PRIORITIES OF CHINESE SPEEDS

Karapetyants, Irina V. *– D. Sc. (History), professor, director of the Institute of International Transport Communications, vice rector for international educational programs of Moscow State University of Railway Engineering (MIIT), Moscow, Russia.*

Sazonov, Sergey L. *– Ph.D. (Economics), senior researcher at the Institute of Far East of Federal Agency for Scientific Organizations, Moscow, Russia.*

ABSTRACT

Dynamic and systematic economic and technological growth of China's economy at the beginning of the XXI century largely predetermined scale investments in transport infrastructure, primarily in the construction of high-speed rail (HSR). Mobility of population increases, travel time of cargo and passengers reduces, mobility speed becomes record, recently remote areas obtain access to the center part of the country. The authors analyze and summarize the current trends in transport market, assess existing competitive advantages of HSR, financial problems of existing programs and the reformist course that China's leadership provides for the modernization of the railway complex.

ENGLISH SUMMARY

Background. *The Chinese leadership considers railway complex as a key life-support system of economics. Dynamic economic growth in China at the beginning of the XXI century was largely provided by large-scale investments in railway infrastructure development, thereby strengthening the integrity of the country and its international influence. New high-speed routes «compress› the vast area of China, transforming the road network into a reliable, efficient and accessible to the population. Construction of a railway complex turned into a new strategic industry that stimulates growth in related high-tech areas of economy.*

Objective. *The objective of the authors is to review situation and current trends in development of high-speed rail lines in China.*

Methods. *The authors use analysis, comparison and descriptive method with elements of economic assessments.*

Results.

More available and faster

In the period of 2000–2013 more than 17 thousand kilometers of new railways have been built and in early 2014 their length exceeded 100 thousand km, including 10,463 km of high-speed railways. Rail network comprises six meridional and five latitudinal lines. According to the «Plan of urbanization development in China during the 2014–2020 period», total length of high-speed rail (HSR) in China in 2020 will exceed 20 thousand km, and the total length of the lines of trains with speed of at least 160 km/h will be 40 thousand kilometers. Conventional railway will connect cities with population exceeding 200 thousand people, and HSR lines consisting of four lines in the direction of «North-East» and four routes in the direction of «East-West», will cover almost all cities in China with population of 500 thousand and more, will provide access to high-speed rail service for not less than 90% of population. Construction of new lines will cost $ 1 trillion yuan.

Growing HSR network will allow people to get from Beijing to the vast majority of provincial capitals of the country in less than 8 hours (Table 1), except for Haikou, Nanning, Kunming, Urumqi and Lhasa, and travel time between major cities should be reduced by 2 times. As a result passenger traffic will accelerate, carrying capacity of railways will increase and the problem of overburdening the largest railway junctions in the period of mass travel of China's residents will be solved. In January 2014 the volume of passenger traffic in comparison with the previous year increased by 7,9% and amounted to 257 million trips, while the number of used trains increased by 157 pairs – to 2667 units. Daily 5 thousand trains cruised in the country, carrying about 6,8 million passengers per day.

Construction of high-speed lines significantly increased mobility of the population of China. By the beginning of 2014 the part of HSR passengers has attained about 25% of total number of rail passengers. Annual growth in passenger traffic on Beijing-Tianjin line since its opening remains at the level of 20%, Beijing-Shanghai – 40%, and that given the fact that the intervals between the departure of the trains in both directions are of 4–5 minutes. In 2013 about 100 million passengers used the services of the world's longest HSR line Beijing-Guangzhou. In addition, the main line made tourist sites more accessible – after its opening the number of tourists who visited Wuhan, Changsha, Zhengzhou, Shijiazhuang and Beijing, has increased by 20%.

Compromises of competitors

As HSR network grows, speed trains began to compete with traditional regional airlines. According to experts at the University of civil aviation of China, HSR commissioning reduces the number of passengers on the relevant direction by 30%.

After commencement of service of the line Zhengzhou- Xi'an travel time between two cities reduced from 6 to less than 2 hours, and regional airlines had to cancel nearly all flights in Hubei Province. And with the opening in 2012 of HSR mainline Beijing-Wuhan some regional airlines have reduced the price of tickets for travel on this route from one thousand yuan ($ 160) to 200 yuan ($ 32). In 2013, HSR line Beijing-Shenzhen came into operation, reducing travel time between two cities to 8 hours instead of previously spent 29 hours (hereinafter it will be extended to Hong Kong).

Price for HSR ticket varies from 2727 to 540 yuan depending on the class (for conventional trains – from 257 to 720 yuan). Ticket for the 3-hour air flight Beijing-Shenzhen operated by China Southern Airlines with Airbus A380 costs 1750 yuan. As a result, in 2013 China's leading companies announced reduction of passenger fares: China Southern Airlines have made discounts up to 73% and Air China has cut prices by 57% on a flight from Beijing to Wuhan. CEO of China Eastern Airlines Shaoyun Liu believes that «in the near future, HSR network of China will cover almost all areas of the country that will have a direct and long-term pressure on the 60% of China's civil aviation market» [1].

Strong competition between two modes of transport in China forced their leadership to start developing ways of cooperation and compromises in the struggle for passengers. In 2013, Air China signed a partnership agreement with the Shanghai road administration of China Railway Corporation (CRC), under which passengers when booking air ticket at any of two Shanghai airports simultaneously can buy tickets for HSR to travel between Shanghai and four surrounding cities – Suzhou, Hangzhou, Wuxi and Changzhou. In addition, Air China develops possibility of connection of their international flights with scheduled high-speed trains

Other Chinese aviation companies resort to more drastic measures: China Eastern Airlines from

Table 1

Travel time using HSR lines from Beijing to the largest cities in China

Beijing						
1 hour	2 hours	3 hours	4 hours	5 hours	8 hours	9 hours
Tianjin	Zhengzhou	Nanjing	Hangzhou	Shanghai	Guangzhou	Hong Kong (2015)
Shijiazhuang	Jinan	Hefei	Wuhan	Harbin		
	Shenyang	Changchun	Xi'an			
	Taiyuan	Dalian				

2013 book and pay for HSR tickets for those airline passengers who use its services, and fly from Shanghai or Wuhan to neighboring cities, and increased the number of trips within a scheme «air-HSR» between two airports in Shanghai (Hongqiao and Pudong) and four major cities – Suzhou, Wuxi, Changzhou and Ningbo. Airline company Hainan Airlines in 2013 adjusted its schedule of flights to schedule of high-speed trains in the province of Hainan.

In modern conditions, in exchange of goods the share of trade of costly goods with short-cycle treatment increases. In China for many years when transporting goods with express delivery service the share of aviation and automotive modes of transportation amounted to 95%, and the share of railways accounted for only 5%. With rapid development of HSR network situation has changed dramatically – the leading railway operator China Railway Group in 2013 signed cooperation agreements with major Chinese and foreign companies of express delivery: SF Express, China Post, UPS, Pony Express, DHL, TNT Express.

Scientific and technical progress

Today, Chinese state-owned corporations develop independently new, more rapid trains for HSR. On the 3d of December 2010, during the pilot test of model CRH-380A, which was held at the section Beijing-Shanghai from Zaozhuang (Shandong) to Bengbu (Anhui), maximum speed reached 486,1 km/h – a new world speed record of trains. Previous record (416,6 km/h) was registered on the 28th of September of the same year during trial operation on HSR line Shanghai-Hangzhou. In July 2012, the management of CSR Corporation announced successful testing of a train, capable of developing a speed of 500 km/h, and in January 2013 a new experimental train set an impressive record – 600 km/h [3].

Experts of Ministry of Railways (MR) pay attention to the improvement and implementation of HSR components and elements. When operating high-speed trains there is increase in dynamic load on the rail bed, braking distance, the centrifugal force on the curves and aerodynamic drag. To solve these problems, the Chinese designers increased axial distance between rail tracks, made a higher radius of curvature and alignment horizontally and vertically, a higher edge of the rail. Moreover special rails, elastic fasteners and larger cross-section of tunnels are applied.

When conducting tests on express CRH380A at speed of 400 km/h, such parameters as possible derailment, degree of pressure reduction on axis wheel and maximum lateral pressure on the wheels, were, respectively: 0,13; 0,6 and 16 [4]. These indicators are key indicators in determining the degree of safety of a high-speed train, the smaller they are, the more is security. International standards require figures 0, 8; 0, 8 and 48 [5].

The noise level in a car CRH380A while driving at a speed above 300 km/h is just 61 dB, whereas in the cabin of Boeing during takeoff it is 81 dB, and in the car at a speed of 120 km/h it is usually close to 76 dB. As for technical reliability, 146 high-speed trains CRH380A produced by CSR Sifang company, constituted in 2013, 50% of HSR rolling stock, and during operation on ten different lines they set a record of a safe run with 160 million km covered.

During rail construction Chinese experts on their own created a number of true innovations. Section Golmud-Lhasa became the highest in the world. 960 km long, it is located at a height of more than 4 km above sea level. HSR lines often cross water bodies deeper than 100 m and pass through bridges-tunnels at an altitude of more than 80 m. In 2014, the world's highest mountain 9490-meter long tunnel was built for line Lanzhou-Urumqi at the height of 4345 m.

China has already surpassed many countries, not only in terms of design and laying of seamless rails, but also mastered the technology to counter the effects of temperature. Designed for traveling in cold regions train type CRH380B (developed by CNR company for HSR line Harbin-Dalian) can run at temperatures of –40°C and +40°C (in winter speed is 200 km/h, in summer it is 300 km/h).

In 2013, CSR Corporation completed testing high-speed trains (200–250 km/h), which can be powered from both catenary and batteries. Now they began to be used in those areas of China, where the rail network at some sections does not have catenary.

Changchun Railway Vehicle Co, Ltd unit of CNR Corporation has created a prototype of hybrid speed locomotive, using two to three power sources: electric, diesel engine and batteries. They will be formed on the principle of «two in one» or «three in one» depending on the operating conditions and the state of the railway bed. Trains are ready to move at the speed of 160–180 km/h, not only on major main lines, but also on subsidiary spur tracks.

To a large extent innovative solutions in development of rolling stock and construction of railway bed for HSR have been achieved due to research and technological development. At the beginning of 2014, development of rolling stock and improvement of the quality of network hardware involved 25 universities, 11 research centers, 51 research laboratories and engineering centers [6]. In 2012 in Changchun (Jilin) the largest Chinese center for R & D and production of high-speed passenger trains (corporation SNR) began its work. Center is able to produce annually 500 cars for ordinary passenger trains, 100 high-speed express trains of new generation – model CRH380A, 800–1000 cars for HSR, 1200 cars for long-distance express trains. In 2013, CSR has opened its first research institute, whose task is not only to develop new technologies for HSR, but determine economic and industrial strategy of the corporation [7].

Multiplier effect

HSR emergence in China was at the same time a technological breakthrough, and played a major role in stimulating the economy and domestic demand. According to calculations of economists on the basis of input-output balances, every billion yuan invested in the development of HSR, creates more than 20 thousand new jobs in the rail industry and 2 times more jobs in related industries. Analyst firm China Galaxy Securities revealed that investing 700 billion yuan ($ 108,5 billion) in railway construction can induce the demand for 30 million tons of steel and 140 million tons of cement.

Chinese experts are unanimous in their assessment: investments in rail infrastructure contribute to the growth of China's GDP by 2–3%.

Construction of railways contributes to dynamic economic development of surrounding areas and many industries associated with laying of a new line. According to the experts of Ministry of Railways, the world's longest HSR line Beijing-Guangzhou will annually increase the country's GDP by 30 billion yuan. This main line links five major economic zones, and the expected increase in business activity in the 28 largest cities, located in the region, will provide, during five years after the line's opening, additional growth of China's GDP by 3–5%.

After commissioning in 2006, of the most remote western 1956 km long Qinghai-Tibet railway GDP of Tibetan Autonomous Region increased from 34,2 billion yuan to 80, 2 billion yuan in 2013. During this period, the local tourism industry revenues rose annually by about 25%, and the total number of tourists visiting the region has increased from 1, 8 million to 12,9 million. In 2013, 330 thousand people or 10% of the population of Tibet have worked in the tourism industry. Thanks to the rapid development of the regional economy the volume of export-import operations in the territory under the jurisdiction of autonomy exceeded $ 3 billion.

These examples to some extent reflect the results of the specialization of China railway complex, which on the one hand, shows the cardinal growth of speed in accordance with the needs of passengers (development of HSR network), and on the other hand – growth of the carrying capacity of conventional lines for mass freight transportation with a minimum prime cost. In fact HSR development produces a significant intra-industry multiplier effect.

According to an analysis conducted by CRC, removal of one passenger train from a main line with a mixed type of operation (creation of a special dedicated railway for high-speed passenger traffic) can improve carrying capacity of a main line by 1,5–2 cargo trains [9]. Growing share of rail freight transportation in the total turnover of the country reduces by 1% the prime cost of national logistics by 21,2 billion yuan [10].

With the opening of lines Jinan-Qingdao, Wuhan-Guangzhou and Shanghai-Nanjing freight turnover on existing freight railways increased by 200 million tons per year. In particular at the section Shanghai-Nanjing of an old spur track Shanghai- Beijing, it amounted to more than 230 tons per day. According to MR, after opening in 2010 of HSR line Beijing-Shanghai carrying capacity of freight main lines in this direction increased by 140 thousand tons daily, or 50 million tons per year.

Creation of the world's largest HSR network costed an astronomical sum – more than 2,5 trillion yuan, most of which was formed through loans and credits with the participation of central banks. According to analysts of the Chinese Minsheng Bank, the ratio of debt to the value of fixed assets of MR could rise to 70% if the ministry will continue to rely on state bank loans and the issue of its securities while continuing to expand the network of conventional and high-speed railways.

Directions for reform

Huge financial debt of MR and the need to find additional sources of financing of industry's development forced the country's leadership to reform railway monopoly. Prerequisites for a course change appeared in 2012, when experts acknowledged that the role of the Ministry should be to create the most favorable environment for the development of competition and entrepreneurship while using for these purposes mainly indirect forms and methods of state regulation. Railway management units should become main economic entities, and the state will be responsible only for overall management of the industry, investment funds for important national programs and projects in the field of railway transport.

Fundamental reform of MR started after 18th Congress of the Communist Party of China and the third plenum of the Central Committee of Communist Party of China of the 18th Legislature (November 2013), which embarked on comprehensive reforms in the sphere of public enterprises, because «they have low efficiency and get excessive public preferences» [12]. China's leadership started market-oriented reforms of state corporations to continue to dismantle their monopoly position and to achieve the promotion of competition. The resolution of the plenum noted that within natural monopolies functions of state authority and management practices should be separated. Private capital will be able to participate in investment projects together with the state and thereby make the transition to an economic model based on the right of mixed ownership.

A plan to restructure MR was approved, which consisted of dividing the functions of government and economic activities of Chinese railways and simultaneous separation of competitive activities from monopolistic structure of the Ministry. Administrative and commercial units appeared, namely State Railroad Administration (SRA) and already mentioned Chinese Railway Corporation (CRC). The task of SRA is to ensure compliance with technical standards, monitoring of railway safety, quality assessment of infrastructure construction. Ministry of Transport of China and SRA assumed control over the activities of CRC. Corporation is charged with operational activities instead of reorganized MR, determining the level of railway tariffs, and ensuring employment of 2 million industrial workers. The Government undertakes to finance the construction of railways, provide CRC with subsidies within three years after the start of the reform, and stimulate investments in the sector.

CRC should cooperate with all stakeholders in order to maximize profits from the assets transferred to it and gradually reduce the amount of debt of the former MR. Corporation is an enterprise based solely on the state capital. Ministry of Finances of China, authorized by the State Council, will act as an investor to monitor the level of debt, to monitor the quality and issuing volumes of securities by CRC.

Subsequently, 18 railway administrations will be transformed into seven regional corporations: Northeast, East, Central, South West, North West, as well as of Beijing and Tianjin. Current Sian Corporation can turn into an independent corporation or enter as a component part in the North-Western Corporation headquartered in Lanzhou (Gansu). Several key HSR lines can enter into new corporations as independent agents – for example, Beijing-Hong Kong line.

For many years, the low cost of passenger tickets and losses within this business segment have been mainly offset by income from freight transportation. Since 2003 the Ministry raised freight rates nine times, and the last increase in March 2013 has recorded their level of 0,13 yuan per ton / km. Chinese analysts believe that if the government refuses to restructure the debt of the former MR, then the new corporation will have no other choice but to increase the cost of rail fares. According to the professor of Beijing University of Transport Zhao Jian, «CRC today, being a commercial entity, is unlikely to put up with a losses» [13].

On the 15th of June 2013 CRC started the second stage of reforming the industry to reduce the overall costs of rail freight transportation. To arrange a competitive market and better meet the needs of China's economy commercial infrastructure of

rail freight market is formed, which should be an effective mechanism for providing services, as well as easy access for interested companies to market, and stimulating the development of competition. For further development of competition and gradual termination of cross-subsidization of freight and passenger transport since February 2014 freight rates were increased by 0,03 yuan per ton / km. According to analysts, this increase will have an impact on the economy especially on coal and steel industries regarding haulage of their products over long distances. As for the railway corporation, then by virtue of new tariffs, its revenues will increase by 40 billion yuan annually.

Long-term investments

In order to further develop the railway network CRC expects to attract additional sources of financing with help of Railway Development Fund (RDF) and by increased cooperation with National Investment Fund of China (NIFC). Distinctive feature of NIFC is the ability to obtain a budgetary financing for infrastructure construction projects under certain conditions, including project's compliance with strategic sectoral government programs.

RDF could play a role of an investment platform, open to private capital and funds of local governments. It is expected that the share of government participation in financial assets of funds may be equal to 50%, that of CRC of 40%, and 10% will remain for other participants, as new rail lines stimulate economic development at the regional level and create new jobs.

By the decision of the 28th of March 2012 on the establishment of the zone of financial reform in the city (Zhejiang) China's State Council has given local municipality the right to attract private investment for the development of urban infrastructure. The first step of local authorities was the sale of 50% stock of shares in state railway under construction, 52,22 km long and valued at 17,6 billion yuan. The package was quickly sold out to individual investors and private companies. Buyers stated that «public company shares are more reliable than the deposits in commercial banks, and long-term interest rates on rail loan look more attractive in comparison with the same «financial products» of banks» [14].

Desire to participate in investments aimed at accelerated development of high-speed railways, is natural for private capital, municipal and regional structures. Everyone can see result of construction and economic efficiency of investments in the sector.

Conclusions. *With total length of operated railways (100 thousand km in 2014), China ranks second in the world (after the United States with 228, 5 thousand km). Load of this mode of transport is the highest on the planet. Rail transport of the country ranks first in terms of passenger traffic (in 2013–2,08 billion), second in the world in terms of cargo (their density is twice as Russian (23,8) and is significantly more than levels of the U.S. (16,1), India (15,5), Europe (3,7). Railway sector in China is the largest employer – in 2013 the number of employees was about 2 million people.*

If China actively implements electrification of existing lines and takes measures to increase capacity of hydro and nuclear power stations, the competitiveness of railways will increase. Transportation cost of one ton of cargo to a distance of 1 km by rail costs now 0,13 yuan, whereas the same transportation by car costs 0,5 yuan, and 6 yuan by air transport. Finally, the practice shows that traffic capacity of the railway which needs less land acquisition is much higher than traffic capacity of a road. In the future, the importance of those factors will determine the further enhancement of the competitiveness of rail transport of China and its role in promotion of its economic and technical progress.

Keywords: rail transport, China, reform, high-speed trains, high speed rail, investments, economy, competition.

REFERENCES (ABRIDGED)

1. China's high-end manufacturing booms on fast track // http://usa.chinadaily.com.cn/business/ 2012–10/22/ content_15836501.htm. [Last accessed 4.04.2014].

2. Shi Yingying (China Daily). Looking to China's logistics market // http://www.chinadaily.com. cn/ business/2013–07/01/content_16695910.htm. [Last accessed 4.04.2014].

3. China rewrites global high-speed rail pattern in six years // http://english.peopledaily.com.cn/ 90778/8139987.html. [Last accessed 4.04.2014].

4. Wu Qi, Ren Qinqin (Xinhua). China grips technology to brake world fastest train // http:// europe. chinadaily.com.cn/business/ 2013–03/08/ content_16291101.htm. [Last accessed 4.04.2014].

5. New bullet train with «Chinese standards» planned // http://en.ce.cn/Industries/ Transport/201401/ 11/ t20140111_2100855.shtml. [Last accessed 4.04.2014].

6. CRH trains take a leading role // http://www. chinadaily.com.cn/business/2014–01/10/content_ 17228708.htm. [Last accessed 4.04.2014].

7. CSR to enhance support for China's rail transport // http://www.china.org.cn/business/2013–04/ 16/ content_28566037.htm. [Last accessed 4.04.2014].

8. Beijing-Guangzhou high-speed rail to add 30b yuan to GDP annually // http://english. peopledaily.com. cn/90778/8074227.html. [Last accessed 4.04.2014].

9. Coates R. Nine Rules for Logistics in China // China Business Review. 2012, Vol. 39, Issue 2. P.15; Shi Yingying (China Daily). Looking to China's logistics market // http://www.chinadaily. com.cn/ business/2013–07/01/content_16695910.htm. [Last accessed 4.04.2014].

10. Cargo transport set to benefit from link // http:// www.china.org.cn/business/2012–12/25/ content_27506969.htm. [Last accessed 4.04.2014].

11. Ju. Shan'shan'. On IPO [Daesh' IPO] Kitaj–2011. Iss. 6, Vol.68., p. 18.

12. Diverse ownership to boost SOE reforms // http:// news.xinhuanet.com/english/ china/2014–01/05/c_133020197.htm. [Last accessed 4.04.2014].

13. Xu Wei, Xin Dingding (China Daily). Reorganized railways an engine for reform // http://www. chinadaily. com.cn/kindle/2013–04/11/content_16391982.htm. [Last accessed 4.04.2014].

14. Private investment in rail project boosts Wenzhou // http://www.china.org.cn/business/2013–04/ 25/ content_27506862.htm. [Last accessed 4.04.2014].

15. Lan Xinzhen. Giving Private Investment More Room. An effective implementation mechanism for encouraging private investment is badly needed in China // Beijing Review / March 5, 2012, Vol. 55, № 10. P. 28.

Координаты авторов (contact information): Карапетянц И. В. (Karapetyants, I. V.) – karapetyants.imo. miit@gmail.com., Сазонов С. Л. (Sazonov, S. L.) – jsazonova2010@mail.ru.

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