Transportation Research Congress 2017

Sustainable, Smart, and Resilient Transportation

Selected Papers from the Proceedings of the Transportation Research Congress 2017

Beijing, China
May 23–25, 2017

Edited by
Linbing Wang, Ph.D., P.E.
Hongren Gong, Ph.D.

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TRANSPORTATION RESEARCH CONGRESS 2017

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EDITED BY
Linbing Wang, Ph.D., P.E.
Hongren Gong, Ph.D.
Baoshan Huang, Ph.D., P.E.

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Preface

Transportation infrastructure is essential to the economic development of a country and the daily life of all users. Transportation researchers and engineers have been striving towards sustainable, smart and resilient transportation systems. Recent years have seen extensive innovations in paving materials, pavement structural design, testing and characterization, construction, operation, maintenance and rehabilitation as well as efforts on improving traffic safety.

This ASCE special technical publication contains twenty-nine fully-reviewed papers, covering the topics of pavement materials, pavement structures, geometric design, and traffic safety. These papers were presented at the Transportation Research Congress (TRC) held at the National Convention Center, Beijing, China, May 23-25, 2017.

The TRC is jointly organized by universities, research institutes, industries, and China Highway and Transportation Society. TRC is intended to serve as an international platform for researchers, educators, practicing engineers, investors, entrepreneurs, and government officials in transportation infrastructure from all over the world. At TRC, experts will present the latest research findings, exchange research ideas, share experiences and lessons learned, showcase successful innovations and practice, identify research and educational needs and provide consultations to transportation community on a regular basis.

All papers published in this ASCE special technical publication were evaluated by at least two reviewers as well as the editors. All comments were adequately addressed by the authors of these accepted papers. In addition, all published papers are eligible for discussion in the Journal of Materials in Civil Engineering or Journal of Transportation Engineering and can also be considered and recommended for ASCE paper awards.

The editors would like to thank all the authors who have submitted their papers to the inaugural meeting of TRC. Thanks also go to many reviewers for their time and efforts. The editors are appreciative to Laura Ciampa and Katerina Lachinova from the ASCE Construction Institute (CI), and Donna Dickert from the ASCE Publications for their great support in approving and scheduling the publication of this proceeding.

Editors
Linbing Wang, Virginia Polytechnic University
Hongren Gong, University of Tennessee
Baoshan Huang, University of Tennessee

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A Study on the Application of the Market-Oriented Pricing Strategies of High-Speed Rail to EMU with Sleepers

Zhong-Wen An[1]

[1]Postgraduate Dept., China Academy of Railway Sciences, PO Box 100081, Daliushu Rd. No. 2, Beijing, China. E-mail: eric1020@139.com

ABSTRACT

EMU with sleepers is a specialty product in China's railway passenger transport. EMU with sleepers usually operates at night with an "evening-morning" (sunset-departure and sunrise-arrival) pattern and combines the high speed of EMU with the comfort of sleepers. Those trains operate in evening hours. Therefore, passengers' rest time at night can be made good use of. As EMU with sleepers is a new product in the EMU system, its cost accounting and profitability analysis lack precedents and experience. China Railway is going through market-oriented reform: a ticket pricing system of high-speed rail and EMU is being launched. This system is based on the market supply and demand as well as the current competitive situation and other factors. Meanwhile, according to the global practice of EMU operation, the implementation of a market-oriented and flexible pricing system, which adapts to the market-oriented trend of high-speed rail passenger transport, can serve as an effective way to boost revenue and to enhance the competitiveness of passenger transport. This paper starts with the analysis of evening-morning EMU with sleepers, and then elaborates on the implementation and existing problems of the market-oriented pricing strategies of high-speed rail EMU with sleepers. It further puts forward a dynamic ticket price fluctuation program after summarizing the principles and methodologies of the pricing strategies. Finally, it proposes some suggestions to improve the market-oriented pricing strategies of high-speed rail EMU with sleepers, which includes refining the current ticket refunding and ticket refunding, establishing a multiple pricing system, enhancing passenger transport service quality, as well as strengthening the marketing management of passenger transport, which may serve as a guidance to improve the competitiveness of high-speed rail EMU with sleepers.

Key Words: High-speed Rail; Multi-fares system; Dynamic pricing; Market-oriented; EMU with Sleepers

1 RESEARCH BACKGROUND

Railway operating mileage in China has reached 124,000 km by the end of 2016, as China has been continuously committed to high-speed rail (HSR) construction. Meanwhile, HSR operating mileage in China has exceeded 22,000 km, which takes up over 60% of the global HSR operating mileage. Currently, China boasts the longest HSR operating mileage around the world. As HSR has been launched recently, the technical equipment of railway has been greatly enhanced, and diverse travel demand of passengers has been successfully satisfied. However, as the launch of HSR in China remains in an early stage, problems still exist in the realm of ticket pricing system planning, as well as the designation and adjustment of ticket fare level. Therefore, it is an inevitable trend to research about issues considering ticket pricing, to enhance the current HSR pricing system, to make the price level scientific, and to ensure the ticket price remain market-oriented.

At the moment, most foreign HSR pricing systems combine state price fixing with market-

oriented practices. Market-oriented ticket pricing involves various factors and adopts differential pricing, revenue management pricing and other market-oriented pricing strategies. Therefore, foreign HSR/ railway market-oriented pricing system is now rather mature. This could lay a basis for the formation of HSR market-oriented pricing scheme in China. Compared with foreign countries, China HSR/ railway pricing system lacks flexibility, sustainability, extensibility and internal adjustability. Meanwhile, the pricing basis is not scientific enough. It cannot reflect the production cost of railway and efficiency of railway passenger transport. Moreover, the pricing system lacks consistency. It fails in the effective pricing of market segmentation. The ticket pricing system does not take into full consideration the economic status of different areas and the time value of passengers.

A brief look at the works done by scholars, home and abroad, will make it easy to observe that research on ticket fare management, factors involved in ticket pricing and the pricing model are relatively abundant. As regards to ticket fare management, countries including France, Germany and Japan have already loosened their regulation on HSR ticket pricing and adopted market-oriented government guidance price mechanism or market pricing strategies. However, the problems of current HSR ticket pricing system in China, like inflexible pattern and disconnection with the market, still remain to be dealt with. Wu Yunyun (2011), Han Baohua and Jia Guangzhi (2013), Wang Xiaogang (2015), Li Jianhai (2015) and others have conducted systematic analysis on the management, pricing mechanism and system. They have further put forward some suggestions to improve China HSR market-oriented pricing system. In the realm of factors involved in HSR ticket pricing, the cost structure, service demand and market competition are the three key factors. Liu Jie and He Shiwei (2010) argued that the HSR ticket pricing shall take into account the competition from other means of transportation, market supply and demand, price level changes, passengers' affordability and HSR's goal of achieving profit benefit. Moreover, multiple ticket discount policies should be rolled out. Wei Jiahua and Fan Lili (2014) upheld that market mechanism shall influence HSR ticket pricing. The ticket fare should be stipulated according to market supply and demand which includes the competitors' ticket price, operation cost as well as passenger demand. As for researches on HSR pricing model, various studies have been made on suitable HSR pricing methods and strategies for China, such as cost plus pricing method, differential pricing method, competitive game pricing method and revenue management pricing method. Those researches are based on foreign HSR/ railway and civil aviation pricing strategies. Yu Liangchun and Peng Hengwen (2006), Cao Guohong and Cheng Qian (2013) inspected that railway transport features peak season and off-season. Therefore, they proposed a differential pricing model to achieve maximization of social welfare and enterprise profitability. Li Mingkun and others (2015) suggested that HSR ticket pricing shall reflect passengers' different time value, different operation time, different consumer groups as well as different services. In their research papers, Zhang Xu and others (2012), Zhang Rui and Luan Weixin (2015), Zhou Yan and others (2016) discussed the optimal HSR pricing model by setting up a bi-level programming model. They all took the perspective of game theory. Separately, Zhang Li and Lan Boxiong (2012), Wang Cancan and Jia Junfang (2016), Sun Tao and Zhao Congcong (2016), Armstrong and Meissner (2010), Hetrakul and Cirillo (2014) and others conducted studies on dynamic pricing model of HSR and the corresponding seat inventory control based on revenue management theory.

In summary, based on foreign HSR pricing model and previous research, HSR ticket price fixing shall take into consideration cost, market demand, competitiveness, change and difference in regional economic situation. As to better fit the marketization of HSR passenger transport and

to enhance the competitiveness and revenue, multi-level pricing strategies and a dynamic ticket price fluctuation program should be launched.

In order to make full use of the transport capacity of HSR, evening-morning HSR and EMU with sleepers from Beijing, Shanghai to Guangzhou and Shenzhen have been launched since January 1st, 2015, which could meet the market demands better. As the fast speed and night operation hours of HSR EMU with sleepers could save passengers' daytime, those trains could meet the needs of most travelers who intend to travel or visit relatives. That is to say, the launch of HSR EMU with sleepers is an endeavor to better fit HSR to the market demand, and to enhance the operation scheme of HSR. As China has aimed at making the HSR EMU with sleepers more market-oriented, the creation of an advanced ticket price fluctuation program is of great importance and in urgent need. This paper first set out from the operation of HSR EMU with sleepers in China. In the next section, it analyzes the implementation of market-oriented ticket pricing system and its problems. This paper further elaborates on the market-oriented ticket price fluctuation model. In the last part, it makes some suggestions to improve the current HSR market-oriented ticket pricing system. The writer, here, hopes that those suggestions could serve as guidance to the formulation of HSR ticket pricing strategies in China.

2 THE OPERATION OF HSR EMU WITH SLEEPERS

Since HSR EMU with sleepers has been launched in January 2015, the passenger flow has increased rapidly, which equipped the railway with the capabilities to compete with civil aviation in an operating mileage of around 2,000 km. Since then, the market share of HSR has witnessed gradual expansion and has achieved good market performance.

2.1 An Enhancement of Operation Scheme

As to better fit passenger demand, the operation scheme of HSR EMU with sleepers has been continuously improved. Initially, 4 pairs of trains were launched per day, which was later increased to 11 pairs at the end of 2016. Meanwhile, short-distance trains heading for Xiamen North, Nanjing East, Guilin North and Quanzhou in daytime have been newly launched. The second-class seats on those trains are redesigned from sleepers which has successfully increased operational efficiency. Because the passenger flow varies within each week, the passenger train plan has been adjusted from "6+1" mode to the current "4+3" mode since late March of 2015, which signifies that trains run on every Monday, Friday, Saturday and Sunday (altogether 4 days), and stop operation on every Tuesday, Wednesday and Thursday (altogether 3 days). Besides, each week is arranged with a four-day "small maintenance gap" and a three-day "big maintenance gap" during which the equipment is examined and overhauled. With the safety guaranteed, the combination of large and small maintenance gaps could greatly optimize HSR transport capacity at night.

2.2 A Significant Growth of Passenger Flow

The passenger flow of HSR EMU with sleepers remains in an upward trend. The market demand was successfully stimulated. In the early stage of its launch, the average load factor per train rose significantly from 42.8% (January 2015) to 92.2% (July 2015). HSR EMU with sleepers ran 225 days in 2015 and 218 days in 2016 and have transported 2.37 million passengers and 2.75 million passengers respectively. The average passenger load factor in 2015 reached 76%. In 2016, the load factor rose to 78.8%. Notwithstanding that the days of operation had been