

Demands, Opportunities and Challenges of Iranian Railway Construction Market from the Perspective of Chinese Enterprises

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Abstract: After over a century's development, rail transport is now occupying an important position in the comprehensive transportation system in Iran. To serve the demands for domestic economic and social development and give full play to the regional advantages as an international transportation hub, Iran has formulated a ten-year railway development plan. By the end of 2025, all the existing railway lines in Iran are expected to be electrified, the rate of double track railways would be increased to 100%, and the railway mileage in Iran would be doubled. This Iranian railway upgrading plan has provided favorable opportunities for Chinese enterprises to enter the Iranian engineering construction market. Meanwhile, Chinese enterprises are facing various challenges, including the unpredictability of the *Joint Comprehensive Plan of Action*, unsound business environment, competition from other powers that are strong in railway construction, and the country's preferences regarding technical standards. Therefore, Chinese enterprises should carefully assess the current and predicted risks while observantly seizing the opportunities, make rational decisions by comprehensively analyzing the international political and economic situations and comprehensively weighting the costs and benefits, and implement stable Going Global strategy aligned with the Belt and Road initiative.

Keywords: Iran; railway; Chinese enterprises; opportunities; challenges

1 Introduction

Iran is located on the southern edge of the Asian continent. As an important global corridor between East and West, and spanning two major oil and gas producing areas (Persian Gulf and Caspian Sea), Iran has significant geographical advantages regarding energy and transport. Iran formulated an ambitious plan for a modern rail system that fully exploits the advantages of the international hub's key location. Iran anticipates that all of its current rail network lines will be electrified by 2025, the double-track rate will have increased to 100%, and the rail transport network size will have doubled.

Iran is more than China's economic and trading partner; it is an important partner in China's promotion of the Belt and Road Initiative (BRI) in the Middle East [1]. When the Kazakhstan–Turkmenistan–Iran railway opened in 2014, Iranian officials stated that it was a strategic route linking Iran to China offering convenient transport and geopolitical benefits.

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Infrastructure connectivity is a BRI priority, and China and Iran have ample possibilities for collaborative construction projects. Encouraged by Iran's rail construction market demands and planning, and aligned with China's Going Global policy regarding foreign investment, Chinese engineering/construction enterprises are actively entering Iran's railway market. This paper analyzes the history of Iran's railway construction and its rail transport status to determine the country's railway development needs and assess the opportunities and challenges for Chinese enterprises in terms of participation in Iran's rail construction market.

2 Rail transport in Iran

The first railway in Iran opened to traffic in 1887. Located in southern Tehran, its total length is less than 10 km and it has a 1000-mm gauge. Iran began renovating its rail network in 1927 in accord with international standards (1435 mm), and rail construction since then mostly has adopted this standard. Before 1979, the country had built 4565 km of track [2]. Subsequently, the government set a long-term development goal for its rail network, which then experienced an important period of development and improvement.

Currently, the construction and operation of Iran's rail system mainly employs the International Union of Railways (UIC) standard. In terms of rail gauges, except for the wide-track eastern Zahedan to Mirjaveh (94 km) line, Iran has used the standard 1435-mm gauges. Moreover, except for a few relatively old lines, Iran's railway mainly uses UIC 600–900A rails and B70 type concrete sleepers. From the technical and equipment perspectives, the overall levels of the hardware facilities are not high. The current rail lines are mostly distributed in the northwestern region of the country and around Tehran. Railway development along the Persian Gulf and in the central and eastern regions lags behind. In addition, more than 80% of Iran's rail lines are single track, the double-track rate is low, and electrification is lagging [3].

Generally, the density of Iran's rail network is low. The *Iranian Statistical Yearbook* (2015–2016) indicates that Iran had a total of 13 345 km of various types of rail transport, including 10 459 km of main rail lines, 1873 km of shunting lines, and 1016 km of enterprise-specific rail lines [4]. These data indicate that Iran's rail network density was 80.98 km/10⁴ km², which was less than the rail network density of neighboring countries, such as Turkey (115 km/10⁴ km², 2016) and Pakistan (92.765 km/10⁴ km², 2008) [5]. The cumulative influence of various characteristics, such as old lines, old locomotives, and low operational efficiency, has put Iran's rail transport system in a relatively weak competitive position with road transport. Most cargo movers and travelers prefer cars or airplanes. In the 2015–2016 fiscal year, Iran's rail system transported 24.45 million passengers, a decrease of 1.4% compared to the previous fiscal year. The rail freight volume was 35.65 million tons, of which minerals accounted for 65.9% and petroleum products accounted for 9.5% of the freight traffic, with industrial products contributing just 8.9%. Rail freight turnover was 25.014 billion tons, which was an increase of 2.3% over the previous fiscal year.

3 Iran's rail development and improvement plan

3.1 Iran's vision for developing its railway

In 2014, Iran's government approved a 10-year railway development plan. It planned to electrify all current rail lines and achieve a 100% double-track rate by 2025. The track length goal was 25 000 km, and the long-term goal was to double the rail mileage. That meant that Iran not only needed to complete the modernization of its existing lines, it also needed to add at least 10 000 km more modern rail.

In addition to planning a thorough upgrade of the network, Iran planned to actively participate in and promote the construction of multiple international rail transport corridors, such as the International North–South Transport Corridor (INSTC) and the Trans-Asian China–Europe Silk Road railway. Based on its intended improvements to the transport capacity of its domestic rail network, Iran proposed seven important international transport corridors, aiming to fully embrace a pivotal role in the anticipated international transport throughout Eurasia and to enhance the competitiveness of international transport [6].

3.2 Key Iran railway construction projects

The official website of The Railways of the Islamic Republic of Iran (RAI) states that the key projects in Iran's rail upgrade plan fall into four categories: new rail line construction, dual-track reconstruction, electrification reconstruction, and multimodal transport and land port projects [7]. The key projects planned for the near future are as follows.

3.2.1 New rail line construction projects

(1) Isfahan–Ahvaz railway. The railway is expected to cost EUR 2.075 billion; cover 545 km; connect Isfahan, (Iran's third largest city) to Ahvaz (its eighth largest city); have an annual freight capacity of 45 million t; and offer an annual passenger transport capacity of two million people. The new line is expected to easily move Isfahan's passengers and goods to the northern port of the Persian Gulf, which would be almost 300 km less mileage than transit from Qom. In addition, the Isfahan–Ahvaz railway would create a new transport corridor to Basra, Iraq.

(2) Rasht–Astara rail connection. This line will be just 164 km long, with a planned annual freight capacity of 2.7 million t and an investment of EUR 350 million. The 2017 Middle East railway map released by the UIC shows the Rasht–Astara line currently under construction. The Rasht–Astara connection is a key “controlling” project of the INSTC. The reason that the INSTC still does not have complete rail connectivity throughout the corridor is the lack of this short rail line.

3.2.2 Double-track reconstruction project

(1) The estimated cost of double-track reconstruction of the Chadormalu–Ardakan railway (201 km; 19 million t/year) is EUR 100 million. The project plans to adopt the build–operate–transfer (BOT) or build–lease–transfer (BLT) model with a three-year construction period and a 10-year concession period.

(2) Badroud–Meybod Railway Double Tracking reconstruction project. About 200 km of this line is slated for reconstruction, the expected cost is EUR 100 million, and the designed transport capacity would be 19 million t/year. The project plans to use the BOT or BLT model, the planned construction period is three years, and the franchise period is 10 years.

(3) Jandagh–Tabas–Torbat-eHeydarieh railway double-track project. About 542 km of the line is expected to be reconstructed, the expected cost is EUR 282 million, and the designed transport capacity will be 10.4 million t/year. The project plans to adopt the BOT or BLT model, the construction period is expected to be three to four years, and the franchise period is set at 10–15 years.

3.2.3 Electrification reconstruction project

Sirjan–Bafq–Bandar Abbas electrification project plans to electrify 613 km, the transport capacity after the transformation would be 25 million t/year, and the budget is EUR 200 million. The project plans to employ the BOT model for construction over three to four years, the franchise period is set at seven to 10 years, and the internal rate of return is about 25%–30%. When completed, this project will enhance the rail transport capacity from Sirjan to the port of Abbas, enhance the freight turnover capacity of the port of Abbas, and enhance that port's customs clearance capacity.

4 Analysis of Iran's railway development needs

Based on the above analysis of the history and status of Iran's rail transport, it is apparent that the railways' overall level of development is weak and plagued with problems, such as aging lines, obsolete facilities, and low network density. However, Iran looks forward to relying on its unique geographical and strategic location at the Eurasian Crossroads to become an important node and actor in Eurasian transport, strengthen its geopolitical influence in the Middle East, and become a regional power. To meet those goals, Iran urgently needs resources and guidance to realize its rail construction and development vision.

4.1 Iran's freight railway needs

Rail transport has significant advantages over other methods in terms of transport capacity, speed, economy, and reliability. However, in competition with road and air transport, and because developed countries, such as the United States, have successively entered the post-industrialized age, rail transport has entered a period of depression. However, recent innovations and developments in rail transport technologies have been achieved, mostly manifested as heavy-haul and high-speed rail. These advances, combined with a development orientation toward a low-carbon economy, have initiated a new railway construction boom worldwide.

Within the Middle East, Iran has a relatively high level of industrialization. By relying on its abundant oil and natural gas resources, Iran has established a relatively complete energy industry, and energy equipment manufacturing there has made considerable progress. However, compared to its huge energy reserves and various advantages, Iran's energy industry (and its entire industrial chain) has much room to grow and improve. Iran also is very rich in mineral resources. It mines 68 important minerals, such as chromium, lead, zinc, copper, coal, gold,

tin, and iron. It ranks fifteenth in the world in total mineral deposits and first in the world in zinc mineral reserves. However, Iran’s mineral resource development rate is relatively low, and it has developed less than 20% of its known reserves [8]. In the future, mineral resource development and the related processing industries might become a new growth area for Iran’s industrial development, but Khorasan Province in eastern Iran and other places urgently need rail transport support to develop their mineral resources.

From the global perspective, Iran is in the industrialization stage of economic development, which takes a long time to complete, and the demand for rail transport is high. Considering Iran’s current economic and social development and its resource endowment characteristics, the country’s rail development needs are focused on upgrading and reconstructing current rail lines and expanding or improving rail networks. Specifically, constructing double-track lines, electrification, building hub stations, and achieving rail and port connectivity are the specific construction tasks of Iran’s rail development.

4.2 Iran’s high-speed rail needs

Iran’s population rapidly increased during the second half of the twentieth century. Between 1976 and 1986, Iran’s average population growth rate was as high as 4%. However, because of various recent changes in the national economy, society, and lifestyle, Iran’s population growth rate has flattened [9]. According to the United Nations’ Population Databases, Iran’s total population in 2017 was about 81 million [10], making it the most populous country in the Middle East and eighteenth in the world. *World Population Outlook* (2017) predicted that Iran’s population will peak in about 2050 at almost 94 million people [11]. The Statistical Center of Iran released population data in 2018 indicating that Iran’s urban population accounts for almost 75% of the total population. The country’s large population and high urbanization rate imply that it is economically necessary for Iran to develop its passenger rail transport, particularly high-speed rail linking the large cities.

Tehran is Iran’s political, economic, cultural, and transport center with a population of about 8.7 million. Mashhad, an eastern town, is Iran’s religious capital with a population of exceeding 3 million, and Isfahan is the third largest city with a population of about 2 million. The latest census data reported that eight cities have populations more than one million and 18 cities have populations above 500 000 [12] (Table 1). The movement of people and materials between cities is continuous, and high-speed rail might energize regional economies and reshape geographical benefits with significant economic spillover effects. It is conservatively estimated that the eight cities with populations above one million in Iran want and need high-speed rail, particularly to link the largest cities, such as Tehran, Mashhad, and Isfahan.

Table 1. Iran’s 10 largest cities by population.

Rank	City	Population
1	Tehran	8 693 706
2	Mashhad	3 001 184
3	Isfahan	1 961 260
4	Karaj	1 592 492
5	Shiraz	1 565 572
6	Tabriz	1 558 693
7	Qom	1 201 158
8	Ahwaz	1 184 788
9	Kermanshah	946 651
10	Urmia	736 224

Source: Statistical Center of Iran (2016)

As early as 2006, Iran’s government began discussing a high-speed rail line linking Tehran to Isfahan. In 2015, the Iranian government and China Railway Group Limited collaborated in the Tehran–Qom–Isfahan High Speed Rail Project. The initial project budget was estimated at EUR 1.8 billion, and the foreign financing of the project was borne by Chinese financial institutions [13]. The design speed of this high-speed rail line is 250 km/h, and it is planned to follow European Train Information System (TIS) standards. The passenger transport operations are expected to begin in 2021, which is expected to shorten the transport time from Tehran to Isfahan from seven to

two hours, greatly facilitating city residents' transit along the line. Currently, the Tehran–Qom–Isfahan project is the only one high-speed rail in Iran actually under construction.

The growth rate of Iran's global tourism market is higher than its national economic growth rate, and tourism has become an important industry for most countries. Iran's abundant tourism resources are found in its unique cultural and historical heritages, and the country has commenced a wide variety of tourism projects, including its 22 UNESCO World Heritage Sites. Thus, Isfahan and many other places are important cultural and historical tourist destinations of foreigners and they attract millions of tourists from around the world every year. Tourism is important to Iran's national economy, and it has ambitious goals for vitalizing the industry. It is planned that, by 2025, the number of foreign tourists annually entering the country will be about 20 million and the generated revenue will be about USD 30 billion. Developing tourism to reach these goals is inseparable from developing convenient and comfortable transport. High-speed rail is relatively cost-effective because it shortens spatial distances between places, which is highly valued by and linked to advancing the tourism industry.

5 Opportunities in Iranian railway construction for Chinese enterprises

Rail transport is an important component of Iran's national comprehensive transport system. A well-developed rail network is a basic condition for industrialization and an important guaranteed way to strengthen national governance and promote balanced economic and social development. To this point, this study's analysis has revealed that Iran needs significant improvements to its rail system's infrastructure. Although the RAI has a relatively clear development and project plan, the rail industry needs about USD 7.5 billion to meet the Iran Vision 2025 goals, and, therefore, investment opportunities abound in Iran's rail construction market.

Regarding Chinese investments, the economic and technical strength of Chinese engineering/construction enterprises continuously increases, and the share of these enterprises represented by China Civil Engineering Construction Corporation, China Railway Construction Corporation Limited, and China Communications Construction Company Ltd. in foreign engineering markets continues to increase. This business volume has been annually increasing by about 30% [14]. Particularly regarding the BRI, Chinese engineering/construction enterprises have actively implemented a global strategy, and the international business volume has rapidly grown.

Iran's ambitious rail system upgrade plan has provided favorable conditions and opportunities for Chinese enterprises interested in entering the Iranian engineering/construction market. In 2015, China Railway Group Limited began construction on the Tehran–Qom–Isfahan High Speed Rail Project. On February 6, 2016, China National Machinery IMP. & EXP. CORP and Beijing Supower Technology Co., Ltd. collaborated in the Tehran–Mashhad Railway Electrification Project for a planned construction period of four years. On July 26, 2017, Export-Import Bank of China and Iran's Bank of Industry and Mine entered into a financial contract for the project [15]. At completion, the maximum operating speed of the Tehran–Mashhad railway would be about 160 km/h (making it a quasi-high-speed railway), which would greatly improve rail transport efficiency. On March 7, 2018, China Machinery Industry Construction Group Inc. and Iran Construction and Development of Transportation Infrastructure Company entered into a CNY five billion Shiraz to Bushehr rail project contract. On March 12, 2018, China Sinomach Heavy Industry Corporation and Iran Construction and Development of Transportation Infrastructure Company signed a CNY 5.4-billion reconstruction and expansion project for the Tehran–Hamadan–Sanandaj railway, using the engineering, procurement, and construction (EPC) model. The project is expected to greatly improve rail transport capacity in western Iran and add significant value to employment opportunities and Iranian society.

6 Challenges in Iranian railway construction for Chinese enterprises

6.1 Uncertain prospects and risk related to the Iran nuclear deal

After the signing of the Joint Comprehensive Plan of Action (Iran nuclear deal) in June 2015, there was some evidence that Iran's economy was improving. Growth in the oil and gas industry drove Iran's Gross Domestic product growth rate up to 12.5% for the 2016–2017 fiscal year, and investment in domestic engineering/construction projects increased. However, Iran's international situation remained volatile. On May 8, 2018, the United States announced its unilateral withdrawal from the Iran nuclear deal, renewed its economic sanctions against Iran, and demanded that other countries reduce their oil imports from Iran. Iran again was a focus on the international political stage. The international community generally posited that the United States' actions would have important negative impacts on Iran's economy in recovery and would increase Iran's market risk.

Because Iran's economy remains highly dependent on oil exports, restricting those exports might stagnate the country's economic growth enough to lead to severe fiscal tightening.

Railways are public products that typically have significant spillover effects, and constructing railways requires huge capital infusions with lengthy cost recovery periods. Therefore, national governments usually undertake rail construction projects, and the investments and project costs strongly depend on the government's financial resources. A significant slowdown or a decline of Iran's economy inevitably would negatively influence the rail projects in which Chinese enterprises have invested money and human resources. Some railway construction projects undertaken by Chinese-funded enterprises (Build-Transfer model or EPC model) might experience increased financing and/or project payment risks.

6.2 The need to improve Iran's business environment and regulations

According to the *Doing Business 2018* released by the World Bank, Iran ranks 124 out of 190 countries and regions regarding business environment [16], which is four positions below its 2017 rank. In the Corruption Perceptions Index 2017, Iran ranked 130 out of 180 countries and regions. Iran's tax system and administrative approval efficiency also need improvement. Trading Economics reported that Iran's most recent annual inflation rate was 9.7% (data as of June 28, 2018). Therefore, there is an overall significant need to improve Iran's business environment, business regulatory system, and market stability.

Regarding Iran's key impending rail projects, the government intends to use BOT, public-private-partnerships (PPP) and other financing models to promote the projects and relatively short operating (franchise) periods. The projects' financial risks have increased because the franchise and PPP models require stable regulations and systems that currently do not exist; however, the future market outlook is good. Otherwise, it would be difficult for a contractor to start a project in terms of quality, schedule, and cost. Ultimately, it would not only be difficult to recover costs, it would be challenging to realize reasonable returns on profits.

6.3 Powers compete for Iran's railway construction, increasing entry barriers and challenges

Iran's neighbors have focused on its railway potential because of its unique geopolitical and transport location. Television news reported on August 23, 2017, that the Central Bank of the Russian Federation (Bank of Russia) invested EUR one billion in Iran for rail electrification projects. Iran's Financial Tribune reported on January 14, 2018, that Iran and India signed a USD two billion railway cooperation agreement, of which Iran used USD 600 million to purchase traction locomotives and trucks from India. India's primary motive seems to be to connect Central Asia to Europe through Iran's ports and railways by funding Iran's construction of the Chabahar-Zahedan-Bam-Hajjaj Railway. The funding sources for international engineering/construction activities historically have profoundly influenced project bidding, qualification approval, and project process management. Chinese construction enterprises might face tangible and/or intangible obstacles regarding rail projects invested in by foreign countries outside the region.

6.4 Iranians' preference for European technology and construction standards

Engineering/construction and technical standards directly influence the challenges and costs of rail construction and importantly affect design, quality requirements, and choices for upstream and downstream equipment. Therefore, in the international engineering/construction market, gaining proactive advantages in standard setting on patent licensing has gradually become a complete competition strategy. In the field of transport construction, China's Going Global strategy is an important guide to Chinese-funded enterprises' foreign development activities. In terms of high-speed rail, China developed a set of systematic integration capabilities and independent innovation capabilities with relatively mature technical solutions and standards for design, construction, equipment manufacturing, operational management, maintenance, and so on. However, Iranian nationals tend to prefer Western products and technologies [17].

Although Chinese enterprises constructed the high-speed rail from Tehran to Isfahan, Iran followed the European Railway Agency's Technical Specifications for Interoperability (TSI) standards. Moreover, the RAI used Italian consultants to supervise the project to ensure that the Chinese construction enterprises complied with the European and other technical standards. Iran's preference for the European standards might have negative consequences for the ability to meet the Chinese Going Global standards and/or they might restrict the Going Global rates of the upstream and downstream equipment manufacturers that rely on standards. Iran's preference

for and choice of European technical standards will undoubtedly challenge the Chinese enterprises regarding engineering design, construction, equipment configuration, and railway operations.

7 Conclusions

Iran's ambitious rail upgrade plan is creating favorable opportunities for Chinese enterprises to enter the Iranian engineering/construction market. Chinese engineering/construction enterprises with foreign experience have accumulated technologies, experience, and cost advantages in the railway construction field that have laid a solid foundation for participating in the expansion of Iran's railway construction market. Chinese-funded enterprises recently have entered that market, and their participation in construction of the railway upgrades is underway. However, Chinese enterprises participating in Iran's railway construction projects face many risks and challenges, such as the unpredictability of the Iran nuclear deal, Iran's weak business environment, competition with other countries involved in Iran's railway construction market, and the country's preferences regarding technical standards.

In the international engineering/construction market, opportunity and risk are closely associated with each other. When they enter Iran's railway construction market, Chinese companies must remain keen on capturing opportunities, and they must carefully assess the current and predicted risks based on the international political and economic climates and comprehensive determinations of costs and benefits. They must make rational decisions and implement stable Going Global strategies aligned with the BRI.

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