Analysis of Revenue Management Performance in the Hotel Industry

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ABSTRACT

Revenue Management (RM) is an important tool for matching supply and demand by segmenting customers into different segments based on their willingness-to-pay and allocating scarce capacity to the different segments in a way that maximizes firm revenues. The benefits of RM are well accepted in the hospitality industry, and the technical aspects of RM form a rich analytical research stream. However, the research is missing a holistic examination of important elements of effective RM. The literature shows that market segmentation, pricing, forecasting, capacity allocation, IT use, organizational focus, aligned incentives, organizational structure, and education and training contribute to effective RM. The researcher groups these elements into two concepts: RM technical capability and RM social support capability and propose that these nine elements positively impact RM performance, and develops scales to measure the constructs and collect responses in the hotel industry. This survey yields interesting results. In line with expectations, the researcher finds evidence that forecasting and organizational focus positively impact RM performance. On the other hand, the results show evidence that improved organizational structure negatively impacts RM performance.

INTRODUCTION

Companies use Revenue Management (RM) to successfully balance supply and demand and increase profits. To name a few, American Airlines credits RM with increasing revenue by $1.4 billion over three years (Smith et al. 1992) and National Rental Car saw a $56 million revenue increase due to RM (Geraghty and Johnson 1997). In general, most firms attribute a 3 – 7 % increase in profit after implementing RM (Cross 1997: pg 4).

Success stories such as these are not typical of all users; not all users of RM achieve the same magnitude of gains (Lieberman 2003). What drives these performance differences? Judging by the focus of the academic literature, the performance differences could result from the fundamental capacity allocation algorithms – over 75 papers have been published on this topic in the last twenty years. However, based on interviews with leading RM software providers and users, some users, including many in the hotel industry, have been reluctant to implement new algorithmic improvements in their RM systems. In fact, the basic capacity allocation algorithm used in the RM systems of the major hotel chains was developed in the late 1980's (the EMSR-b heuristic by Belobaba (1989). This happens despite the fact that a rich stream of research on improved algorithms has appeared since this time. A possible reason for this reluctance to adopt new algorithms, often proposed by this group of users, is that potential improvements from better algorithmic performance are small compared to other opportunities.

It has been proposed that these other improvement opportunities include "soft" skills and other technical skills beyond algorithmic improvements. The researcher identified and defined these possible RM success drivers, then test how they impact firm performance. More generally, tired to answer the following two research questions:

1. What are the primary skills necessary for effective use of RM?
2. How do these skills impact RM performance?

To better understand the antecedents of RM success, the researcher conducted an exploratory, empirical study to determine what drives the differences in RM performance.

This research examines the factors which differentiate performance levels within RM. This research contributes to theory by incorporating concepts across disciplines for a complete picture of necessary elements for RM success. This research also contributes to practice by empirically testing how the different RM skills impact RM, and the limits of different RM skills. From a managerial perspective, this research provides evidence for essential building blocks in RM implementation and operations. This evidence applies to the hotel industry, and has potential to apply to other industries.

LITERATURE REVIEW

Operations Management Literature

The operations management field has made significant improvements in capacity allocation algorithms, improving from single-leg (Littlewood 1972, Belobaba 1989, Curry 1990, Wollmer 1992, Brumelle and McGill 1993, Robinson 1995, Van Ryzin and McGill 2000) to network control (Dror et al. 1988, Curry 1990, Talluri and Van Ryzin 1998, Cooper 2002). Modelers in this area continue to produce more complex and complete models. Some airlines incorporate aspects of these advanced models into practice (Vinod 2006). This literature stream indicates that capacity allocation plays an important role within RM systems. However, most hotel RM systems today use EMSR-b (Belobaba 1989), a method developed by Belobaba in the 1980's, instead of a more advanced method (Steve Swope, personal communication, February 2006). It has been proposed by some RM experts that many hotels have not adopted updated allocation algorithms because potential return on other investments is larger than potential return on upgrading algorithms. This stream guides us to examine how capacity allocation impacts RM performance.

Pricing in revenue management is also a large and growing research stream. Bitran and Caldentey (2003) summarize analytical modeling research in this area. The core model assumes price is a function of inventory (or capacity) and time until the product perishes (Bitran and Caldentey 2003). From these basic assumptions, researcher has discovered how to optimally price products given constraints on pricing functions for a single product with deterministic demand (Bitran and Caldentey 2003).

Marketing Literature

RM crosses two functional disciplines: operations management (OM) and marketing. The marketing function within firms typically controls pricing decisions and bases these decisions on the firm's strategy. A firm may want to set prices to survive, or to maximize profit, revenue, sales growth, or market skimming (Kotler 1998). Depending on the firm strategy, upper and lower price bounds may be set to accomplish these strategies. Within these bounds, a firm must consider three C's in order to set an actual price: cost, competitors' prices, and customers' assessment of the product (Kotler 1988).

Many firms do not possess the knowledge and processes to consistently translate these factors into optimal or near-optimal pricing decisions (Cressman 1997, Smith 1995, Ross 1984) and therefore pricing can be a key competitive advantage (Monroe 2003, Dutta et al. 2003).

Marketing researchers have also investigated market segmentation and concluded that six characteristics determine the desirability of a segmentation: identifiability, substantiality, reachability, stability, responsiveness, and actionability (Frank et al. 1972, Loudon and Della Bitta 1984, Baker 1988, Kotler 1988). Identifiability is defined as the extent to which distinct groups of customers can be recognized in the marketplace by using specific segmentation bases. Substantiality measures whether the targeted segments represent a large enough portion of the market to ensure the profitability of targeted marketing programs. Accessibility measures the degree to which the targeted segments can be reached through promotional or distributional efforts. Responsiveness measures the extent to which segments respond uniquely to targeted marketing efforts.

Organizational Behavior Literature

The organizational behavior literature provides the basis for many of our RM performance drivers. Throughout the management literature, researcher asserts that organizational structure affects organizational performance (Van de Ven 1976, Hall 1977, Dalton et al. 1980, Galbraith and Lawler 1998). Many support the contingency view, which says that organizational structure must fit with firm strategy, the external competitive environment, and other factors (Lawrence and Lorsch 1967, Galbraith 1977, Ruekert et al. 1985, Nadler and Tushman 1997, Russo and Harrison 2005). Scholars consistently agree that there is no one ideal organizational structure for all organizations (Galbraith 1977, Mintzberg 1980, Van de Ven and Drazin 1985, Galunic and Eisenhardt 1994, Gresov and Drazin 1997).

Equifinality suggests that there is no one magic structure and even a good proposed structure has shortcomings that an alternate structure may counter-balance. This theory suggests flexibility in designing high performing

organizations (Gresov and Drazin 1997). Even though researchers do not agree which organizational structure is best, they do agree that organizational structure impacts performance. Based on this and work from the hotel literature, we include organizational structure in our research and measure how it impacts performance.

Antecedents to Success Literature

In a more general grouping, research concerning attributes which impact success of a new program, process or change, consistently includes elements such as executive commitment and education and training. This literature spans across disciplines and our review is by no means exhaustive, but representative of a consistent theme. A metaanalysis of executive commitment shows positive influence of management commitment on program success (Rodger et al. 1993). Similar evidence for a positive relationship between executive commitment and the success of a given program or process is found in the research on total quality management (Ahire et al. 1996, Jun et al. 2006), enterprise resource planning (King and Thompson 1996, Stratman and Roth 2002). Additionally, total quality management programs find the same results (Ahire et al. 1996, Jun et al. 2006). This literature reinforces the necessity of both executive commitment and education and training on new programs.

Hotel Literature

Kimes (1989) described the concept of RM and the industry characteristics which make an industry conducive to RM implementation. Both the work of Jones and Hamilton (1992) and Donaghy et al. (1997) yield valuable information about steps needed for successful RM implementation within the hotel industry. Neither, however, had rigorous methodology supporting their claims. Farrell and Whelan-Ryan (1998) used a semi-structured interview process to gather data from over 50 hotels to support their proposed model of best implementation, including an education and training step and the development of a [RM] culture. Hansen and Eringa (1998) review the existing hotel literature to summarize critical success factors, which we include in our RM drivers. Brotherton and Turner (2001) conduct a case study of a RM implementation, including delineation of success factors. Manzier (2004) describes RM implementations in hotels in general, including areas for implementation improvement. Importantly, he describes the differences between the airline industry and the hotel industry, which explains some significant differences between hotel and airline RM implementation.

THEORY DEVELOPMENT

Many firms have achieved increased profitability due to RM, however, all firms do not achieve the same level of profitability improvements. This difference is due to a combination of technical and social support skills embedded within a company. RM research within the Operations Management (OM) field has concentrated on technical aspects of RM: forecasting, capacity allocation, and pricing. However, these elements alone cannot guarantee superior performance. Other non-technical, or "social support" elements aid performance by reinforcing and encouraging advanced technical skills and improved decision making skills. This claim is supported by socio-technical systems (STS) theory.

STS theory suggests that systems should not dictate how people work, but instead should support and facilitate people in their jobs (Trist and Bamforth 1951, Emery 1959). For a system to work well, all elements should complement each other and align with overall goals. Alignment of structure and support consistently appears in empirical studies within the OM field. For example, Ahire et al. (1996) draw on the existing Total Quality Management (TQM) literature to develop comprehensive, valid scales for an "integrative QM philosophy" (Ahire et al. 1996: pg 23). Building on the previous literature, their scales include both technical and social support constructs in TQM systems, which work together for the most effective results. Similarly, the ERP literature supports the concept that technical and social support systems must align to achieve the most effective results (King and Thompson 1996, Stratman and Roth 2002). This previous work on program implementation supports the notion that RM should be integrated into an organization to maximize its impact.

RM Technical Capability

After grouping customers into segments, a firm must set prices for each segment. The researcher defines pricing as the process of setting rates to try to extract the optimal revenue from the firm's customers (Dutta et al. 2003, Vorhies and Morgan 2005). RM yields higher revenue to firms because of the ability to charge some customers higher prices than others. However, setting prices wisely has never been an easy task. A manager must consider the value of the good to the customers, the competitors' prices, the customer price elasticities, and many other factors (Monroe 2003). Many of these variables are either unknown to the firm or constantly changing, thereby increasing the difficulty of setting prices. Regardless of the complexity of pricing, it is a critical element of RM (Jones and Hamilton 1992, Bitran and Caldentey 2003, Talluri and van Ryzin 2004, Preslan and Newmark 2004, Phillips 2005) and therefore we include it as one of the constructs of RM technical capability.

Practitioners make RM decisions based on huge amounts of data stored, cleaned, and analyzed within an IT system and therefore we include IT as a part of RM technical capability. The researcher defines IT as the hardware, software, and people necessary to configure and maintain information systems in support of the business (adapted from Stratman and Roth 2002). Firms must use IT resources well to successfully use RM. Firms are able to segment markets, understand consumers' price elasticity, and allocate capacity more effectively, due in a large part to the data and programs within an IT system (Talluri and van Ryzin 2004: pg 5). While users must apply their own expertise and adjust system recommendations judiciously, IT facilitates the decision process which relies on detailed analysis of sizable data in RM applications.

While it may seem obvious that IT improves RM performance, the impact of IT on performance has been questioned in the past. The term "productivity paradox" has been used often to describe investments in Information Technology unaccompanied by expected increases in productivity (Brynjolfsson and Hitt 1996, Brynjolfsson and Hitt 1998, Carr 2003). However, some researchers have generally shown that IT capability, when used to enhance and complement firm core competencies, can be a competitive advantage for a firm (Brynjolfsson and Hitt 1996, Bhardarwaj 2000, Dedrick et al. 2003, Bhatt and Grover 2005, Ravichandran and Lertwongsatien 2005). Bharadwaj (2000) and Ravichandran and Lertwongsatien (2005) found that IT capability can provide competitive advantages to firms. Whereas the physical assets of IT can be easily imitated, the knowledge to apply IT assets to a specific business are much more difficult to imitate. This research guides us to think of IT as an enabling component of overall firm performance.

RM Social Support Capability

Most OM modeling research simplifies situations by assuming that employees responsible for a process or system act consistently and rationally and are not a driving factor in whether or not a system succeeds (Boudreau et al. 2003). This generalization includes RM modeling research. However, employees involved in a system have been shown to be a major factor in whether or not a system or initiative works within the OM field (Bendoly et al. 2006). This holds true within RM; those that implement RM contend that RM employees determine RM success or failure (Yeoman and Watson 1997, Farrell and Whelan-Ryan 1998, Hansen and Eringa 1998, Ingold et al. 2000, Talluri and van Ryzin 2004: pg 16). We fill a gap in RM research by incorporating processes and policies which impact employee behavior through the overall concept of RM social support capability.

The hotel-based literature also supports the importance of organizational structure in RM (Kimes 1989, Hansen and Eringa 1998). This literature suggests that persons responsible for RM decisions should have a respected voice within the organization and enough authority to create change. Although it is agreed that organizational structure affects organizational performance, scholars struggle to reach a consensus of what organizational structure will most benefit performance. In fact, scholars consistently agree that there is no one ideal organizational structure for all organizations (Galbraith 1977, Mintzberg 1980, Van de Ven and Drazin 1985, Galunic and Eisenhardt 1994, Gresov and Drazin 1997).

Contingency theory explains that different size firms in different industries have specific needs and a given firm with a specific set of contingent factors should follow a prescribed best organizational structure (Drazin and Van de Ven 1985). Contrasting contingency theory, equifinality theory proposes that a given level of organizational

performance may be reached through many different organizational structures, even if firms have similar competitive pressures and internal processes. Equifinality suggests that there is no one magic structure and even a good proposed structure has shortcomings that an alternate structure may counter-balance. This theory suggests flexibility in designing high performing organization (Gresov and Drazin 1997). This reinforces our statement that it is difficult to agree to one best organizational structure. In alignment with others, we believe organizational structure influences RM performance as part of RM social support capability.

METHODOLOGY

Performance Measures

Not only do hotels measure RM performance on a hotel specific basis, but hotels measure RM performance using a standardized, objective performance measurement. Even though perceptual performance measurements could be used (and we do measure these as well), an objective performance measurement eliminates respondent bias. More specifically, we use a hotel's ranking within its competitive set to determine its RM performance. We explain this further. Hotels measure their RM performance through RevPAR (Revenue Per Available Room). Hotels also define a competitive set (comp set) of hotels to their own – these are similar service level hotels within the same geographic area. An independent third party firm named Smith Travel Research (STR) aggregates this information and reports performance measurements, compared to the hotel's competitive set, back to the hotels. STR calculates a RevPAR index = RevPAR*i* / RevPAR (comp set) (100), where *i* = the hotel in question. A firm with a RevPAR index over (under) 100 generated more (less) than their fare share of revenue. The RevPAR metric controls for hotel service levels and outside economic factors, so we do not further control for these effects. STR ordinally ranks all hotels within their competitive set so that the hotel with the highest RevPAR index is ranked first, the second highest is ranked second, and so forth. Because the number of hotels within a competitive set varies, we normalized rankings so performance ranges between 0 and 1.

Data Description

The researcher collected data from U.S. hotels within 3 different parent hotel companies which use RM. Three different service levels of hotel are included in the survey: luxury, upper mid-scale and mid-scale. Data was collected via a web-based survey. An executive within the parent hotel company contacted potential respondents via email. The email explained the survey purpose and importance and requested the on-site revenue manager participate through a web link to the online survey. Participation was voluntary. The executives sent 2132 email requests. 216 surveys were returned, for a response rate of 10.1%. See Table 2 for a specific distribution of our sample population. Out of the 216 returned surveys, 166 were complete, including objective performance data.

Construct validity

Construct validity includes unidimensionality, reliability and convergent and discriminant validity. This section describes how we measured each of these dimensions of our measurement scales. Unidimensionality refers to "a single trait or construct underlying a set of measures" (Gerbing and Anderson 1988: pg 186) and is essential for valid scales (Gerbing and Anderson 1988, O'Leary-Kelly and Vokurka 1998, Ahire et al. 1996, Ahire and Deveraj 2001). O'Leary-Kelly and Vokurka (1998) recognize Confirmatory Factor Analysis (CFA) as the preferred method to test for unidimensionality. We created two measurement models: one for technical RM capability and one for social support capability. We created two models because our sample size was not large enough to test the entire model simultaneously. The literature (Bollen 1989, Hatcher 1994) considers a model to have good fit if indices are greater than or equal to 0.90. Using CFA, the RM technical capability model yielded fit indices of GFI = .90, NNFI = 0.87, and CFI= 0.90, indicating that the market segmentation, pricing, forecasting, capacity allocation, and IT scales all exhibit unidimensionality.

The RM social support capability model for CFA yielded unfavorable fit indices, with items of given constructs more closely relating to other constructs. Although CFA is the generally the preferred method to test for

unidimensionality in confirmatory research, some researchers argue that exploratory factor analysis (EFA) is more appropriate for exploratory research (O'Leary-Kelly and Vokurka 1998).

Reliability is the second component of construct validity. Reliability is the degree to which items within a given construct vary together and shows the consistency of that given construct. Nunnally (1978) concludes that scales should have an alpha level of 0.70 or higher to be considered reliable. However, Hair et al. (1998: pg 118) state that exploratory, early research scales with $\alpha > 0.60$ are satisfactory.

RESULTS AND DISCUSSION

Objective Performance Regression Results

The researcher analyzed the hotel sample using regression to find relationships between RM drivers and performance, based on our objective RevPAR measure. A multinomial logit regression model (MNLM) captured the relationship between RM drivers and our objective performance measurement, while a linear regression model captured the relationship between RM drivers and our perceptual performance measurement.

A linear regression model would be the most straightforward model to test the relationship between our proposed RM drivers and objective RM performance. However, a linear regression model is inappropriate for our objective performance data for two reasons. First, a linear regression model does not allow us to set bounds on the dependent variable. However, our objective performance metric is bounded by (0,1] and because we defined "1" as the best performance a hotel can achieve, an answer greater than 1 would not make sense. Therefore, a linear regression model can return nonsense answers. Second, the linear regression model requires the dependent variable to be a continuous variable. Our objective performance metric is not a continuous variable; a given hotel can only achieve one of a handful of discrete values. Because we violate these assumptions inherent to a linear regression model, we look to other models.

Even though we did not use the linear regression model, we did test for multicollinearity. The variation inflation factor (VIF) was less than 3 for every independent variable. Variables with VIF less than 10 are not considered a collinearity problem (Belsley, Kuh, Welsch 1980). Another indication of collinearity can be found by looking at condition indices and estimated proportion of variance from each principal component (Belsley et al. 1980). Principal components with high condition indices and strong contributions (> 0.5) to the variance of more than one variable can signal multicollinearity. There was no evidence of ulticollinearity based on this diagnostic.

Organizational Focus Discussion

Results indicated an increase in organizational focus decreases a hotel's chance of being in group E, but does not change a hotel's chance of being in any other group. In other words, a hotel may need to increase organizational focus to rise out of the E group, but there is no evidence that further increases will help that hotel rise to greater performance levels. We measure organizational focus with items including enthusiasm from management, an understanding across various levels and roles of how to improve revenues, and support for long-term decision-making. One could interpret this result to say management should invest resources to improve the awareness of the discipline of RM in order to form a foundation for improved RM, but focus on organizational focus alone will not help a hotel achieve the highest levels of performance; a hotel must improve in other areas to achieve further performance gains.

Forecasting Discussion

The top hotels (A hotels) differentiate themselves from all other hotels through increased forecasting abilities. Intuitively, accurate forecasting should play a fundamental role in RM. Forecasts directly impact the optimal capacity to allocate for high value customers. This capacity allocation (and subsequent sales at high prices) lies at the heart of RM and increases revenue. The data show that the best hotels within a competitive set show significantly higher forecasting ability than the lower ranked hotels. The competitive landscape bounds hotel prices and therefore hotels cannot differentiate themselves on price. Instead, they must differentiate themselves based on the amount of rooms sold to higher paying customers. This is achieved by reserving the right number of rooms, which is accomplished through accurate forecasting.

Perceptual Performance Regression Results

In addition to performing analysis using objective performance data, the researcher also analyzed perceptual performance data. Although objective performance data is preferable to perceptual performance data because of its unbiased nature (Dess and Robinson 1984), it is useful to collect perceptual data in case the objective data has a low response rate and in order to compare and contrast the results. The linear regression model with perceptual performance as a dependent variable has an R2 equal to 46.4%. Forecasting, aligned incentives and organizational structure all prove to be positive and significant predictors of performance.

CONCLUSIONS

The researcher has developed a framework which postulates relationships between the elements of RM technical capability, RM social support capability, and RM performance.

This framework incorporates the technical skills of market segmentation, pricing, forecasting, capacity allocation, and IT use. Additionally, it incorporates the social support infrastructure of organizational focus, organizational structure, aligned incentives, and training and education. This framework allows both researchers and practitioners to view RM problems with a broader lens than traditionally used, allowing a more complete picture of the RM problem.

In addition to a theoretical framework, the researcher developed scales to measure and test

this framework. The researcher has conducted limited empirical research in this area, so scales did not exist previously. This initial scale development effort provides a foundation for further research.

The hotel analysis with perceptual performance measurement showed evidence that improved forecasting, organizational focus, and aligned incentives positively correlate with improved performance. These results tell researchers how managers perceive the RM skill level and RM performance of their hotel. Additionally, it provides support for the theory that both technical and social support capabilities impact RM performance.

In summary, the researcher has proposed a more holistic lens with which to view a RM system, which includes both technical and social support aspects. We developed scales to measure our proposed constructs and tested our theory within the hotel industry. Our data consistently support the idea that both technical and social support skills contribute to performance. We have also shown how organizational focus, organizational structure, and forecasting contribute to and differentiate various performance levels of hotels. This paper is the first (to the authors' knowledge) to empirically test RM performance drivers across a large sample size. This work contributes to the academic literature by empirically testing if the RM elements suggested by the academic literature impact RM performance. Furthermore, this work combines both technical and social support skills. Previous work tended to look at one or the other in isolation. This work suggests that both are important aspects of RM success. The existing rich analytical research stream has provided many insights. We argue that it needs a parallel, and supporting empirical stream to test and validate the existing theories.

This research contributes to the practitioner literature by quantifying how individual aspects of a RM system impact RM performance. This information will aid managers in allocating resources to improve their RM performance.

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