seidel and others 2004) The decline in passenger transport performance was reflected in a 13% decrease in turnover.

In response to the bitter complaints from passengers and customer organizations as well as a drop in passenger numbers and turnover, DBAG revised the system in August 2003, which included BahnCard revision, reduced cancellation fee, and fewer early booking discounts. The launch of the new revised fare system put an end to the public discussion as surveys indicated that the majority of train users perceive the revised system as an improvement. Nevertheless, DBAG now has to prove that they are able to achieve their chief goal of significantly increasing the number of passengers using long-distance train transport.

4.5 Canada

4.5.1 Background

Reformation of Canada's intercity passenger railway system initially took place in 1978 with the creation of VIA Rail, a state-owned corporation. While there have been no major organizational changes since its creation, VIA Rail was subject to several national policy actions throughout the 90s leading to significant changes in how the railway operator conducted its business. One such driver was a gradual reduction in the amount of funding it received from the government. In 1991, the government began informally capping the subsidy, steadily decreasing from $440 million in 1990 to $170 million in 2000 – a significant reduction of 62%. (VIA Rail Canada) In order to survive and succeed, VIA had to radically change the way it did business. Its goals were to improve the level and quality of service, increase ridership and revenue, and reduce the corporation's need for government subsidies.

Pricing strategies to maximize revenue have played an important role in achieving VIA's goals, and VIA took the decision to create a form of a RM system by mid-1991. Discussions with other carriers and software suppliers showed that purchasing an existing air or hotel system and then modifying it for railways was both time consuming and beyond their budget. They chose to develop in-house on a step by step basis. A research-based process is followed to determine the most effective strategies for each market in which VIA operates. This process includes a periodic evaluation of the appropriateness of price points, and the type of regular discounts needed to induce price-sensitive travelers to use the train., Pricing strategies are evaluated on a regular basis to determine their success, to ensure that they continue to maximize revenue, and to make sure they complement the service improvements that have fueled steady increases in ridership since the early 1990s.

4.5.2 System Architecture

The most immediate need for VIA was to manage and adjust the balance of full fare and discount seats. Initiatives for special pricing action were also structured so that the maximum amount of new revenue was induced without "bonusing" existing customers for whom a discount fare is not a motivator for traveling by train. There are several approaches that VIA uses to minimize such "bonusing", namely: limiting the number of seats available under a pricing initiative; introducing cancellation penalties; introducing advance purchase requirements; or limiting the travel times for particular fare levels. VIA uses a RM system whereby available seat inventory is allocated to different fare plans in such a manner as to maximize revenue. For example, VIA estimates that adding an extra car normally costs around $1.00 per mile, meaning that only 10 passengers, even at discount fares, would be required to break even. Thus, the forecasts allow decisions to be made about both adding cars and adjusting discount seats.

VIA is controlling reservations directly by origin and destination in order to maximize revenues since their system does not support nested fare classes. It is inferred that network controls are only implemented in a relatively crude manner due to limitations in ReserVIA. VIA's demand forecasting system consists of two models, long term forecasts and short term forecast, and is integrated with both their capacity allocation system and their revenue management system. The capacity allocation system considers the marginal cost and the revenue generated from additional cars, and demand characteristics that may vary over different legs of the train cycles. (Berwick and Therrien 1997)

It seems that VIA implemented overbooking relatively aggressively. Based on statistical results of no-shows and go-shows gathered in 1993, overbooking began in mid 1994 on a limited basis and was finally applied throughout the Ontario-Quebec Corridor in 1996. Since properly chosen overbooking levels result in very few oversold situations on board trains, the benefits generated by the extra seats sold almost always exceed compensation costs. (VIA Rail Canada)

4.5.3 Outcome

VIA's yield growth, a measure calculated by dividing total passenger revenues by the number of passenger miles traveled, increased to 36% between 1990 and 2000. (Berwick and Therrien 1997) The steady increase in yield demonstrates that the company consistently undertakes pricing action to maximize revenue. The revenue-focused pricing strategies have been an important part of its success.

While ultimately the goal behind any pricing initiative is to induce new traffic and stimulate revenues, there are times when an initiative is purely defensive. For example, when airlines offer drastic discounts, VIA's pricing initiative would serve to limit the damage to its revenue base rather than attempt to increase it. VIA currently faces such a challenge from the airlines in parts of the Quebec City – Windsor Corridor, where it accounts for 70% of annual revenues and 85% of the company's ridership, and in major markets in Maritime Canada. The threat from discount air carriers is significant given the tendency of travelers to switch easily between railway and airlines particularly on long distance services where airlines have a significant time advantage.

In terms of the system architecture, the EMSR method will be employed at VIA in the future to optimize the seat mix for the greatest potential revenue gain. VIA expects that immediate future enhancements include extending the time horizon to departures more than 11 months, capturing cancellations as well as reservations, operating up to eight nested booking levels within one class of service, and adding network traffic controls. (Berwick and Therrien 1997)

4.6 U.S.

4.6.1 Background

Since Amtrak's inception in 1971, it has struggled to become financially solvent. Amtrak has run a deficit each year and required federal assistance to cover operating losses and capital investment. While there have been some railway reform proposals to rectify the situation, Amtrak continues to be the main provider of intercity passenger railway services in the US The routes it has served fall into two distinct types, long-distance routes and short-distance corridors. Northeast Corridors (NEC) is one of the short-distance corridors and, according to Amtrak, about two-thirds of its ridership travel either wholly or partially on this route. (Government Accountability Office 2006)

While one sees multiple fares more often in short-distance markets, long-distance trips rely more on product differentiation (type of accommodation) 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.

4.6.2 System Architecture

Amtrak implemented the world's first automated railway revenue management system in July, 1991. The system was customized from Sabre, the system used by American Airlines. The primary focus of RM at Amtrak has been to ensure that short-distance, low revenue passengers do not block capacity across peak load segments, which could be sold to longer-distance, higher revenue passengers. Traffic management considers the trade-off between the revenue value of accepting a booking request, versus the expected opportunity cost of alternative future requests that may be displaced. Amtrak's ARROW reservation system supports serial nesting of fare classes, where a higher value fare can always be sold if a lower value fare class is still open. At the time of implementation, there were about 10 employees who did RM manually.

At Amtrak, the overbooking model is currently used very conservatively and causes negligible standees. Amtrak's current discount allocation model is based on the EMSR approach, which is a heuristic rule to allocate capacity on a single flight leg by equalizing the expected marginal revenue of each fare class. ARROW is a leg-based reservation system. (Kraft, Srikar, and Phillips 2000, 157-176)

Amtrak is reported to use five fare buckets, opening and closing them depending on demand to come, with the capacity decisions made jointly between the train or corridor manager and the central RM department. Dynamic pricing in the form of weekly promotions, which usually carry some sort of advance-purchase and cancellation restrictions, is becoming more prevalent.

4.6.3 Outcome

The initial focus of RM was on long-distance intercity trains, where it performed overbooking, discount allocation, and network traffic controls. On average, Amtrak has realized an additional 3% to 5% in incremental revenues from the current revenue management practices. (Boston Region Metropolitan Planning Organization 2006)

Under pressure from President Bush and Congress to reduce its $1 billion annual losses, Amtrak introduced RM on NEC's Regional Service in October 2005 and on the Acela in February 2006 by variable rates on Acela and Metroliner services based on demand for tickets. Instead of three fare levels pegged only to what time of day people travel, Amtrak started offering five levels. The new system made the top fare 15% higher than current levels for peak-period trips bought on the same day of travel. Passengers with flexible travel time can take advantage of reduced fares – up to 15% less than the previous lowest price -- by purchasing tickets early and traveling during off-peak hours. It is reported that since October 2005, reduced fares have been very popular, as evidenced by an increase in off-peak travel. Amtrak's FY 2006 budget assumes $15 million will be realized from RM of the NEC trains. Through July, Amtrak estimates $18.5 million in revenue is attributable to RM. However, it is difficult to separate out multiple pricing factors, but Amtrak assumes one quarter to one half of all revenue increases are due to RM. (Boston Region Metropolitan Planning Organization 2006)

4.7 *Summary*

Five examples have been showcased to explore the various approaches to implement RM systems for railways. *Table 4-1* shows the comparison among the five countries discussed above. It can be concluded that the development varies greatly depending on the national settings. Based on the discussion in this chapter, further argument will be presented in Chapter 6, where a new framework which is used to implement RM systems for the railway industry is prepared.

	France	U.K.	Germany	Canada	U.S.A.
Operator	SNCF	GNER	DBAG	VIA Rail	Amtrak
Year introduced	1993	2004	2002	1993	1991
Base system	Sabre	software vendor		"in-house"	Sabre
Background	← deregulation →			← deficit reduction →	
Initial purpose	fill empty trains during off-peak increase profits on busy routes	fill empty trains during off-peak	ease the overcrowding during on-peak		fill empty trains on long-distance routes increase profit on busy routes
Problem	← complex fare system → Inadequate system		Inconvenient	← (no issue) →	
Railway structure					
operation	Single operator (State-owned)	Multiple private operators, which compete for franchises.	Multiple private operators (DBAG, state-owned joint-stock company)	Single operator (State-owned)	Multiple operators (State-owned)
infrastructure	Single owner (State-owned)	Single owner (First a public stock company; now, a private corporation)	Single owner (Joint-stock company)	Multiple owners (Primarily freight railways)	Multiple owners (Primarily freight railways)
Result	**Simplified**		**Simplified**	**Will extend**	**Extended**

Table 4-1 Comparison of RM Practices among Five Countries

In terms of the system architecture, the EMSR method with virtual nesting seems to have prevailed in the railway industry, as far as we can observe (see *Table 4-2* for the comparison of the system architecture in France, Canada, and the USA). This practice makes sense because their systems are mainly customized from systems which have been implemented for the airline industry. However, as discussed in Chapter 3, several researches suggest that a bid-price method will be advantageous for railways. Newly designed RM systems for railways which can incorporate a bid-price method is desirable, especially when they are introduced to countries like Japan where a railway system is extremely complicated, and a highly sophisticated automation system is essential.

	France	Canada	USA
Operator	SNCF	VIA Rail	Amtrak
System	Socrate	ReserVIA	ARROW
Base system	Sabre	In-house	Sabre
lines	TGV	Quebec City - Windsor Corridor	long-distance intercity trains (1991-) Acela, Metroliner (2005-)
architecture	part of an integrated decision support system	integrated w/ capacity allocation system and RM system	
fare structure	2	2	5 on Acela
seat allocatin	EMSR	mannaully	EMSR
nest	virtual nesting	system not support nested fare classes	hierarchical nesting (not virtual nesting), another consideration needed
Overbooking	Adjusting by capacity	Yes	Yes, but conservatively
organization	Center of Operations in 1994 mainly to perform the RM and capacity adjustment		Joint decisions b/w regional managers and central RM Dept.

Table 4-2 Comparison of the RM system architecture for Railways in France, Canada, and the USA

Chapter 5 *Stakeholder Theory*

In the previous chapter, various examples showed that the implementation of Revenue Management (RM) in the railway industry has not always achieved the initial goals that the policy makers and railway operators intended. Furthermore, the degree to which the implementation process succeeded also varied depending on the countries. While it is theoretically possible to implement RM in the railway industry as described in Chapter 2 and Chapter 3, the case studies in Chapter 4 imply that theory alone is not enough to guide the implementation. We therefore need a framework to balance various interests among the people involved. In order to create a new framework which can be used for better RM implementation, the concept of 'Stakeholder Theory' is introduced in this chapter.

5.1 Origin of Stakeholder Concept

The development of the stakeholder concept in the literature on management can be classified into different stages as shown in the stakeholder literature map (see *Figure 5-1*). The origin of 'stakeholder' in management literature can be traced back to 1963, when the word appeared in an internal memorandum at the Stanford Research Institute (SRI). Stakeholders were defined as 'those groups without whose support the organization would cease to exist.' The SRI researchers argued that unless executives understood the needs and concerns of these stakeholder groups, they could not formulate corporate objectives which would receive the necessary support for the continued survival of the firm. (Freeman 1984, 276)

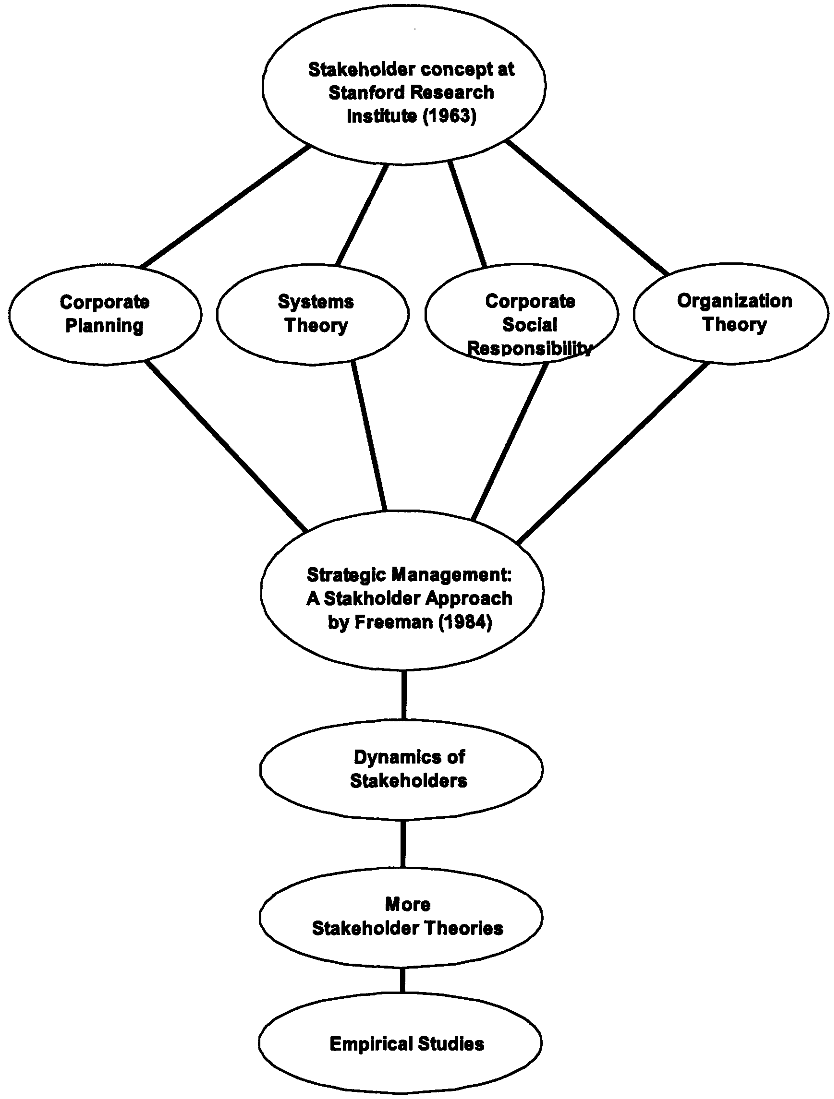

Figure 5-1 Stakeholder Literature Map

Source: Elias, Cavana, and Jackson 2000 (Modified by author)

While there have been considerable developments since the original work at SRI, most researchers in the stakeholder field acknowledge Freeman's book 'Strategic Management: A Stakeholder Approach' as a landmark in stakeholder literature. (Freeman 1984, 276) In his book, Freeman defines stakeholders as 'any group or individual who can affect or is affected by the achievement of the firm's objectives.' He proposed a framework, which fits three levels of stakeholder analysis – rational, process and transactional.

At the rational level, an understanding of 'who are the stakeholders of the organization' and 'what are their perceived stakes' is necessary. *Figure 5-2* shows the stakeholder map for one very large organization which is used to identify its stakeholders. However, while "Government" is a category, it is EPA, OSHA, FTC, DOT, Congress, etc. who can take actions to affect the achievement of an organization's purpose. Thus, a stakeholder chart is prepared as a next step by identifying specific stakeholders based on the stakeholder map. For example, *Figure 5-3* shows the stakeholder chart of specific stakeholders to accompany *Figure 5-2*. Most very large organizations have a stakeholder map and accompanying stakeholder chart which is similar to *Figure 5-2* and *Figure 5-3*. Although there will be variations among industries, and from company to company, these two figures can be used as a checklist of stakeholder groups.

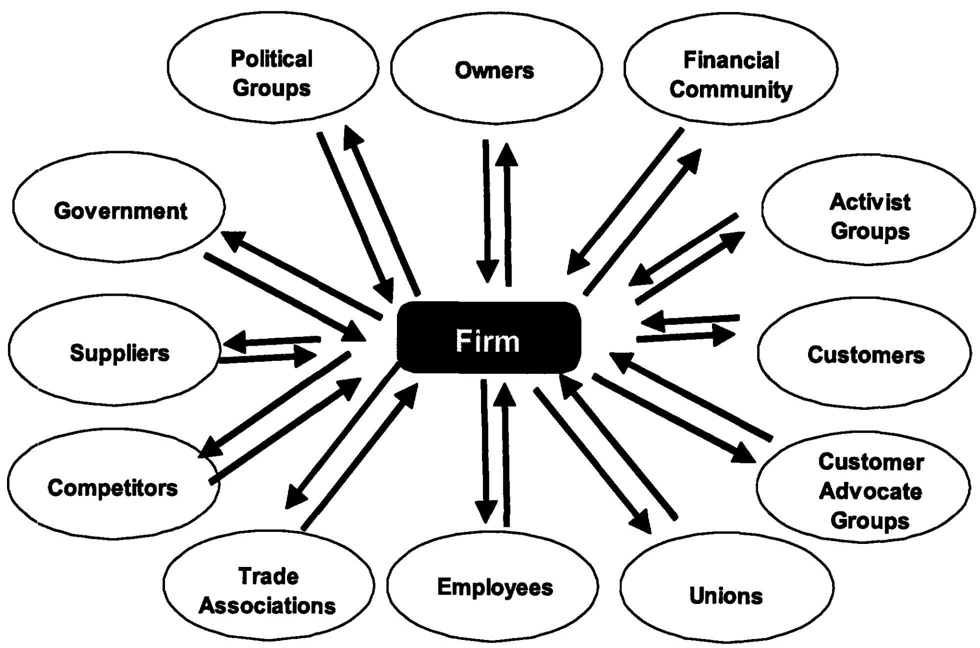

Figure 5-2 Stakeholder Map of a Large Organization

Source: Freeman 1984, 276

Owners	Financial Community	Activist Groups
Shareholders	*Analysts*	*Safety and Health Group*
Bondholders	*Investment Banks*	*Environmental Groups*
Emloyees	*Commercial Banks*	*Single Issue Groups*
	Federal Reserve	
Suppliers	Government	Political Groups
Firm A	*Congress*	*Political Party A*
Firm B	*Courts*	*Political Party B*
Firm C	*Agency A*	*etc.*
etc.	*Agency B*	
Customers	Customer Advocate Groups	Unions
Customer Segment A	*Consumer's Union*	*Union of Workers A*
Customer Segment B	*etc.*	*Union of Workers B*
etc.		*etc.*
Employees	Trade Associations	Competitors
Employee Segment A	*Customer Trade Org. A*	*Domestic Competitors A*
Employee Segment B	*Customer Trade Org. B*	*Domestic Competitors B*
etc.	*etc.*	*Foreign Competitors A*
		etc.

Figure 5-3 Stakeholder Lists of a Large Organization

Source: Freeman 1984, 276

Large organizations have many processes for accomplishing tasks from routine applications of procedures to the use of more sophisticated analytical tools. At the process level of stakeholder analyses, it is necessary to understand how the organization either implicitly or explicitly manages its relationship with its stakeholders, and understand whether these processes fit with the rational stakeholder map of the organization. One well known approach is Strategic Management Process as shown in *Figure 5-4*. The idea of this process is for the top executives in a company to periodically meet with division managers in a formal review session. Progress towards the planned goal is reviewed and new strategies are sometimes formulated. These reviews are usually built into the strategic planning cycle and are used as methods of communicating expectations and evaluating business performance.

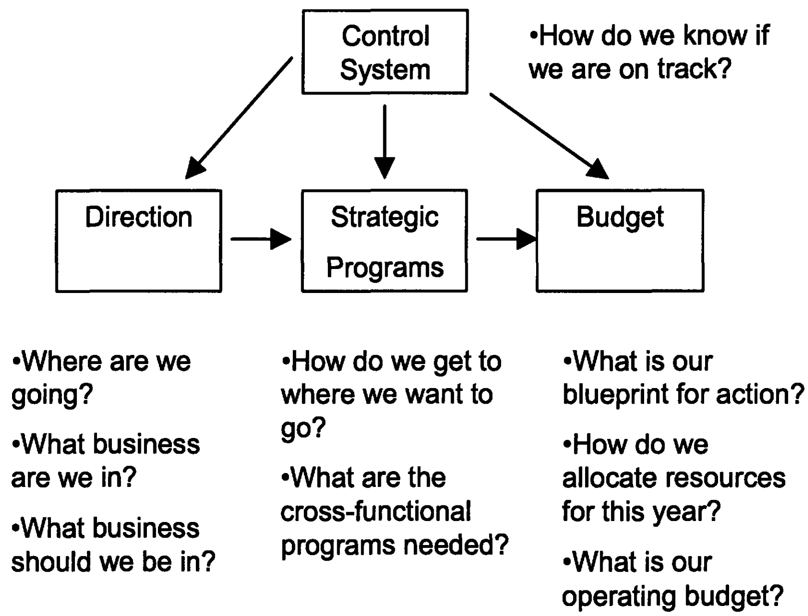

Figure 5-4 Typical Strategic Management Process

Source: Lorange 1980

According to Freeman, existing strategic processes that work reasonably well could be enriched with a concern for multiple stakeholders. For example, three questions can be added to *Figure 5-4* in order to encourage managers to think through the external environments of their business (see *Figure 5-5*).

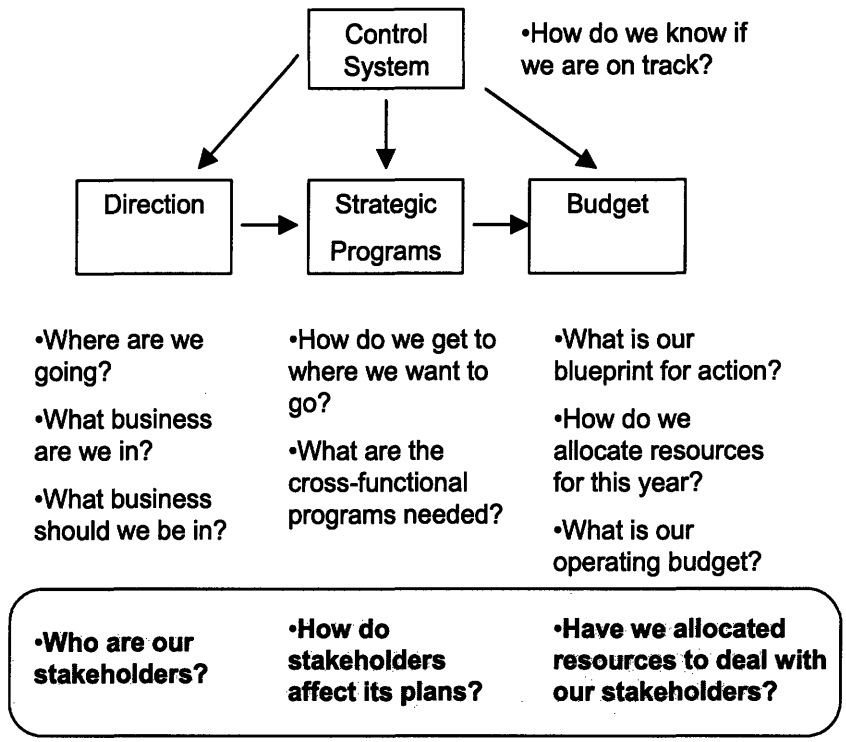

Figure 5-5 Revision of Strategic Management Process

Source: Lorange 1980 (Modified by author)

Companies have many daily transactions with stakeholder groups, such as selling things to customers and buying things from suppliers. At the transactional level, we must understand the set of transactions or bargains among the organization and its stakeholders and deduce whether these negotiations fit with the stakeholder map and the organizational processes for stakeholders. The lack of "fit" of an organization's transactions with its processes and its processes with its stakeholder map can become a source of discontent. According to Freeman, successful transactions with stakeholders are built on understanding the legitimacy of the stakeholder and having processes to routinely surface their concerns.

Broadly, the emphasis of Freeman's book is to construct an approach to management that takes the external environment into account in a systematic way.

5.2 Next Stages of Stakeholder Concept

There have been several developments in the stakeholder concept since Freeman wrote his book, but one interesting characteristic of the stakeholder concept is categorized as the dynamics of stakeholders in *Figure 5-1*. Over time, the mix of stakeholders may change. This concept was first presented by Mitchell et al., and they proposed that classes of stakeholders can be identified by the possession or attributed possession of one or more of three relationship attributes: power, legitimacy and urgency. By including urgency as an attribute, a dynamic component was added to the process where stakeholders attain salience in the minds of managers. The detail of this concept is discussed in section 5.3.

After developing the depth and breadth of the stakeholder concept, researchers felt that the abundance of theory and models surrounding the issue of stakeholders was not matched by any depth of empirical research. In general, the results of empirical studies have confirmed the theoretical models which were developed earlier. For the model proposed by Mitchell et al., Agle et al. empirically tested their model on CEOs in eighty US firms. (Agle, Mitchell, and Sonnenfeld 1999, 507-525) The results suggest that as the stakeholder attributes gather in the mind of the manager, selectivity is enhanced, intensity is increased, and salience is heightened. Urgency was found to be the best predictor of salience. Additionally, Page presented a tool for the determination of organization stakeholder salience that assists managers in establishing priorities for a public health service. (Page 2002, 76-84)

5.3 Stakeholder Salience

Stakeholder salience is one extension of stakeholder theory developed by Mitchell et al.

in 1997, and is classified in "Dynamics of Stakeholders" in *Figure 5-1*. (Mitchell, Agle, and Wood 1997, 853-886) 'Salience' means the most important or most noticeable parts of something. Thus, their model addresses the dilemma managers face in determining which stakeholders are salient so that strategic planning as well as day-to-day management decisions are effective and efficient. They argue that there is no agreement on what Freeman calls 'the principle of who or what really counts', i.e. who the stakeholders of the firm are and to whom managers pay attention. They call for a model of stakeholder identification,

- to explain logically why managers should consider certain classes of entities as stakeholders
- to separate stakeholders from non-stakeholders, and
- to explain how managers prioritize stakeholder relationships.

They suggest that stakeholders become salient to managers to the extent that those managers perceive stakeholders as possessing three attributes: the stakeholder's *power* to influence the firm; the *legitimacy* of the stakeholder's relationship with the firm, and the *urgency* of the stakeholder's claim on the firm. The concepts of legitimacy, power, and urgency and permutations of these attributes are used to create seven stakeholder categories and one non-stakeholder category. *Figure 5-6* shows how a mixture of attributes can create different types of stakeholders with different expected behavioral patterns with respect to the firm.

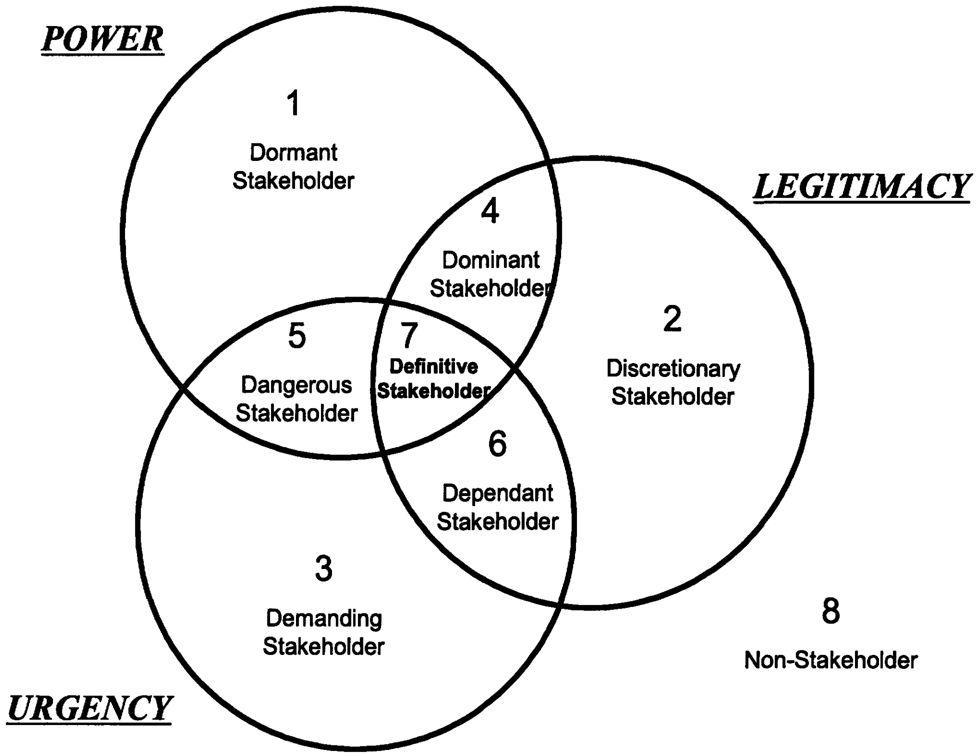

Figure 5-6 Model of Stakeholder Salience

Source: Mitchell, Agle, and Wood 1997, 853-886 (Modified by author)

Their definitions of these attributes (Power, Legitimacy, and Urgency) are paraphrased here for application to the purpose of this thesis.

Power

Power is the extent to which each stakeholder can gain access to:

- coercive power over the organization, based on physical resources of force, violence, or restraint,
- utilitarian power over the organization, based on financial or material resources, or
- normative power over the organization, based on symbolic resources such as being able to command the attention of the media.

Legitimacy

Legitimacy is a generalized perception or assumption that the actions of stakeholders are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions. It is required to provide authority. Weber proposed that legitimacy and power exist independently although they were often considered as similar. (Weber 1947) That is, even though stakeholders may have a legitimate claim on the organization (or the firm), unless they have power, they will not achieve salience for the firm's management.

Urgency

Urgency is based on:

- Time sensitivity – the degree to which managerial delay in attending to the claim or relationship is unacceptable to the stakeholder.
- Criticality – the importance of the claim or the relationship to the stakeholder.

Such stakeholders have something that they want the organization (or the firm) to pay attention to so that they can achieve their purposes. Thus, urgency is defined as the degree to which stakeholder claims call for immediate attention of the firm's management.

When a stakeholder has all three attributes, a manager must give a very high priority to that stakeholder in decision making; when a stakeholder has two attributes, moderate priority is needed; and when a stakeholder has only one, it becomes a low management priority. Of course, if it does not have any, it cannot really be considered a stakeholder. Each stakeholder is explained below.

1. Dormant Stakeholders (attribute: POWER)

Dormant stakeholders possess power to impose their will on a firm, but by not having a legitimate relationship or an urgent claim, their power remains unused. For example, power is held by those who have a loaded gun (coercive), those who can spend a lot of money (utilitarian), or those who can command the attention of the news media (symbolic). Management should remain cognizant of such stakeholders because it is possible for them to acquire a second attribute due to the dynamic nature of the stakeholder-manager relationship.

2. Discretionary Stakeholders (attribute: LEGITIMACY)

The key point about discretionary stakeholders is that there is absolutely no pressure on managers to engage in an active relationship with such a stakeholder due to the absence of power and urgent claims. One example is nonprofit organizations, such as schools and hospitals who receive donations and volunteer labor from companies.

3. Demanding Stakeholders (attribute: URGENCY)

Demanding stakeholders are those with urgent claims but having neither power nor legitimacy. They are bothersome but not dangerous for managers. Where stakeholders are unable to acquire either the power or the legitimacy necessary to move their claim into a more salient status, the noise of urgency is not sufficient to get attention paid by managers. For example, the claims of picketers remain largely unconsidered if they cannot acquire other attributes.

4. Dominant Stakeholders (attribute: POWER and LEGITIMACY)

In the situation where stakeholders are both powerful and legitimate, their influence in the firm is assured, since they form the dominant coalition in the firm by possessing power with legitimacy. We can expect that these stakeholders will have some formal mechanism in place that acknowledges the importance of their relationship with the firm. For example, corporate boards of directors generally include representatives of owners, significant creditors, and community leaders, and there is normally an investor relations office to handle ongoing relationships with investors.

5. Dangerous Stakeholders (attribute: POWER and URGENCY)

Dangerous stakeholders will be coercive and possibly violent, making the stakeholder literally dangerous to the company. Examples of unlawful, yet common, ways of using coercive means to advance claims include employee sabotage and terrorism.

6. Dependent Stakeholders (attribute: LEGITIMACY and URGENCY)

Dependent stakeholders depend upon other stakeholders or firm's managers for the power necessary to carry out their will. To satisfy their claims, these stakeholders have to rely on the advocacy of other, powerful stakeholders or on the voluntarism of the firm's management. In the case of seawater pollution by oil, local residents, birds, and even the natural environment are categorized in this group. They usually need a guardianship of the state government or the court system.

7. Definitive Stakeholders (attribute: POWER, LEGITIMACY and URGENCY)

By definition, a stakeholder exhibiting both power and legitimacy already will be a member of a firm's dominant coalition. When such a stakeholder's claim is urgent, managers have a clear and immediate mandate to give priority to that stakeholder's claim. The most common occurrence is likely to be the movement of a dominant stakeholder into the definitive category.

Another point which should be paid attention to is that the presence of each attribute is a matter of multiple perceptions and is in effect socially constructed. While an individual or entity may not be conscious of possessing an attribute, or may not choose to enact any implied behavior, groups can be reliably identified as stakeholders based on their possession of power, legitimacy, and/or urgency. It is, however, the manager who determines which stakeholders are salient and therefore which will receive attention. Thus, a manager could incorrectly perceive the field. Furthermore, this model recognizes that each attribute is treated as absent or present for the sake of simplicity. However, as will be shown in the following chapter, in reality each operates on a continuum.

As described in section 5.2, a dynamic component was added to the process where stakeholders attain salience in the minds of managers. For example, the African National Congress (ANC) in South Africa began as a group with an urgent claim but not a legitimate one, given the ruling South African culture and government. It did not have power, either. It was a demanding stakeholder at first. The ANC then moved into the dangerous stakeholder category by using coercive power, but this did not lead immediately to definitive status. It was only by acquiring legitimacy that the ANC could achieve definitive status, high salience, and eventual success.

5.4 Stakeholders in Railway Operations

Freeman and Reed recognized that there would be serious differences of opinion about broad versus narrow definitions of 'stakeholders'. (Freeman and Reed 1983, 93-94) Freeman's definition which is cited above is certainly one of the broadest definitions. This type of view is typically based on the empirical reality that companies can indeed be vitally affected by, or they can vitally affect, almost anyone. Given this definition, stakeholders in the broadest sense can be any or all internal and external individuals and organizations generally thought to qualify as actual or potential stakeholders. This incorporates persons, groups, neighborhoods, organizations, institutions, societies, and even the natural environment.

For example, the organizational stakeholders (as opposed to individual employees or individual passengers) in railway operations may include passengers, local communities, national or local government, policy makers, employees, employee's families, unions, stockholders, media, and manufacturers. Not surprisingly, such an extended list of potential stakeholder groups results in an equal number of models for stakeholder identification and classification. *Figure 5-7* shows the stakeholders from the viewpoint of railway operators.

Figure 5-7 Stakeholders from the view point of Railway Operators

Source: Author

5.5 Summary

This chapter introduced what is known as Stakeholder Theory. In particular, the stakeholder salience model was explained in detail to systematically explain stakeholder salience and dynamism. Based on Stakeholder Theory, key stakeholders from the viewpoint of railway operators were also identified. These components will be used in Chapter 6 to create a new framework which is used to assess the applicability of Revenue Management (RM) in the railway industry.

Chapter 6 *A New Framework for the Stakeholder Analysis*

Up to this point, we have discussed two topics in parallel with each other. First, implementations of Revenue Management (RM) to the railway industry have been described and actual cases have been showcased. As shown in Chapter 4, implementation processes were not necessarily successful in some countries. Secondly, 'Stakeholder Theory' was introduced in Chapter 5 to identify the key stakeholders. In this chapter, we will combine these two components to create a new framework by applying 'Stakeholder Theory' to RM implementation processes for railways. The methodology is first explained, and then a new framework is constructed step by step.

6.1 Methodology

In order to create a new framework to analyze a salient stakeholder identification and RM applicability for railways, we will follow the following four steps.

1. <u>Map stakeholders on a salient identification framework presented by Mitchell.</u>

We will start with a salient identification framework presented by Mitchell et al., which was introduced in Chapter 5. It will be applied to each national setting based on the discussion in Chapter 4.

2. <u>Identify stakeholders who are mapped differently depending on the country.</u>

After mapping stakeholders, we will notice that some of them are placed in a different area depending on the country, while others are placed in the same place. It is important to identify who changes its position at this point.

3. Analyze the differences and identify the determinants that cause differences.

We then focus on stakeholders who possess more than one attribute (Power, Legitimacy and Urgency) since they are considered high priority stakeholders from the viewpoint of railway operators. Furthermore, we also pay attention to stakeholders who are placed differently among each country, since such differences are likely to have implications for our analysis. We will identify the determinants that cause these differences.

4. Create a table based on the above analyses.

Finally we will present a framework that presents some suggestions on who will be stakeholders and what the conditions are when introducing RM for railways to a new national setting. This framework will be tested in the following chapter.

6.2 Step 1: Mapping Stakeholders

Seven stakeholders have been identified in Chapter 5: Public, Government, Employees, Owner, Industries, Media, and Global Community. Based on the case examples in Chapter 4, the stakeholders above are mapped onto Mitchell's framework in a different way according to the national settings. In this section, we base our arguments on his framework illustrated in *Figure 5-6*.

6.2.1 France

The initial implementation of the RM system caused a tremendous adverse impact on the whole society in France. Especially, passengers who used trains on a regular basis could not commute due to the technically inadequate system by which they were not able to make reservations online or were allowed to buy tickets for non-existent trains. The problem was obviously urgent for them. Additionally, it was appropriate to take actions if passengers could not receive services. Thus, the public initially became a dependent stakeholder without power. As soon as the problem was perceived, however, the media covered the problem nationwide by broadcasting large queues of irate customers in all major stations. Backed by the media, several interest groups who represented public opinions demanded an urgent solution to this problem. In fact, passengers' associations sued SNCF. Thus, the public shifted to become a definitive stakeholder by acquiring power.

Employees were also significantly affected by the RM implementation. They were inherently a discretionary stakeholder because they possessed the legitimate right to organize labor unions. Furthermore, sales staff had to deal with requests from angry customers without receiving adequate training or understanding themselves how the price was calculated. Employees were a dependent stakeholder at first by possessing legitimacy and urgency. Finally they became a definitive stakeholder after acquiring power by going on strike and rejecting the pricing policy.

The French government was a dominant stakeholder possessing power and legitimacy due to its supervising position. However, if the problem remained unresolved, it would be possible for the government to become a definitive stakeholder for SNCF. We here assume that owners can be considered as a synonym for the government because the majority of SNCF's stock is owned by the government. Thus, the owners are also placed in the category of a dominant stakeholder. Finally, the media is considered as a dormant stakeholder due to its power to influence the society.

Figure 6-1 illustrates the stakeholder salience map for France based on the above discussion.

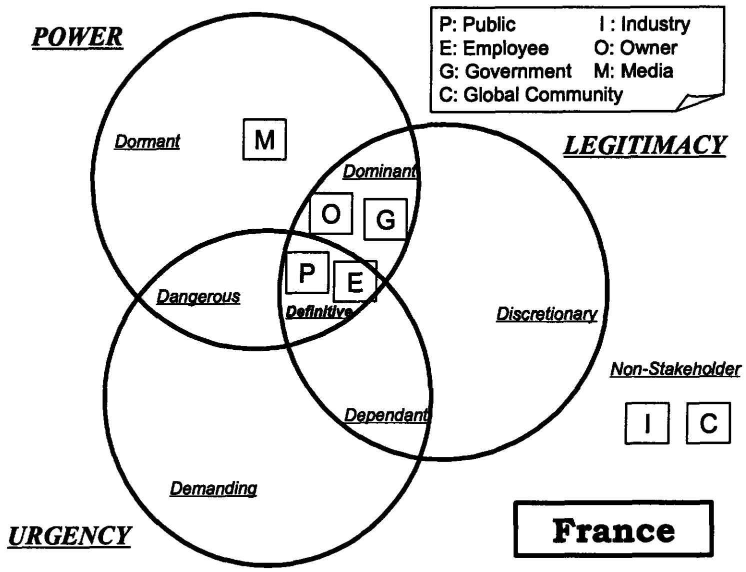

Figure 6-1 Stakeholder Mapping for SNCF

6.2.2 U.K.

In the case of GNER which was described in section 4.3, it seems that the initial implementation process was not as terrible as the case in France. After the implementation of the new RM system, GNER enjoyed an annual increase in revenue without explicit protests from the public or employees. However, two issues are still the subject of debate from the viewpoint of public acceptability. One is whether high fares are tolerable for the public, and the other concern is that there are many kinds of fares which are applied in different conditions, and therefore the fare structure is confusing. While the public was a discretionary stakeholder possessing legitimacy, they were not as urgent as the case of SNCF due to the fact that the new system technically worked well, and that airlines offered an alternative service between London and Edinburgh. So the public had an option not to use trains. The public did not get enough power to stimulate the national debate partly because this change affected only the local public who travelled between London and Edinburgh. Thus, the public stayed as a discretionary stakeholder. Employees also possessed legitimacy, but no power or urgency. The British government stayed as a dominant stakeholder because they possessed both power and legitimacy over GNER, but no urgent issue.

The owner of GNER is a private company called Sea Container Ltd which operates a transport business and a container leasing business. They can be regarded as a dominant stakeholder with power and legitimacy. Since Sea Container Ltd is a private company, the business environment is more unstable, and more competitive than it would be for a state-owned company. Thus, it is more likely to become a definitive stakeholder by acquiring urgency.

Figure 6-2 illustrates the stakeholder salience map for the UK based on the above discussion.

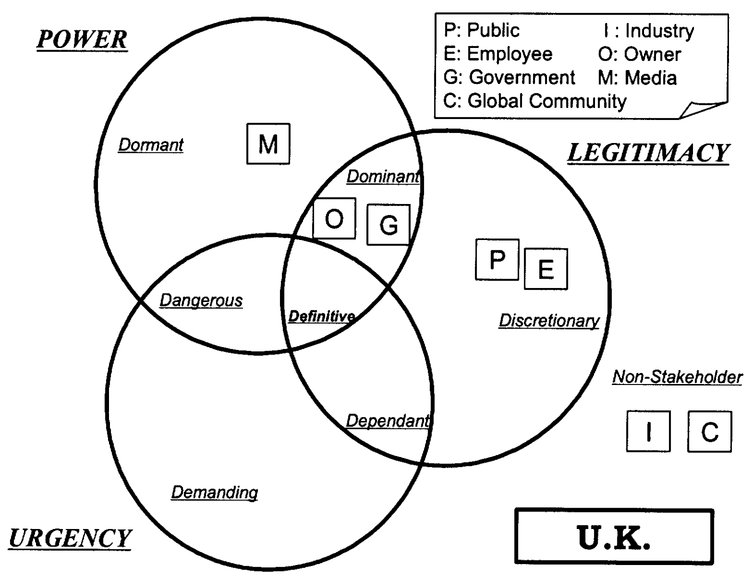

Figure 6-2 Stakeholder Mapping for GNER

6.2.3 Germany

As soon as the DBAG presented full details of the new fare system, several interest groups carried out various protest campaigns supported by the media. The public considered the new system as complex and unfriendly due in part to the fact that several popular discount tickets were abolished. Just as in the case of SNCF, the public became a definitive stakeholder with legitimacy, urgency, and power. Employees were dominant stakeholders with legitimacy and power to organize unions. However, the system technically worked well, and employees did not protest much.

The German government was a dominant stakeholder possessing power and legitimacy due to its supervising position. As an owner, their interests are profit maximization of DBAG. After it turned out that the new system was a disaster financially, it could become a definitive stakeholder by acquiring urgency. Media supported the protest campaigns by interest groups, and they clearly had power to influence the public. Thus they are considered as a dormant stakeholder in a sense that the operators need to deal with them carefully.

Figure 6-3 illustrates the stakeholder salience map for Germany based on the above discussion.

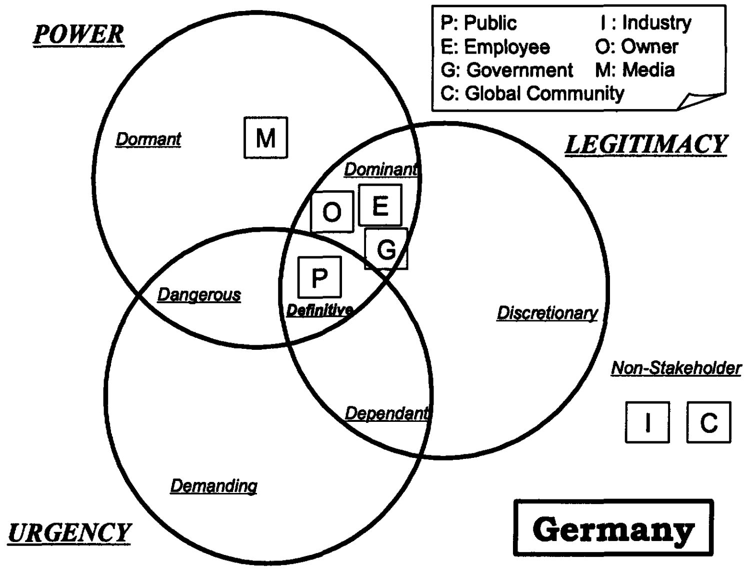

Figure 6-3 Stakeholder Mapping for DBAG

6.2.4 Canada

VIA developed their in-house RM system from 1993 on a step-by-step basis where RM practices could be applicable. The current system was eventually introduced throughout the Ontario-Quebec Corridor in 1996. That is, the implementation process was not as radical as the case of SNCF and DBAG. Additionally, airlines are the dominant transportation methods whereas railways are minor ones from a user share viewpoint. Thus, neither the public nor employees were influenced much, even though both of them were initially discretionary stakeholders for the same reason as with the case of France. The public did not protest and employees did not exercise their rights to go on strike. The government stayed as a dominant stakeholder with legitimacy and power, and did not find urgent issues, because VIA steadily increased its yield growth during the implementation process. Since the process was slow, media did not cover this topic intensively.

Figure 6-4 illustrates the stakeholder salience map for Canada based on the above discussion.

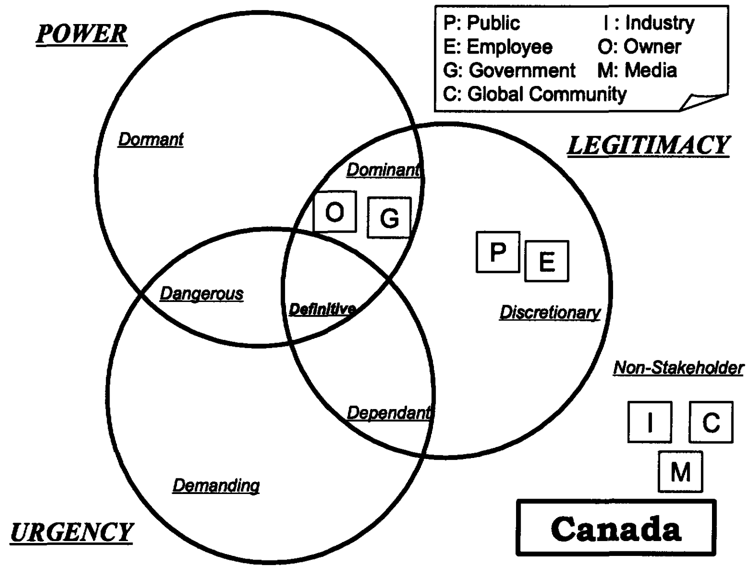

Figure 6-4 Stakeholder Mapping for VIA

6.2.5 U.S.

Amtrak initially focused on their long-distance intercity services to implement RM practices. After seeing the successful implementation, Amtrak extended the practice to the Acela Corridor. In other words, Amtrak followed a similar path to VIA, and developed the RM system gradually. Thus, we can assume that each stakeholder is mapped in a similar way to the case of VIA. However, Acela is the most profitable line for Amtrak and the traffic volume is much larger than that of the VIA case. Media also covered the fare change between Boston and Washington D.C.

Figure 6-5 illustrates the stakeholder salience map for the US based on the above discussion.

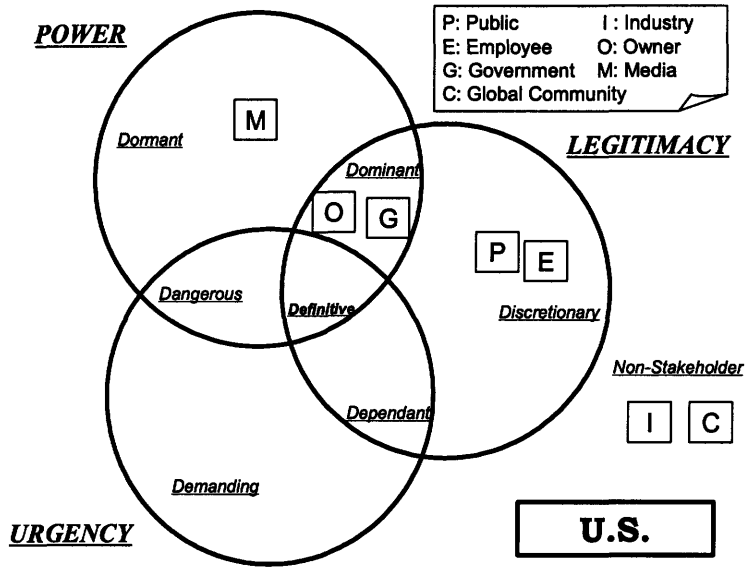

Figure 6-5 Stakeholder Mapping for Amtrak

6.3 Step 2: Identification of High Priority Stakeholders

In this section, we will pay attention to high or moderate priority stakeholders who possess more than one attribute (Power, Legitimacy and Urgency). Furthermore, we also take a close look at stakeholders who change their positions depending on countries. Meanwhile, following the definition by Page, we hereby define stakeholders with three attributes (i.e. definitive stakeholder) as 'high priority stakeholder,' stakeholders with two attributes (i.e. dominant, dependant and dangerous stakeholder) as 'moderate priority stakeholder,' and stakeholders with one attribute (i.e. discretionary, dormant and demanding stakeholder) as 'low priority stakeholder.' (Page 2002, 76-84) *Figure 6-6* illustrates how each stakeholder is mapped in a different way. The particular situation of each stakeholder will be briefly explained below, focusing on differences.

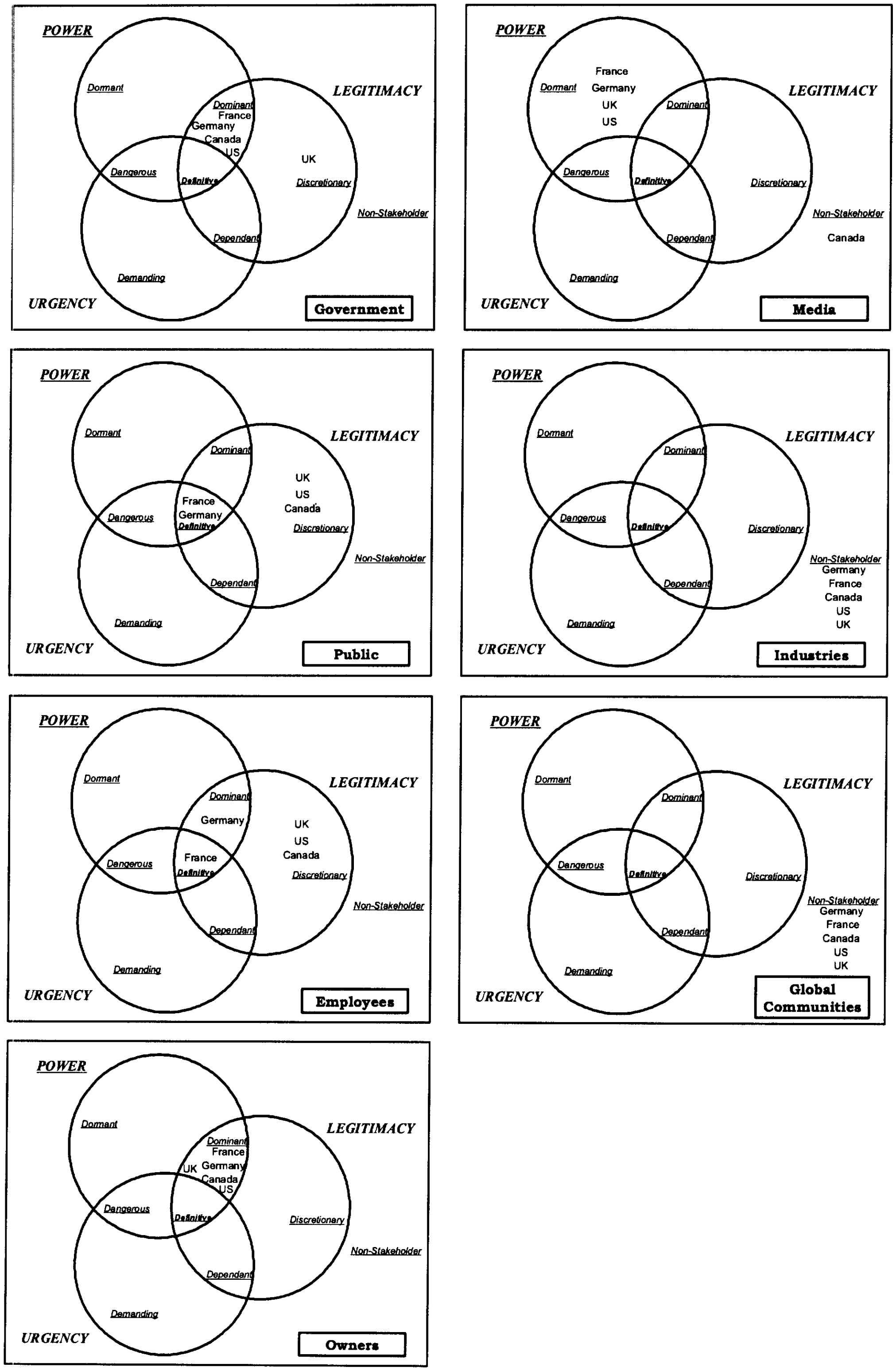

Figure 6-6 Country Mapping for Each Stakeholder

The public and employees are the two stakeholders which are placed as a high priority stakeholder (i.e. a definitive stakeholder) in one or more countries. They also change their positions most depending on the country. In France and Germany where railways play an important role, the public eventually became a definitive stakeholder. Employees also became a definitive stakeholder or dominant stakeholder from the viewpoint of railway operators. In the U.S. and Canada, however, these stakeholders stayed as discretionary stakeholders.

In complete contrast, industries and global communities are placed as non-stakeholders, and do not seem to change their positions at all in all countries. Even though Freeman's definition of 'stakeholder' implied that they should be included as stakeholders, they are not even considered as low priority stakeholders from the salience model by Mitchell et al.

Owners stay in a position of dominant stakeholders with power and legitimacy in all countries, and considered as a moderate priority stakeholder. The government changes its position depending on the country. In most countries where the railway operators are state-owned companies, the government and owners can be seen as the same stakeholder, and mapped in a same area. Media is basically a dormant stakeholder that possesses only power, but it is classified as a non-stakeholder in Canada because it does not play an important role.

6.4 Step 3: Identification of Determinants

Based on the above discussion, we suggest that the Government, Owners, Employees, and the Public can be the high/moderate priority stakeholders. We will now discuss what causes the differences for several stakeholders in more detail.

6.4.1 *Public*

The public is inherently a discretionary stakeholder because they have the right to receive services in compensation for the fare they pay. A discretionary stakeholder can then become a dependent stakeholder by acquiring urgency. Whether this transition takes place is judged by two criteria. First, the number of people who are affected by the new system determines how the public perceives it. The public heavily rely on railways in France and Germany, and passengers wanted to maintain railways as a mobility option in these countries. If benefits such as widely-used discount tickets are taken away from them, they perceive the problem as urgent. Second, the complexity of the fare structure also determines how the new system is perceived by the public. A complex fare structure is difficult to understand, and is considered as something the public does not want to accept.

A dependent stakeholder will become a definitive stakeholder by acquiring power. This process is usually preceded with the help of the media which support the public by broadcasting protest campaigns.

This process is illustrated in *Figure 6-7*.

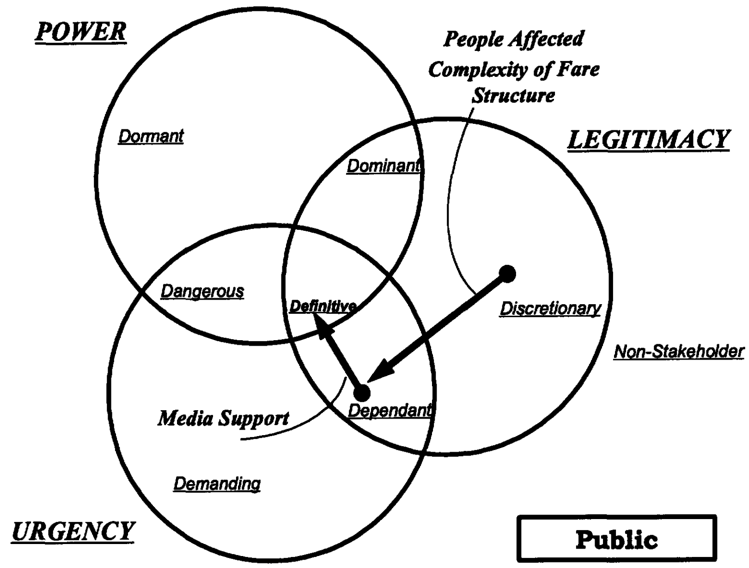

Figure 6-7 Transition Process for the Public

6.4.2 Government and Owner

The influence of the government on railway operators varies greatly depending on their relationship in terms of financial or political structures. Railway operations are nationalized in most countries. Even if they are privatized, the government owns most of their shares, so they are owned by the government for practical purposes. Under such conditions, the government can be classified as a dominant stakeholder because they possess both legitimacy and power. To the contrary, if the railways become privatized and the owners of railway operators are private firms, the role of the government lessens and it becomes a discretionary stakeholder by losing power. Thus, the corporate structure of railway operators determines the position of the government from the viewpoint of operators.

This process is illustrated in *Figure 6-8*.

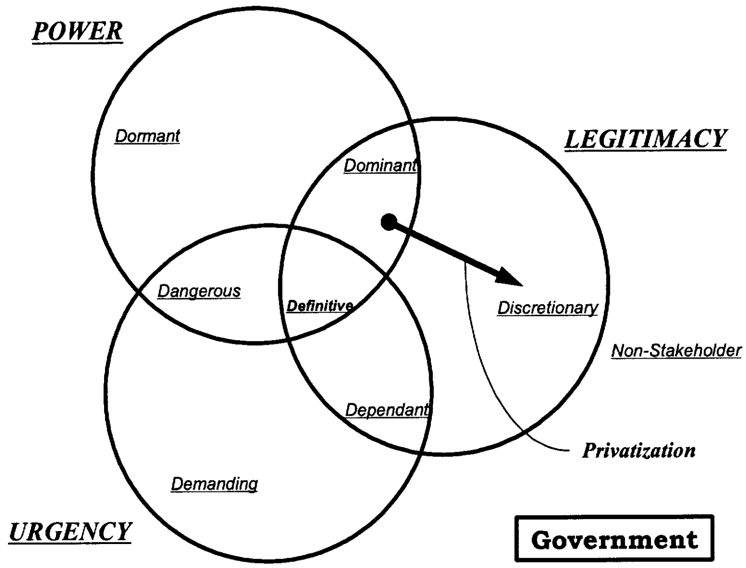

Figure 6-8 Transition Process for the Government

Owners and the Government are practically the same and they are mapped in a same area as long as the railway operators are state-owned companies. The only difference is that owners are classified as a dominant stakeholder unlike the Government who changes its position depending on the structure of the railway operators.

6.4.3 Employee

Employees work for the railway operators and they are naturally considered as a discretionary stakeholder. Whether they move to become a dominant stakeholder depends on how their labor unions perceive the problem, and how actively they act. It would be possible for labor unions in France and Germany to go on strike to protest against the troubles which the new system might have caused. A dominant stakeholder then goes up to a definitive stakeholder by acquiring urgency. This move took place in France where sales staff could not deal with the trouble which was caused by the technical failure of the new system. Thus, the determinant of such a transition is how seriously the problem was perceived from the viewpoint of employees.

This process is illustrated in *Figure 6-9*.

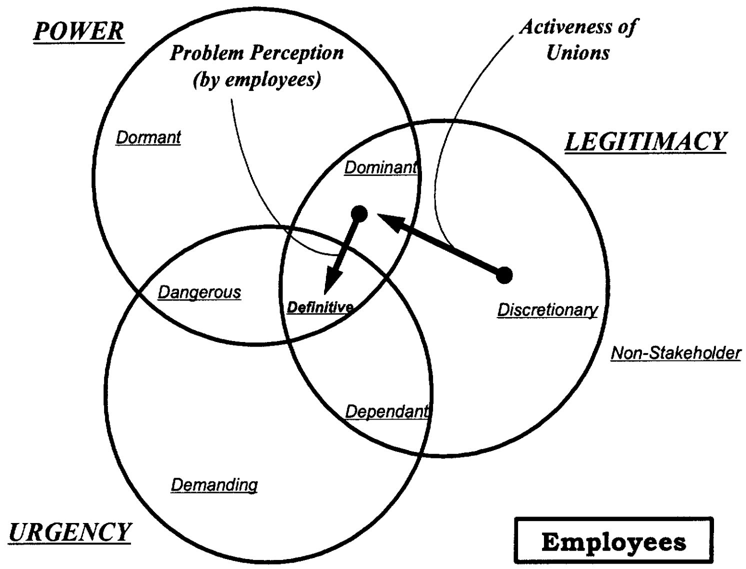

Figure 6-9 Transition Process for Employees

6.5 Step 4: Creation of a New Framework

In addition to the above discussion which has been categorized by stakeholders, there are several issues which should be taken into account regardless of stakeholders. First, the implementation process can be an important determinant of how successful the RM practice turns out to be. The process was extremely drastic in France and Germany, whereas the new system was gradually developed on a step-by-step basis in the US and Canada. It is implied that how the new system is introduced greatly affects the acceptability for stakeholders, especially the public and employees. Another consideration is how other stakeholders perceive the current situation. The RM practice is understandably preferable for railway operators because revenue is technically expected to increase. However, other stakeholders might not understand the problem. For example, passengers might have other complaints such as delays to the train service or a low quality of customer service even though they are aware of the necessity of increasing revenues for railway operators. Such a problem perception will also affect the acceptability.

Stakeholders / ***Criteria***	Government	Employees	Public	Owners	Media	Industry	Global Community
Corporate Structure	Private / Public						
Labor Unions		Active / not Active					
Problem Perception by employees		Serious / not Serious					
People Affected			Many / Few				
Complexity of Fare Structure			Complex / Simple				
Implementation Process	Drastic / Gradual						
Problem Perception by stakeholders	High / Low						

Table 6-1 Criteria for RM Implementations

Table 6-1 shows the criteria that emerge from the above discussion. *Table 6-1*, along with *Figure 6-7*, *Figure 6-8* and *Figure 6-9*, are combined to form the new framework. This framework specifies several criteria which determine the stakeholder mapping based on Mitchell's salience model. These criteria will be the key determinants to find out whether the RM implementation to railways can be successful.

Other stakeholders such as owners, media, global communities and industries can be a high priority stakeholder, too. The government usually acts as owners and becomes a dominant stakeholder if the railway operators are nationalized. Global communities and industries are classified as non-stakeholders, but drastic changes in fare systems might cause problems and it is possible to become low priority stakeholders by acquiring one of three problems and it is possible to become low priority stakeholders by acquiring one of three attributes. Finally, media has the power to influence other stakeholders. For example, several interests group in France and Germany which were organized for the general public used the media, hoping that their voices are heard. In this sense, the media can act as a catalyst even though they might not have direct interests to railway operators.

6.6 Summary

Combining case examples in five countries and stakeholder theory, we have constructed a new framework which can be used to determine the acceptability of RM implementations to railways. This framework has been created based on actual examples, but is also expected to be applicable in new national settings. Thus, we need to examine this framework by applying it to new countries. In the following chapter, it is applied to two different national settings, Japan and Portugal.

Chapter 7 *Applying the New Framework*

In the previous chapter, we developed a new framework to determine the applicability of Revenue Management (RM) to the railway industry. In this chapter, we will apply the framework to two new national settings; Portugal and Japan.

7.1 Japan

7.1.1 Background

While railway operations in Japan began in 1872, Japanese National Railways (JNR) was reorganized into a state-owned company in 1949 by a directive of the U.S. General Headquarters which was established after World War II. Even though JNR enjoyed many successes, including the inauguration of the Shinkansen high-speed railway service, rapid expansion of the railway network also pulled JNR further into debt as it took out huge loans to fund new capital projects. JNR faced other problems including management inefficiencies, profit losses, labor-management discord, and rapid fare increases. By 1987, JNR's debt reached over $200 billion. (East Japan Railway Company 2006) Finally, the railway network was privatized on April 1, 1987 by an act of the Diet of Japan, and divided into eight companies collectively called the Japan Railways (JR) Group in order to restore financially sound operations.

Figure 7-1 Map of Areas Covered by Each Passenger Company in the JR Group

Source: Japan Railways Group 2007

The JR Group consists of six passenger service companies, one freight service company and one technical research institution that took over most of the assets, operations, and liabilities of JNR. As illustrated in *Figure 7-1*, passenger service companies include JR Hokkaido, JR East, JR Central, JR West, JR Shikoku, and JR Kyushu. There are considerable disparities in profitability among these six companies. While JR East, JR Central, and JR West in the mainland take advantage of being in command of large metropolitan networks such as Tokyo and Osaka, the other three companies struggle to make their businesses profitable. In fact, the three companies on the mainland have already completed their privatization processes, whereas the majority of stock for the other three companies is still owned by the government.

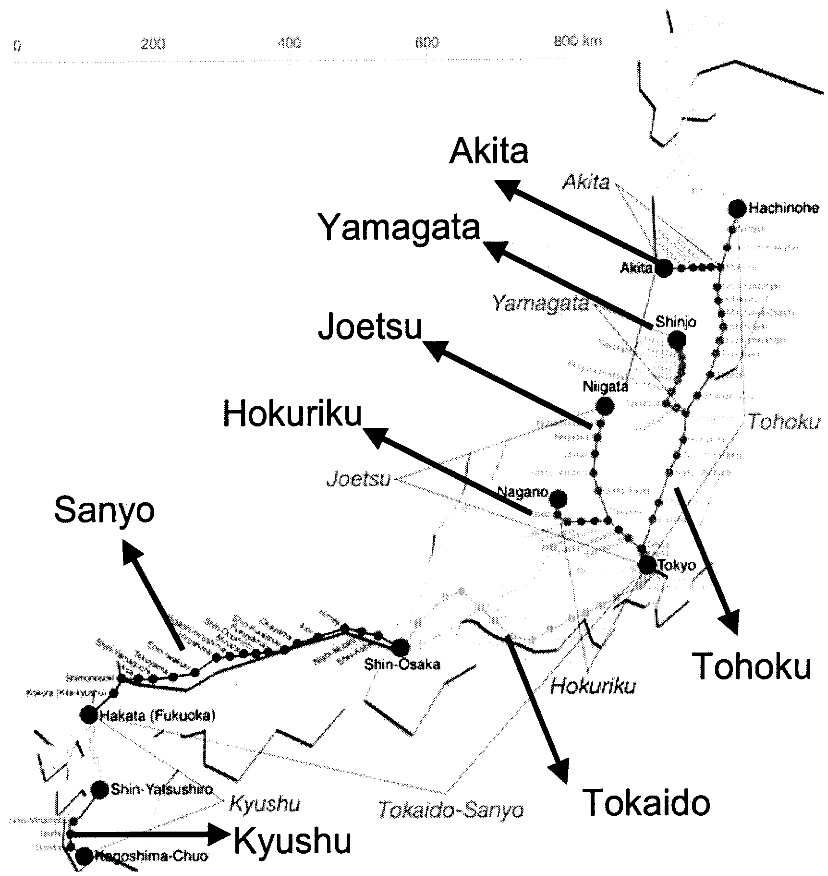

Figure 7-2 Map of Shinkansen Network

Source: Japan Railways Group 2007 (Modified by author)

The Shinkansen is a network of high-speed railway lines which are operated by JR (see *Figure 7-2*). The network has expanded to link most major cities on the mainland. There are six major Shinkansen lines which use dedicated standard gauge tracks, and two further lines, known as Mini-Shinkansen, have also been constructed by upgrading existing narrow gauge tracks. JR Central operates Tokaido Shinkansen which is the most profitable line, and relies heavily on this line financially. However, this line connects the two largest cities in Japan, Tokyo and Osaka, making the competition against airlines and buses extremely fierce. Furthermore, Sanyo Shinkansen which is operated by JR West and offers a direct service with Tokaido Shinkansen for passengers departing from Tokyo also competes against other means of transportation. *Table 7-1* summarizes the network.

Line	City			Gauge	Operator	
Tokaido	Tokyo	-	Osaka	Standard	JR Central	Direct Service
Sanyo	Osaka	-	Hakata	Standard	JR West	Direct Service
Tohoku	Tokyo	-	Hachinohe	Standard	JR East	
Joetsu	Tokyo	-	Niigata	Standard	JR East	
Hokuriku	Tokyo	-	Nagano	Standard	JR East	
Kyushu	Yatsushiro	-	Kagoshima	Standard	JR Kyushu	
Yamagata	Tokyo	-	Shinjo	Narrow	JR East	
Akita	Tokyo	-	Akita	Narrow	JR East	

Table 7-1 Comparison of eight Shinkansen Lines

Even though the reform of price regulation permitted railway operators to set many different fares for each route, day of the week, and hour of the day, fares in Japan have not changed dramatically so far. Meanwhile, competition between airlines and railways has become increasingly fierce as the airline firms started to offer discounted tickets after the deregulation in the late 1990s. Under these circumstances, JR West announced in its annual report in 2004 that it had begun to implement flexible pricing, and planned to move forward with the more aggressive use of RM, especially with regard to its high-speed railway services. (West Japan Railway Company 2004) It is therefore evident that the major railway operators have become interested in RM.

7.1.2 Mapping Stakeholders

The new framework which was defined in Chapter 6 will now be applied to the Japanese case. We will start with the government, employees and the public, and then discuss other stakeholders who were identified in section 5.4.

As discussed in section 6.4, the government is inherently a discretionary stakeholder due to its supervising position over the railway operators. Then, whether it moves to become a dominant stakeholder depends on the structure of the operators. The institutional setting of the railway operators in Japan varies considerably among each JR Group. The three companies on the mainland (JR East, JR Central, and JR West) have completely privatized and all the stocks have gone public, whereas the other three companies (JR Hokkaido, JR Shikoku and JR Kyushu) have not begun their privatization processes. Because the latter three companies have been formally privatized, they are supposed to act as a private company. However, their stock is still owned by the government, so considerable influence is exerted by the government on the management of railway operations. Thus, we consider that the government moves to a dominant stakeholder from the viewpoint of JR Hokkaido, JR Shikoku and JR Kyushu, but that it stays as a discretionary stakeholder in the eyes of JR East, JR Central and JR West. *Figure 7-3* illustrates the mapping of the government in Japan.

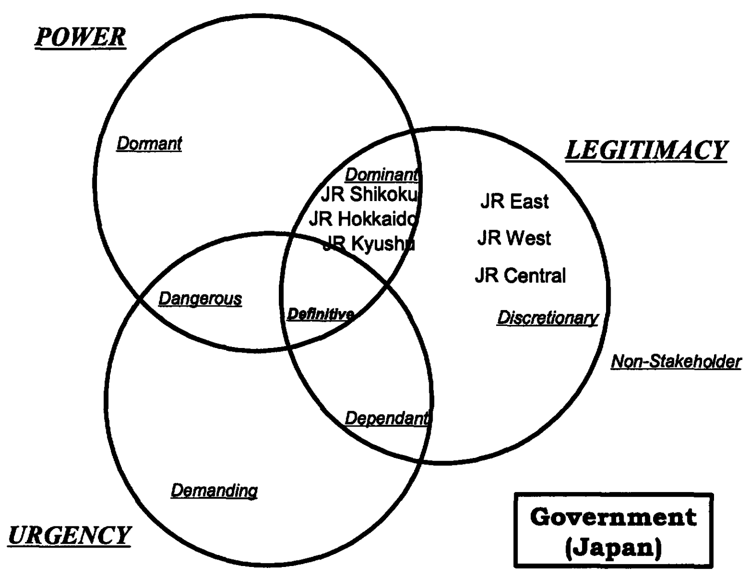

Figure 7-3 Mapping of the Government in Japan

The new framework in Chapter 6 implies that the position of employees is determined initially by 'Activeness of Unions,' and then by 'Problem Perception'. Activeness of labor unions in the JR Group is inferred from the process of JNR's demise which was described in section 7.1.1. There were several factors which caused the management inefficiency of JNR, but the strong dispute against the labor unions was one of the most significant. The railway industry has been historically labor-intensive, and there were several labor unions in JNR which were grouped by the type of work such as drivers, maintenance workers, sales staff, etc. The situation in Japan was unique in the sense that there was usually only one union in each firm. It was therefore necessary for the management to negotiate with each union independently. Additionally, the unions fiercely contested any proposal from the management which might threaten their vested interests. These circumstances made negotiations between management and labor enormously time-consuming, and often produced nothing effective, resulting in an unsuccessful reformation of JNR.

Unions became cooperative after the privatization so as not to repeat the same failure, and the activeness of labor unions varies among JR Groups. However, labor unions among the JR Group have generally maintained their strength. Thus, employees will become a dominant stakeholder.

Another consideration for employees as a high priority stakeholder is the problem perception by employees. In the case of France which was explained in Chapter 4, technical errors of RM systems initially caused tremendous burdens for sales staff. It goes without saying that there should be no technical mistakes, but it is also important to prepare well before introducing new systems. Thus, employees stay as a dominant stakeholder as long as employees feel comfortable with the new RM system, but it is possible for them to become a definitive stakeholder if the system does not work well technically. *Figure 7-4* illustrates the mapping of the employees, supposing that the system works technically well and employees are generally comfortable with the new system.

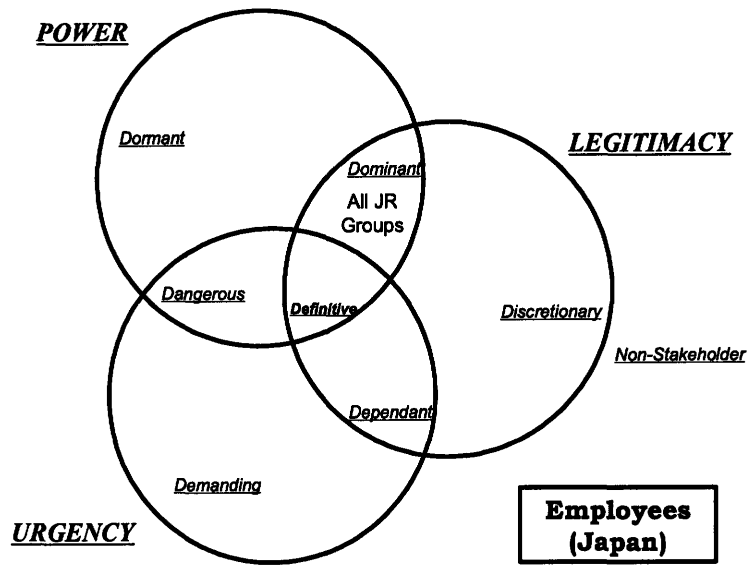

Figure 7-4 Mapping of Employees in Japan

According to the new framework, three determinants for mapping the public are 'Number of People Affected,' 'Complexity of Fare Structure' and 'Media Support'. The public is initially a discretionary stakeholder, and the following two determinants tell us whether they might become a dependent stakeholder. First, we can surmise that the implementation of a new system in Japan would affect a huge number of people, considering the population of major metropolitan areas such as Tokyo and Osaka. For example, approximately 16 million passengers use the railway network run by JR East every day. Secondly, even a moderate change in fare systems would affect many passengers in Japan, and railway operators usually have to familiarize the public with such a change by active public relations. Thus, the pubic progressing to a dependent stakeholder is a strong possibility.

We now need to take the media support into account. There are many consumer groups which advocate their interests, and they usually try to make use of every media channel such as TV and newspapers when their interests are affected by changes in public policy. On the other hand, changes in the public transportation fares and their effects on the society are always popular targets for the media in Japan because many people pay attention to such articles. In short, both sides would benefit. Thus, the public could successfully gain the support of the media and eventually move to become a definitive stakeholder. *Figure 7-5* illustrates the mapping of the public in Japan.

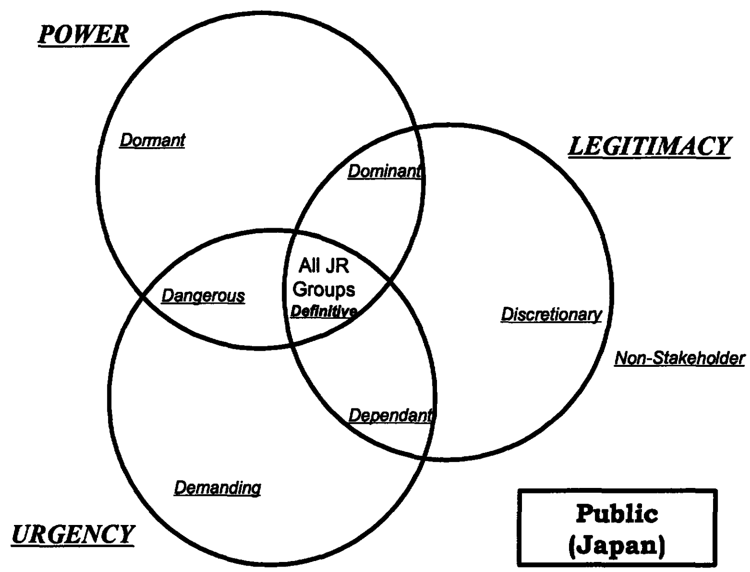

Figure 7-5 Mapping of the Public in Japan

7.1.3 Implications

Figure 7-6 illustrates the above discussion and shows the stakeholder mapping for Japan. It shows that the public is a definitive stakeholder to whom most attention should be paid, while the employees and owners, and the government in some companies, are also important as dominant stakeholders for the railway operators in Japan. It is possible for employees to be a definitive stakeholder. Technical problems initially caused tremendous burden in France, so it is critical to have a system which works properly for employees to be able to deal with the system comfortably.

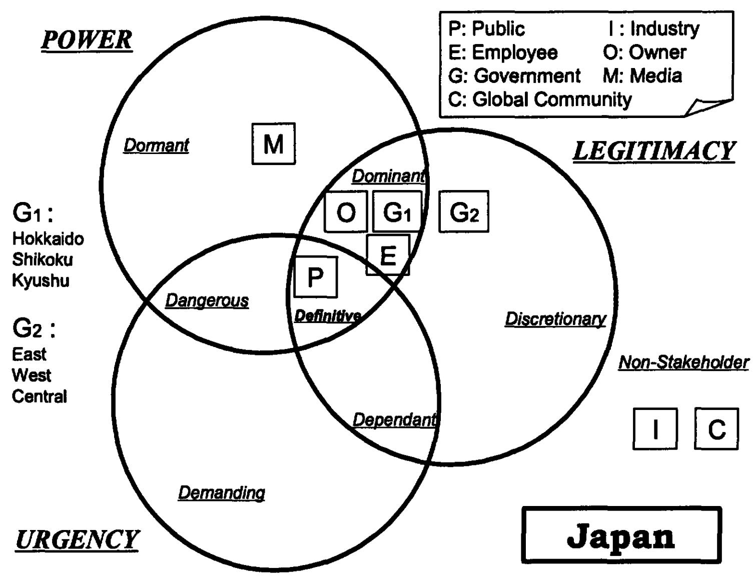

Figure 7-6 Stakeholder Mapping for Japan

In *Table 6-1* which comprises the new framework, we have pointed out that 'Implementation Process' and 'Problem Perception by Stakeholders' should also be included as criteria for the acceptability of new RM systems. Because the effect of fare changes will affect many passengers in Japan, the gradual implementation of RM systems is preferable. As we discussed in Chapter 3, key strategies for RM to be successful are 'effective seat allocation to maximize revenue' and 'offering discount tickets to stimulate demand'. We insisted that these two strategies were fundamentally independent and that they should be considered separately depending on the load factor. In the case of Japan, one approach would be to start offering discount tickets for low demand trains without considering the seat allocation strategy.

With regard to 'Problem Perception,' it is important to consider how the public, a definitive stakeholder, perceives the problem. That is, RM practices will not be accepted by the public if railway operators cannot justify their purpose to introduce new systems. For example, RM implementation between Tokyo and Osaka would be more acceptable for the public than between Tokyo and Akita because people understand that railway operators want to expand their market share against airlines and buses. In this sense, availability of other modes of transportation also affects how the public perceives the new system. We assume that other stakeholders such as industries and global communities stay as a low priority stakeholder although we should not ignore them.

7.2 Portugal

7.2.1 Background

The first passenger train service opened in Portugal in 1856, operated by Caminhos de Ferro Portuguese (CP). Although CP remained profitable until the 1920s, it faced financial problems after World War I and the Great Depression in 1929. In addition to the heavy burden of repairing infrastructure after the wars, the ruinous state of the global economy reduced railway demand, resulting in the closing of numerous local lines and the passing of many of its operations into the government's hands. However, Portuguese railways were not nationalized in the same way as other European countries, and CP continued to be heavily subsidized by the government. After World War II, however, the business environment for railways became even worse. Economic growth and advanced airplane technology allowed airlines to become the favored mode for long distance transportation. Additionally, automobiles became considerably cheaper and captured a larger travel market share. CP was eventually nationalized in 1975 in response to an enormous call to take all major Portuguese industries into the public sector.

Portugal joined the European Union in 1986. As explained in section 4.1, Directive 91/440/EEC (29^{th} July, 1991) brought about significant changes to the railways in Europe. The objective of this directive was to reduce deficits, put railway companies on a viable financial footing and maintain financial sustainability. As a result of the directive which aimed to achieve deregulation, internationalization and privatization, infrastructure and train operations were organizationally separated. In Portugal, railway reforms were carried out in 1997. The national railways CP were divided into an infrastructure company called REFER and a railway operator which kept the name CP. At the same time, the railway regulator INFT was founded with the aim of supervising the relationship between the infrastructure and the operating companies. Even though private operators were encouraged to compete with CP, until the present day only Fertagus has entered the railway market up to now. (Petkova 2006)

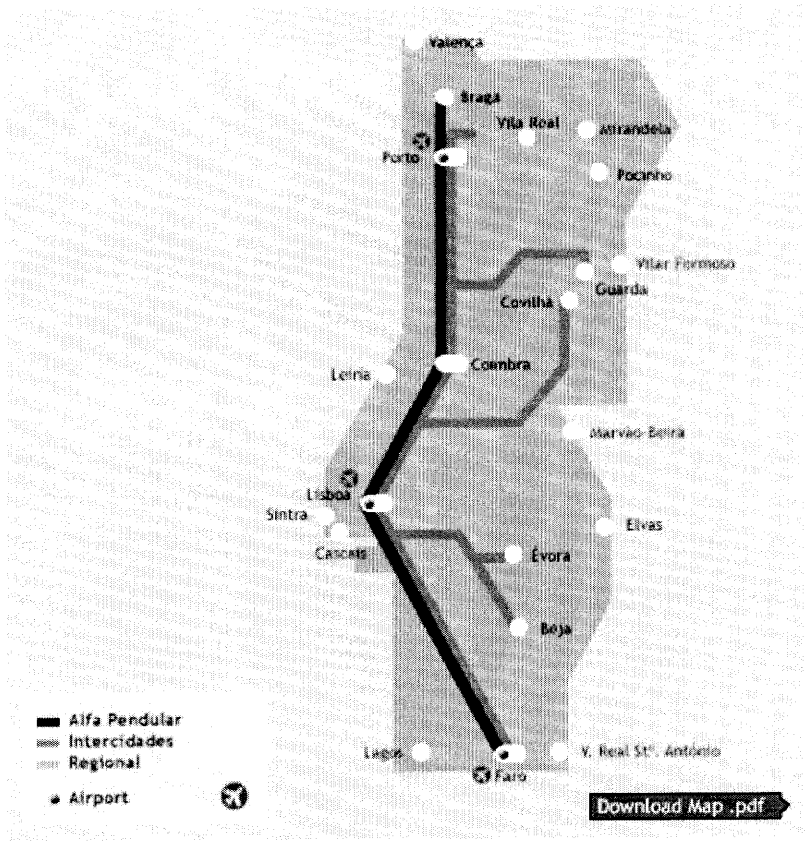

Figure 7-7 National Railway Network in Portugal

Source: CP 2007

The railway network offered by CP can be categorized into two types: national and international. *Figure 7-7* shows the national railway network in Portugal. The Alfa Pendular (AP) is the express railway service inaugurated in 1999 which initially connected Lisbon and Porto. This line was later extended to the cities of Braga (to the north) and Faro (to the south). However, AP trains have not achieved the good performance that the Portuguese had hoped for due to operating and financial problems. *Figure 7-8* shows the current international railway network around Portugal which includes two major lines to Hendaye at the French border, and to Madrid.

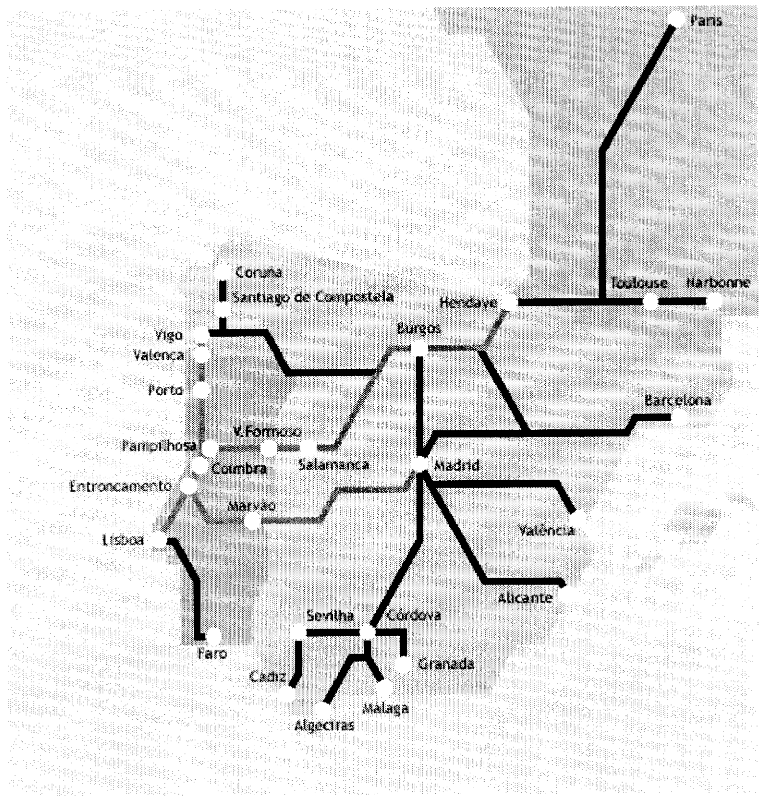

Figure 7-8 International Railway Network around Portugal

Source: CP 2007

High-Speed Railway technology has become a major policy issue in Europe since the early 1990s, and Portugal decided in 1993 to introduce the new railway network. By this decision, Portugal is expected to invest in two new lines for which TGV technology might be used. One is the Lisbon-Madrid line, and the other is the Lisbon-Porto line. Construction is expected to begin in 2008 and will be completed in 2014.

7.2.2 Mapping Stakeholders

The new framework which was defined in Chapter 6 is next applied to the Portuguese case. We will start with the government, employees and the public.

We start with the government as a discretionary stakeholder just as in the Japanese case, and then it should be determined whether the government can become a dominant stakeholder. CP is considered the state owned entity which monopolizes the entire railway network in Portugal because there are few private operators that can compete with CP. The management of CP is greatly influenced by the government both institutionally and financially. This is especially true because the construction of the new high-speed railway network is expected to begin from an initiative by the Portuguese government. It is implied that the influence of the government is stronger than in the cases of other European countries. Thus, the government can be considered a dominant stakeholder. *Figure 7-9* illustrates the mapping of the government.

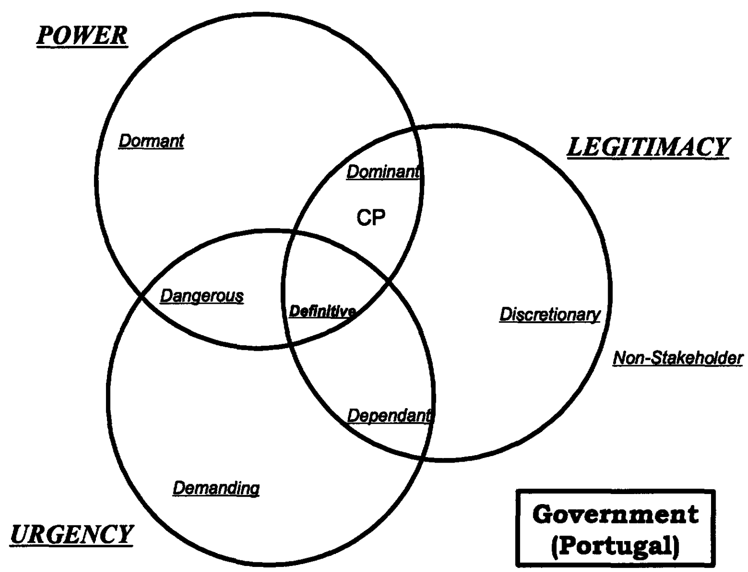

Figure 7-9 Mapping of the Government in Portugal

The position of employees is determined initially by 'Activeness of Unions,' and then by 'Problem Perception'. However, we do not have enough information on these two issues. Even though the railway industry is considered labor-intensive and generally has an active union, we do not know specifically the case of Portugal. Supposing that the union of CP is active enough and employees become a dominant stakeholder, we then have to judge how the new system will turn out. For example, technical failures of the new RM system just as in the case of France would be unacceptable for employees. We cannot reach the single conclusion due to the uncertainty about our determinants. In other words, they could stay as a discretionary stakeholder, or they could eventually move to a definitive stakeholder. However, it might be reasonable to classify them as a dominant stakeholder, assuming that the system technically works well and the other situations are similarity with other European countries. *Figure 7-10* illustrates the mapping of the employees.

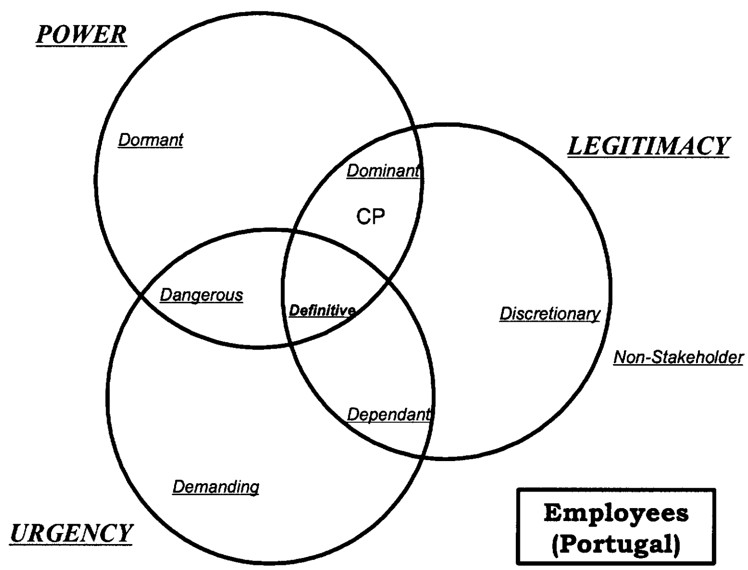

Figure 7-10 Mapping of Employees in Portugal

Three determinants for mapping the public are 'Number of People Affected,' 'Complexity of Fare Structure' and 'Media Support.' The public is initially a discretionary stakeholder, and two determinants tell us whether they move to a dependent stakeholder. The number of people affected by new systems would not be significant in Portugal, considering the current demand for railways. Additionally, the eventual complexity of the new fare structure will depend on the future design of RM systems, so it is uncertain. Thus, the public might stay as a discretionary stakeholder, or might become a dependent stakeholder if the new system turns out to be complex enough to make the public confused. *Figure 7-11* illustrates the mapping of the public.

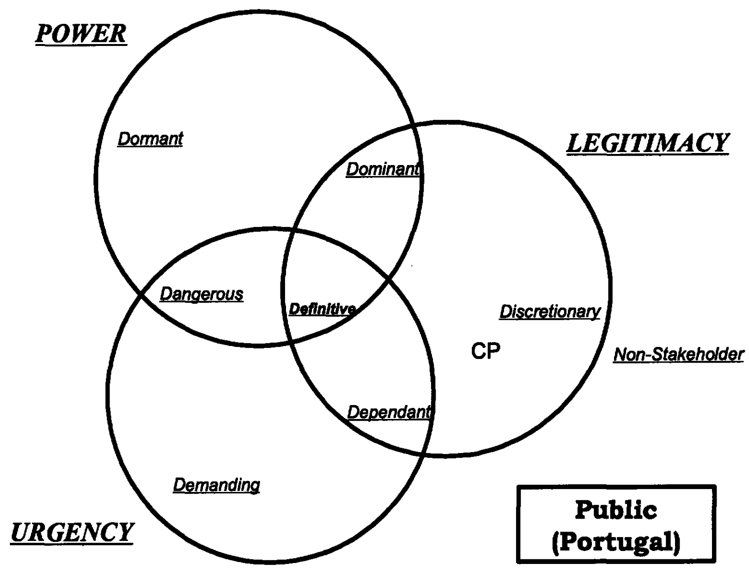

Figure 7-11 Mapping of the Public in Portugal

7.2.3 Implications

Figure 7-12 illustrates the above discussion and shows the stakeholder mapping for Portugal. Even though several uncertainties prevent us from determining key stakeholders, it is anticipated that the government, owners, employees and the public can equally be the key stakeholders. It is implied that high priority stakeholders for CP will change depending on the above uncertainties such as how well the system works technically, and how they design the fare structure for the RM system.

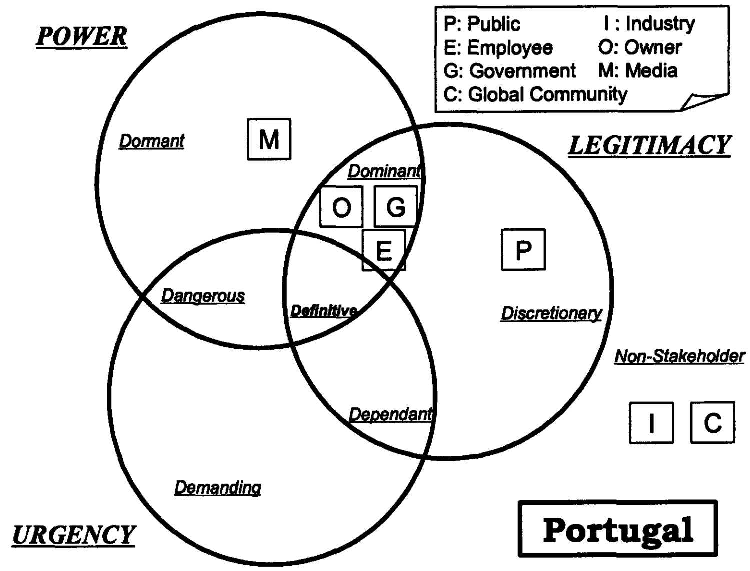

Figure 7-12 Stakeholder Mapping for Portugal

Again, we will discuss 'Implementation Process' and 'Problem Perception' in *Table 6-1* to assess the acceptability of the new RM system in Portugal. Since people do not rely heavily on railways in Portugal, it is implied that even drastic changes in the fare structure might not result in such tremendous confusion as in France and Germany. If that is the case, aggressive RM systems which incorporate simultaneously both effective seat allocations for high demand trains and discount tickets for low demand trains can be introduced quickly.

From the point of view of stakeholders surrounding railway operators, the introduction of RM practices to increase revenues may be more easily justified because they are generally aware that railways have not so far made any profit and that the railway operators want to maintain financial sustainability. In the Portuguese case, the high priority stakeholder is most probably the government. Additionally, discount tickets would make it possible for the public to use the railways at considerably lower cost, and to give them another travel option. This situation should enable RM to be accepted in Portugal. Furthermore, since the transportation policy of Portugal is largely affected by European Union countries, especially Spain due to its geographical location. In that sense, it is possible for global communities to become a low priority stakeholder by acquiring one of three attributes.

7.3 Summary

We have applied the new framework to two new national settings; Japan and Portugal. The analysis which was explained in Chapter 6 and Chapter 7 produced different predictions of RM applicability for the railways in Japan and Portugal. It implies that it might be possible for Portugal, whereas it will be difficult in Japan. There are several uncertainties in the Portuguese case, and we need to update the stakeholder map after such uncertainties become clear.

In the next chapter, we will summarize the whole discussion of this thesis with suggestions on how the acceptability of RM could be improved.

Chapter 8 *Conclusion*

8.1 Conclusion and Recommendation

This research set out to achieve three goals:

- Understanding how Revenue Management (RM) has been implemented in the railway industry.

First, the key concepts of RM were described for practitioners considering adopting RM practices for railways. Managers who intend to introduce RM practices for their own industries have often discussed RM exclusively in the context of applications and techniques, without taking its root concepts into account. Some managers even believe that RM is simply the new computer reservation system with state-of-the-art information technology. This misunderstanding has sometimes resulted in unsuccessful implementations. Instead, RM is the process of segmenting consumers with different "willingness to pay" and of controlling seat allocations continuously. To follow the definition of the former CEO of American Airlines, RM enables companies "to sell the right product to the right customer at the right time for the right price".

Second, it was discussed how RM for railways should be different from RM for airlines. Both conceptual differences and mathematical considerations were presented to better understand variations within RM. Simple adaptations of RM for airlines to other industries would not work well. In the case of railways, we proposed that different strategies should be employed depending on the load factor. One is effective seat allocation to maximize revenue for high demand trains, and the other is appropriately discounted tickets to stimulate ridership for low demand trains.

Third, actual case examples in five countries (France, the UK, Germany, Canada and the US) were showcased from both quantitative and qualitative perspectives. These case surveys were intended to give practitioners with little knowledge a broad insight into how RM strategies were in reality introduced to the railway industry. Additionally, these examples could indicate to us what we should and should not do when introducing RM practices for railways.

- Proposing a new framework which can be used to define an approach for implementing RM.

The case surveys in Chapter 4 showed us that the implementation processes do not necessarily turn out to be effective and do not always achieve the initial goal that policy makers intended. This difficulty comes in part from the fact that railway operators had to deal with several stakeholders at the same time, all of whom had different interests. Stakeholder theory can provide us with one approach to handle such complex relationships among stakeholders. By utilizing the stakeholder salience model which was proposed by Mitchell et al, we constructed a new framework used for implementing RM in various national circumstances. This framework can be useful because 1) it explains why managers of railway operators should consider certain classes of entities as stakeholders; 2) it separates stakeholders from non-stakeholders; and 3) it explains how managers should prioritize stakeholder relationships.

In this thesis, we mainly focused on three stakeholders; the government, employees and the public. Several criteria are used to determine how each stakeholder can be salient to the managers of railway operators. For example, the corporate structure determines the relationship between the railway operators and the government. Employees can be salient for railway operators depending on how active the labor unions are, and to what extent RM implementation can cause problems. Furthermore, the public increases its presence in the eyes of the railway operators if a large number of people are affected by changes in the fare structure, and if it is too complex for the public to understand. Finally, the implementation process and problem perception are two further important criteria for judging the acceptability of RM for several stakeholders.

- <u>Applying the framework to other countries, specifically Japan and Portugal.</u>

The new framework was applied to Japan and Portugal, and it produced different predictions of RM applicability for each railway. Several suggestions can be derived from the application processes to Japan and Portugal.

In Japan, the public is expected to be the stakeholder to whom the railway operators need to pay most attention. Employees can also be such a stakeholder depending on the extent to which the new system places a burden on employees. Since the railways play such an important role in Japan and the public relies heavily on railway operations, it is suggested that the railway operators introduce any RM system step by step. Drastic changes in the fare structure will cause a tremendous disturbance just as in France and Germany. In addition, the case in Germany where most managers in the DBAG's RM Department came from the US airline industry implies that the whole concept of RM should be familiarized not only by the management but also by the employees. That is, the managers of the railway operators need to foster the culture of the RM concept. In that sense, the role of RM analysts who communicate with other departments in the company will be essential.

All major stakeholders can be critical in Portugal, although we were unable to decide the priority exactly because data was lacking. Since people generally do not rely on railways in Portugal as much as in Japan, it might be possible to introduce RM strategies in a quicker way.

8.2 Further Research

While research using quantitative analysis based on mathematical models is relatively abundant, little research on RM has been undertaken which involves qualitative analysis. In this sense, this thesis is designed to bridge the gap between RM researchers and policy makers, with a definite focus on qualitative analysis. As a final remark, suggestions for the direction of further research are presented below.

First, seven stakeholders were distinguished from the viewpoint of railway operators: the Public, the Industries, Media, Global Communities, the Owner, Employees, and the Government. However, while the government is one category, it is the local government, the national government, and policy makers within the Ministry of Land, Infrastructure and Transport (MLIT) of Japan who will take actions to affect the operator's purpose. A more refined definition of stakeholders would produce more precise results, even though the analysis would inevitably be much more complex.

Second, while we used several criteria to create a new framework and applied them to the new national settings as a one-off analysis, it is assumed that more precise predictions would be achieved by recursive analyses. As discussed in Chapter 5, dynamism is one of the important characteristics of Mitchell's model. Any stakeholder can increase or decrease his salience to managers and move into other categories as time goes by. In that sense, it is suggested that this framework should be used repeatedly. The key determinants might change after such recursive processes. Furthermore, first-hand information about the railway industry in each country will produce a better and more in-depth analysis.

As described in Chapter 1, transportation policy and energy policy are closely related topics that should be discussed together. As the most energy-efficient mode of transportation, railway transportation is expected to play an important role around the world in the future. Implementing RM for railways can be one solution for lessening the environmental burden by making better use of the existing railway infrastructure, as well as for allowing railways to be financially sustainable. Integrating both quantitative and qualitative approaches will lead to the successful RM implementation for railways, and I hope this thesis will be used for this purpose.

END

Appendix

Abbreviations and Terminologies

BOAC :	British Overseas Airways Corporation
BR :	British Railways
CAB:	Civil Aviation Board
COTGV :	Center for Operations of TGV
CP:	Caminhos de Ferro Portugueses (Portuguese Railways)
CRS:	Computer Reservation System
DB:	Database
DBAG:	Deutsche Bahn AG
DLP:	Dynamic Linear Programming
EMSR:	Expected Marginal Seat Revenue
GDS:	Global Distribution System
GNER:	Great North Eastern Railway
LCC:	Low Cost Carrier
NEC:	Northeast Corridor
JNR:	Japan National Railway
JR:	Japan Railway
OD:	Origin – Destination
PEP:	Preis- und Erlösmanagement Personenverkehr (Price and Revenue Management for Passenger Transport)
PNLP:	Probabilistic Nonlinear Programming
PRO:	Pricing and Revenue Optimization
RM:	Revenue Management
ROSCO:	Rolling Stock Leasing Company
SNCF:	Société Nationale des Chemins de fer Français (French National Railway Company)
SRI:	Stanford Research Institute
TOC:	Train Operating Company

Bibliography

Agle, Bradley R., Ronald K. Mitchell, and Jeffrey A. Sonnenfeld. "Who Matters to CEOs? an Investigation of Stakeholder Attributes and Salience, Corporate Performance, and CEO Values." *Academy of Management Journal* 42, no. 5 (1999): 507-525.

Amtrak. *Two Pricing Optimization Application at Amtrak: ShareFares, and OneTouch*2006.

Belobaba, Peter P. *Fundamentals of Pricing and Revenue Management*MIT, 2005.

———. "Application of a Probabilistic Decision Model to Airline Seat Inventory Control." *Operations Research* 37, no. 2 (1989): 183-197.

———. "Air Travel Demand and Airline Seat Inventory Management." Ph.D., MIT, 1987.

———. "Airline Yield Management: An Overview of Seat Inventory Control." *Transportation Science* 21, no. 2 (May, 1987): 63-73.

Ben-Akiva, M. and S. Lerman. *Discrete Choice Analysis: Theory and Application to Travel Demand.* Cambridge MA: MIT Press, 1985.

Ben-Khedher, Nejib, Josephine Kintanar, Cecile Queille, and William Stripling. "Schedule Optimization at SNCF: From Conception to Day of Departure." *Interfaces* 28, no. 1 (1998): 6-23.

Berwick, J. and C. Therrien. "Revenue Management at VIA Rail Canada."1997.

Borenstein, S. and N. L. Rose. "Competition and Price Dispersion in the U.S. Airline Industry." *Journal of Political Economy* 102, (1994): 653-683.

Boston Region Metropolitan Planning Organization. *Trans Report.* Boston, MA: Boston Region Metropolitan Planning Organization, 2006.

Campbell, Keith and Edward K. Morlok. "Rail Freight Service Flexibility and Yield Management." *Transportation Research Forum* 2, (1994): 529-548.

Carlucci, Fabio. *Competition in Railways: The Case of United Kingdom*University of Salerno, .

Ciancimino, A., G. Inzerillo, S. Lucidi, and L. Palagi. "A Mathematical Programming Approach for the Solution of the Railway Yield Management Problem." *Transportation Science* 33, no. 2 (May, 1999): 168-181.

CP. CP. http://www.cp.pt2007).

Dana, J. D. "Advance-Purchase Discounts and Price Discrimination in Competitive Markets." *Journal of Political Economy* 106, (1998): 395-422.

———. *Peak-Load Pricing when the Peak Time is Unknown*Kellogg School, Northwestern University, 1996.

East Japan Railway Company. *Annual Report 2006.* Tokyo, Japan: East Japan Railway Company, 2006.

Eisenkopf, Alexander. *Competition between Low Cost Carriers and Railways in Germany*Zeppelin University, .

Elias, Arun A., Robert Y. Cavana, and Aaurie S. Jackson. "Linking Stakeholder Literature and System Dynamics: Opportunities for Research."2000.

Freeman, R. Edward. *Strategic Management: A Stakeholder Approach.* Boston MA: Pitman, 1984.

Freeman, R. Edward and D. L. Reed. "Stockholders and Stakeholders: A New Perspective on Corporate Governance." *California Management Review* 25, no. 3 (1983): 93-94.

Geraghty, M. K. and E. Johnson. "Revenue Management Saves National Car Rental." *Interfaces* 27, no. 1 (1997): 107-127.

GNER. "Company Information." GNER. http://www.gner.co.uk/GNER2006).

Government Accountability Office. *Intercity Passenger Rail: National Policy and Strategies Needed to Maximize Public Benefits from Federal Expenditures.* Washington D.C.: Government Accountability Office, 2006.

Hatano, Linda. *Complexity Versus Choice: UK Rail Fares*Japan Railway & Transport Review, 2003.

Holvad, Torben, John Preston, and Biao Huang. *Review of Introduction of Competition in Railways in Europe*University of Oxford, .

Hopperstad, C. "The Application of Path Preference and Stochastic Demand Modelling to Market Based Forecasting." Hong Kong, 1994.

House of Commons, Transport Committee. *How Fair are the Fares? Train Fares and Ticketing.* London: House of Commons, Transport Committee, 2006.

Japan Railways Group. "Railway Network in Japan." http://www.japanrail.com/.

Kimes, Sheryl E. "Yield Management: A Tool for Capacity-Constrained Service Firms." *Journal of Operations Management* 8, no. 4 (October, 1989): 348-363.

Kraft, Edwin R., Bellur N. Srikar, and Robert L. Phillips. "Revenue Management in Railroad Applications." *Journal of the Transportation Research Forum* 39, no. 1 (2000): 157-176.

Kretsch, S. S. *Airline Fare Management and Policy.* New York: McGraw-Hill Company, 1995.

Lee, A. O. "Airline Reservations Forecasting: Probabilistic and Statistical Models of the Booking Process." Ph.D., MIT, 1990.

Li, Ting, Eric Van Heck, and Peter Vervest. *Dynamic Pricing Strategies for Yield*

*Improvement with Smart Card Adoptation in the Dutch Travel Industry*RSM Erasmus University, .

Lieberman, Warren H. "Debunking the Myths of Yield Management." *Cornell Hotel and Restaurant Administration Quarterly* 34, no. 1 (Feb, 1993): 34-41.

Link, Heike. *PEP - A Yield-Management Scheme for Rail Passenger Fares in Germany*Japan Railway & Transport Review, 2004.

Littlewood, K. "Forecasting and Control of Passenger Bookings." Nathanya, Israel, 1972.

Lorange, P. *Corporate Planning: An Executive Viewpoint*Prentice Hall, 1980.

Manugistics, Inc. "GNER: Implementing the UK's First-Ever Rail Optimization Solution." manugistics. http://www.manugistics.com/documents/collateral/GNER.pdf.

McGill, Jeffrey I. and Van Ryzin, Garrett J. "Revenue Management: Research Overview and Prospects." *Transportation Science* 33, no. 2 (May, 1999): 233-256.

Ministry of Land, Infrastructure and Transport Japan. *Survey on Arterious Passenger Flow.* Tokyo: Ministry of Land, Infrastructure and Transport Japan, 2003.

Ministry of Science, Technology and Higher Education Portugal. *MIT-Portugal Collaboration: Program Overview*. Portugal: Ministry of Science, Technology and Higher Education Portugal, 2006.

Mitchell, Ronald K., Bradley R. Agle, and Donna J. Wood. "Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and what really Counts." *Academy of Management Review* 22, no. 4 (1997): 853-886.

Mitev, Nathalie N. "Electronic Markets in Transport: Comparing the Globalization of Air and Rail Computerized Reservation Systems." *Electronic Markets* 9, no. 4 (1999): 215-225.

———. *A Comparative Analysis of Information Technology Strategy in American Airlines and Frech Railways*University of Salford, 1998.

———. "More than A Failure? the Computerized Reservation Systems at French Railways." *Information Technology & People* 9, no. 4 (1996): 8-18.

Monami, Eric. "European Passenger Rail Reforms: A Comparative Assessment of the Emerging Models." *Transport Reviews* 20, no. 1 (2000): 91-112.

Orkin, E. B. "Boosting Your Bottom Line with Yield Management." *Cornell Hotel and Restaurant Administration Quarterly* 28, no. 4 (1988): 52-56.

Page, Catherine G. "The Determination of Organization Stakeholder Salience in Public Health." *Journal of Public Health Management Practice* 8, no. 5 (2002): 76-84.

Petkova, B. *150 Years of Railway Transportation in Portugal: Birth, Decay and Revival.* Cambridge MA: MIT, 2006.

Preston, John. "Competition in British Railways - what have we Learned?" Aalborg, University of Oxford, August 30th, 1999.

Sa, J. "Reservations Forecasting in Airline Yield Management." M.S., MIT, 1987.

Seidel, Tina, Andreas Matthes, Bernhard Wieland, Bernhard Schlag, Jens Schade, Erik Verhoef, Barry Ubbels, Katalin Tanczos, Agnes Kosztyo, and Ferenc Meszaros. *Political Acceptability and Perceived Legitimacy of Transport Policy Implementation*Transport Institutions in the Policy Process, 2004.

Simpson, R. W. "Setting Optimal Booking Levels for Flight Segments with Multi-Class, Multi-Market Traffic." Hikone, Japan, 1985.

Smith, B. C. and C. W. Penn. "Analysis of Alternative Origin-Destination Control Strategies." New Seabury, MA, 1988.

Smith, Barry C., John F. Leimkuhler, and Ross M. Darrow. "Yield Management at American Airlines." *INTERFACES* 22, no. 1 (January-February, 1992): 8-31.

Talluri, Kalyan and Van Ryzin, Garrett J. *The Theory and Practice of Revenue Management*. Vol. 1. New York: Springer, 2004.

VIA Rail Canada. "VIA: Financial Viability." VIA Rail Canada. http://www.viarail.ca/corporate/en_entr_viar.html.

Weatherford, Lawrence R. and Samuel E. Bodily. "A Taxonomy and Research Overview of Perishable-Asset Revenue Management: Yield Management, Overbooking, and Pricing." *Operations Research* 40, no. 5 (Sep-Oct, 1992): 831-844.

Weber, M. *The Theory of Social and Economic Organization*. New York: Free Press, 1947.

West Japan Railway Company. *Annual Report*. Osaka, Japan: West Japan Railway Company, 2004.

Williamson, L. Elizabeth. "Airline Network Seat Inventory Control: Methodologies and Revenue Impacts." Ph.D., MIT, 1992.