Revenue Management in the Service Industry: Research Overview and Prospect

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Abstract—**With service economy time coming, the service industry is playing an increasingly important role, meanwhile the research of Services revenue management is moving frontier rapidly. On the base of consulting large amount of relative literatures, this article shows the western progress of research on revenue management in the service industry and sums up the domestic studying actuality. Finally this article gives the prospect of researches in the future.**

Keywords-service industry; revenue management; research overview

I. INTRODUCTION

Revenue Management is a new management theory developed on the basis of the supply and demand management theory, derived from marketing, operations research, group theory, decision theory, information science, managerial economics, forecasting techniques, statistics, mathematics programming , put forward its new issues in this field.

Revenue management with systematic theoretical foundation and advanced technical methods was first created and widely used in airline industry abroad. With the theory and application of revenue management in airline industry got a great success, revenue management theories and methods started applied to hotels, freight, car rental, tourism and other areas. With the expansion of applications, services revenue management becomes an important area of research in the management academia. In mainland, there are still no systematic empirical research and theoretical framework, so in terms of theory and practice it is a ground-breaking work. The Management Department of National Natural Science Fund committee in 2009 proposed "services revenue management research (G0103)" as one of 15 key projects. [1]

This paper reviews the progress of western services revenue management theory in hope of that the domestic theorists and practitioners to learn from the mature Western theories and methods, but also hope that through awareness of the status of the domestic research, as well as recommendations for future research directions, to promote service revenue management theory research deeply and innovational.

II. THE PROGRESS OF WESTERN SERVICES REVENUE MANAGEMENT THEORY

Though Services revenue management theory has been made for 40 years , but the real study of them is from the 20th century, early 90s. This new theory, after nearly 20 years of research and development, its connotation and extension are constantly developing, theorists did not form a common understanding or a complete system of the subject, but in some aspects of the theory have had a number of research results [2]. Services revenue management theory is gradually formed and developed with Western management service features and service management knowledge understanding and undergoing following three stages.

A. The ground-breaking period (20th century, late 70s-the late 80s)

Revenue management can be traced back to the 20th century, 50s-60s, but not until the later of 70,20th century, the U.S. government deregulated civil aviation, the U.S. civil aviation passenger transport industry has experienced an unprecedented fierce competition, which encouraged rapid development of the theory of revenue management. The late 70s 20th century, American Airlines first developed and used revenue management system, in the early 90s 20th century, under the environment of the general loss in the air transport industry, they created a record of revenue growth by 6% in a year. In the four years from 1989 to 1992, they received nearly 2 billion dollars in revenue, caused concern and imitate by the world's major airline companies. Belobaba (1987) [3] pointed out that through the application and implementation of revenue management, the airline industry revenue can be improved by 5 percent or even higher. Since then, American Airlines, KLM Royal Dutch Airlines, Lufthansa German Airlines, Canadian Airlines International and so on have applied revenue management systems, the average annual income growth reached 3% -5%. Through the use of revenue management systems, the United Auto Leasing company increased revenues by 56 million dollars in the first year, not only pull the company from the brink of liquidation, but also renewed vitality in operations. In the early 90s 20th century, the Marriott hotel in the United States take the lead in the hotel industry to introduce revenue management system, then the hotel's sales revenue has increased by 7% in the same year, with only a small change in the cost of expenses, such increased revenue almost entirely converted into profits,

accounting for 50% of hotel profits. The great achievements Revenue management got in aviation, hotels and other service industries, raised academic and business notice, and revenue management start as an independent branch of management to conduct cross-disciplinary study based on the success in other industries like leasing and tourism[4].

The first pioneer work is marginal seat revenue rules raised by Littlweood (1972) [5] and applied to single route segment, two levels of airline seat reservation and space distribution, and Rohtstein's (1974) [6] over-booking policy . The starting point for the revenue management study is that Belobaba (1987[3],1989[7]) established the probability model and propose EMSR (Expected Marginal Seat Revenue) Rules apply to American Airlines.

B. The initial formation period (20th century, the end of the 80s - the late90s)

In the 90's, the service revenue management as a discipline began to be studied , the researchers began trying to conduct a comprehensive definition of it, and they proposed characteristics of industries that services revenue management is applicable, initial constructed conceptual model and framework for services revenue management.

Kimes (1989) [8] pointed out that revenue management is sell the right products to the right customer at the right time, right place with right price. American Hotel and Motel Association(AHMA) believes that revenue management is a series of demand forecasting techniques, used to determine the price up or down and whether to accept the booking request or not , in order to maximize revenue. Weatherford and Bodily (1992) [9] defined the product of fixed number and price-sensitive and over period would lose its value as perishable assets, and proposed perishable asset revenue management concepts. Lieberman (1993) [10] pointed out that revenue management is a management tool, it increase revenue and customer service capabilities through a combination of information systems, technology, statistics, organizational theory, business experience, knowledge, and thus generate income. Jauncey et al (1995) [11] indicated that revenue management related to maximize revenue, by the management of product prices, given the forecast demand patterns, to achieve maximum income. Dnogahy et al (1995) [12] also pointed out that revenue management is a tool to maximize the return, aimed at increase net income by selling products to different types of subdivision customers at the best price. Desriaju et al (1999) [13] suggested that revenue management is to achieve the full capacity usage and create maximum profit, which can use computer systems to define more complex pricing rules.

During this period there have been almost one hundred literatures studied on the theory and application of revenue management from different industries or different perspectives in the same industry,. Among this literatures, Weatherford and Bodily (1992) [9] review the literatures of studies of general perishable products revenue management. Van Westering (1994) [14], Kimes (1998) [15] and other scholars proposed seven important characteristics of applicable industries of the theory, after long-term study on the applications of revenue

management theory in industries such as air, hotel and catering. Donaghy et al (1995), [12] reviewed the study of corresponding stage, Robert G. Cross (1997) [16] proposed seven core essence to more fully reflected the nature of revenue management, McGill and Van Ryzin (1999) [17] gave a comprehensive overview of the development of revenue management (early most known as the Yield Management) in recent 40 years, their article gathered a lot of references of revenue management research.

C. In-depth study period (late 20th century, 90 - present))

The late 90s the 20th century, the world's economic developed rapidly, the researchers no longer stayed in the general description, many well-known economists, operations research, management scientists, transportation experts had joined the field of study and made great achievements. During this period the Western study of the services revenue management theory focused on the following three directions [18].

1) Conducted in-depth studies on the framework for services revenue management system, and focused on methods and models vertically (deep) research in four core elements of the system: demand forecasts, pricing strategies, inventory control, and overbooking, and in the direction to the network revenue management research. Such as Brumelle and Walczak (2003) [19], Anjos, etc. (2004) [20], Zhang and Cooper (2005) [21], Cooper, etc. (2006) [22], Mukhopadhyay, etc. (2007) [23], van Ryzin and Vulcano (2008) [24], Currie et al (2008) [25], and so on.

2) Concerned about horizontal research of the relationship between revenue management and other management method, including revenue management and customer satisfaction, price guarantees, price bid management, online auctions, risk management, production and project management, e-commerce and competitive analysis in revenue management, etc. Related research can be found in Boyd and Bilegan (2003) [26], Netessine and Shumsky (2005) [27], Pinder (2005) [28], Cooper and Gupta (2006) [29], Levin, etc. (2007) [30], Caldentey and Vulcano (2007) [31], Lindenmele and Tscheulin (2008) [32].

3) Promote relatively mature aviation industry theory to other industries, and carry out surveys and case studies in different industries. A large number of researchers more inclined to use empirical, quantitative research methods, and try to explore theories and methods of different industrial applications, including the hotel industry, air cargo, telecommunications, retail, rental industry and the different characteristics of producing enterprises' revenue management research. The relevant literatures have Weatherford and Kimes (2003) [33], Slager and Kapleijns (2004) [34], Kimes and Thompson (2005) [35], Netessine, etc. (2006) [36], Lindenmeier and Tscheulin (2007) [37], Kimes (2008) [38], Gallego, etc. (2008) [39].

During this period, overseas mainly classic literatures on revenue management are: Elmghraby and Keskinoeak (2002) [40], Bitran and Caldentey (2003) [41], Talluri and van Ryzin (2004) [42], they all completely described the related revenue

management research content, research status and future research directions.

III. DOMESTIC RESEARCH STATUS

Domestic revenue management research are covered each aspect, which can be divided into three aspects, the introduction and absorption of the theory, the promotion outside the industries and local part deepening, but mainly focused on both the introduction and absorption, and promotion outside the industries [15]. **The introduction and absorption,** the current research results in most cases are extension of the foreign existing models, lacking new models in accordance with domestic reality; **Promotion outside the industries**, research results do not combine with the domestic reality, many research results has not been able to get really used, such as research revenue management apply in the hotel industry, railway transportation, car rental industry, the shipping industry and other industries, most remain in the general description, there still a lot to do to further in-depth research.

Local part deepening, although few literatures, but reflect the high academic standards of domestic researchers, the current published research focused on pricing strategy, and demand forecasting techniques, inventory control technology and overbooking problems were relatively rare. In the literatures from China Journal net, the literatures about **pricing strategy** are less than 40, which related to the airline industry, hotel industry, tourism, telecommunications, maritime industry and the electricity supply industry and other service industries. There are not only strategy studies but also model researches. Typical studies are XIAO Yong-bo, etc. (2008) [43], Wei Yi-hua, et al (2008) [44], YANG Hui and Zhou Jing (2006) [45]. More than 10 literatures research on **demand forecasting techniques**, mainly for the aviation industry. Representative researches are Guo Peng, et al (2008) [46], Wang Bin and Zhang Jinlong (2008) [47], Guo Hui, et al (2008) [48]. The literature in **Inventory control techniques** are less than 20, early the literatures are main introduction and overview, concentrated in the airline industry and the freight industry. In 2005 inventory control model began to emerge, mainly include Zhang Wen and FAN Wei (2008) [49], Bu Xiangzhi, et al (2008) [50], Luo Li and Wang Nianxing (2005) [51]. The literature of **Overbooking problem** less than 10, focus on static control of single class, mainly contain Heng Hongjun and Yang Jue (2005) [52], Li Bingzhou, etc. (2006) [53], Li Jinlin and Wang Min (2007) [54]. In addition, the comprehensive combination of both **pricing strategy and the inventory control technology** in the country also occasionally appear, and relatively literatures are rare. Representative are Li Xiaohua and Xiao Bochun (2004) [55], Chen Xu (2005) [56].

Domestic literatures reviewed revenue management mainly include: Liu Jun (1999) [57], Chen Xu (2003) [58], Luo Li and Xiao Bochun (2004) [59], Song Shaofeng and Xiao Bochun (2005) [60], Li Jin-Lin and Xu Liping (2007) [61], Shi Ruo and Gu Baoyan (2009) [62] and so on, they combined object of study and specific industries, such as hotel industry, airline industry, the container shipping industry, rail transport, high-tech products, and then summarized and analyzed the status of revenue management research and pointed out their development prospects. The remarkable one is that Zhou Jing and Yang Hui (2008) [63] aimed at the applications characteristics of revenue management industry, on the basis of seven core point of view proposed by Robert G. Cross (1997) [16], added the new point of view of "to maximize revenue in order to maximize profit ", expounding its meaning and relevance.

IV. RESEARCH PROSPECT

On the basis of review the formation and development process of Western services Revenue management theory, as well as comment development status of domestic services revenue management disciplinary, we believe that future studies will be more extensive, deeper and more detailed, and the existing theoretical and operational research in revenue management yet to develop into the depths, particularly the basic research will be further strengthened. According to the 2009 annual project guide of National Natural Science fund committee, to face the new competitive environment and operational mode that may emerge in services currently or in the future, revenue management theory and its application should follow the following six specific areas[1]:

A. Service chain management model and algorithm under the conditions of Competition for resources

Effective supply chain management is very important to the manufacturing sector, as well as the service industry. In order to gain a competitive advantage in the effective supply chain management, service sector are looking for new ways to restructure and reorganize the whole industry system, while reengineer its business process and application. Future research should focus on service chain management based on services' characteristics, and further research should test the validity of this model among different industries, meanwhile, collaborative revenue management between service-oriented enterprises of service chain under the conditions of competition for resources, is a worthwhile study.

B. Bidding and auction of resource with model and algorithm of options

The network's rapid development has brought a growing number of online transactions, so the bid and auction of perishable product / service through the network has become a very popular approach to access to product / service, meanwhile the research on revenue management issues in the method of auction theory is prompted. Some scholars at home and abroad have been used the auction theory in revenue management, but research in this area are still in the initial stage. In addition, the customer who provides the highest bid win the product in revenue management theory research, so the current sale of the products contain a kind of option value, the real options theory is also a new direction[61] to study revenue management issues.

C. The model and algorithm of revenue management under the e-commerce environment

With the network technology and e-commerce developing rapidly, the services revenue management is facing new opportunities and challenges. On the one hand, development of network technology reduced costs and improved efficiency in

the process of the service information collection, analysis and sharing; On the other hand, the development of network technology reduced the "information asymmetry" between service-oriented business enterprises and customer, so even intensified the fierce competition. The services revenue management under E-commerce environment is a new task in the further development and research of the services revenue management.

D. Comprehensively integrated decision-making theory, methods and techniques of revenue management

A major cause for the development of services revenue management is the multi-dimensional nature of demand, it refers to the extensive research areas on techniques, decision-making, methods, processes and techniques of demand management, namely it is to study decision-making problems of demand management, and develop decision-making method and decision support systems [42]. Services revenue management emphasizes structural pricing, timing and quantitative decision-making, made by service-oriented enterprises in the time of mining potential of multi-dimensional demand. Many scholars at home and abroad conducted in-depth study on different decision-making aspects of revenue management, but the comprehensive integrated study on decision-making in all aspects has not yet been noticed. English Irene, et al (2008) [64], proposed a integrated revenue management ideas and methods in order to achieve strategic revenue management for service-oriented business enterprises, this direction deserves our attention and further study.

E. Suitable theories, methods and techniques of revenue management for China

Western revenue management application research involves a number of service industries, combined with their industry characteristics, from general concepts to qualitative analysis, and then to complex quantitative techniques, studies of the application are at all levels. How to apply the Western relatively mature results in Chinese service industry and establish a set of revenue management theories, methods and techniques for Chinese service industry, it is an urgent topic should be of common concern for domestic research workers and the services sector.

F. Revenue management application in particular service industries

As the revenue management got great success in the civil aviation industry, at present, revenue management has been widely used in hotels, car rental, television advertising, road transport, telecommunications and energy supply, tourism and other service industries, and extend to financial services, retail, medical services and Internet services, and other areas. With the revenue management applications continuous expanding, research of revenue management application in particular service industries should also be continuously improved and in-depth.

V. CONCLUSION

Revenue management gradually developed from the theoretical study of service management. Initial results of research revenue management are mainly for the aviation industry. Subsequently, as the scope and depth of research continues expanding, gradually extended to other service industries and even the high-tech industry, manufacturing operations management and other fields. Recently, a growing number of scholars study on the measurement, statistics, and decision support model, in the future there will be more quantitative results. However, more comprehensive and in-depth discussion focused on the theory of services revenue management, to build a integrated system of services revenue management theory, need a long way to go, as well as to conduct a large number of practices to conclude its activities rules. However, revenue management has its own applicable conditions and the addressed issues, the study found only in a certain service industry, its application was most effective.

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