

CASE STUDY

Luoyang Metro Project, China

August 2026



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Executive Summary

Luoyang city of Henan province in central China has rich historical and cultural heritage sites and attracts large numbers of tourists. Despite its cultural prominence and growing urbanisation, the city faced urban mobility challenges. In recognition of the need to create an efficient, integrated, and sustainable urban transit system in Luoyang, the municipal government developed a four-phase strategy to create a metro network in the city, starting from Metro Line 1 (Line 1) that connects the eastern and western parts of the city with the historical city centre.

In July 2018, the New Development Bank (NDB) approved a sovereign loan of USD 300 million to support Luoyang Metro Project, representing about 10.8% of the total estimated project cost of roughly USD 2.8 billion. Passenger satisfaction reached 98% in 2022, exceeding the appraisal target of 97%.

The project aligned with national policies promoting green urban mobility and provided an opportunity for multilateral development financing to support sustainable infrastructure in medium sized cities, an area where NDB demonstrated impact. Technological innovations under the project have been replicated in other city metro systems in China.

1. DEVELOPMENT CONTEXT

Luoyang, located in Henan Province, is one of China's oldest historic cities and a rapidly urbanising medium-sized metropolis. The city holds important place in the cultural and civilisational map of China. Luoyang was the capital city of 13 dynasties of China, has rich historical and cultural heritage sites, and attracts a large number of tourists every year. Despite its cultural prominence and growing urbanisation, the city faced mounting urban transport challenges. Rising private vehicle ownership, congestion, air pollution, and long travel time were undermining economic productivity, tourism, and quality of life. Public transport relied heavily on buses and taxis operating in mixed traffic, with limited reliability and capacity.

Luoyang's growing urban footprint, expanding new districts, and heavy tourist inflows highlighted the necessity of upgrading of the existing transport infrastructure. The authorities recognised that road-based solutions alone were neither sustainable nor sufficient to support long-term development. The concept of "constructing rail transit to build a city" has become the guiding principle for developing major cities in the country.

The People's Government of Henan Province recognised the urgent need to create an efficient, integrated, and sustainable urban transit system in Luoyang. It supported Luoyang to develop a four-phase strategy to create a metro network with low carbon footprint. The project aimed to establish a safe, reliable, and high-quality urban transit system to improve mobility for Luoyang's residents. It was designed to enhance connectivity between residential catchments and the city centre, while facilitating efficient access to public services, employment areas, educational hubs, commercial districts, and cultural assets. In parallel, the project sought to support Luoyang's economic development objectives by strengthening its function as a provincial sub-central city, reinforcing its manufacturing base, and fostering sustained growth in the tourism sector.

2. PROJECT DESCRIPTION

The Luoyang Metro Project was designed to establish the city's first rapid transit system, with Line 1 as the initial phase. Line 1 extended approximately 25.342 km, connecting the eastern and western urban corridors with 19 stations, and is supported by underground tunnels and modern depots. Subsequently, Line 2 was added, creating a basic cross-shaped network that links key residential, commercial, and transport hubs in the city.

New Development Bank (NDB) approved a sovereign loan of USD 300 million in July 2018, representing about 10.8% of the total estimated project cost of roughly USD 2.8 billion for the construction of Luoyang Metro Line 1. The loan primarily financed critical systems, including rolling stock, signalling, power supply, and electromechanical equipment associated with Line 1. The actual cost of project turned out to be USD 2.6 billion with remaining financing coming from the People's Government of Luoyang (USD 0.5 billion) and Chinese commercial banks (USD 1.8 billion). The project was implemented by Luoyang Rail Transportation Co. Ltd. (LRTC) (Luoyang Metro Group). The commercial operations of LML1 commenced in March 2021.

3. DEVELOPMENT IMPACT

The Luoyang Metro Project was completed with 17% time saving and has generated substantial mobility, economic, and environmental benefits. The share of metro in motorised travel surpassed expectation, reaching 9.18% in 2023, exceeding the 9% target established at design. The share of metro in public transportation reached 27.2% in 2023, which is 70% higher than the target set in the design and monitoring framework. Passenger satisfaction reached 98% in 2022, exceeding the appraisal target of 97%. Importantly, the metro enhanced social inclusion by offering affordable, safe, and accessible transport options, particularly for low-income groups, elderly residents, and tourists. Line 1 has been successfully integrated with Line 2 which was completed in December 2021. On December 31, 2023, Luoyang metro (Line 1 & Line 2 combined) successfully serviced a record daily ridership of 514,600 passenger-trips.

The project evaluation indicates that travel time was reduced, improving access to employment centres, railway stations, educational institutions, hospitals, and tourist attractions. According to Amap Urban Traffic Analysis of Key Chinese Cities, in 2016 the Rush Hour Congestion Index for central Luoyang was 1.74, and average driving speed was 22 km/hour. In 2022, one year after Line 1 was put to service, rush hour congestion level was down to 1.43, while the average driving speed increased to 31 km/hour. With such improvements, Luoyang was ranked No. 2 among key Chinese cities for easiness of urban road traffic.

The project demonstrated strong technical sustainability, supported by adequate staff capacity and adherence to rigorous safety and environmental standards. Environmental sustainability outcomes are reflected in measurable reductions in carbon emissions, noise, and local air pollution. These benefits are further reinforced by energy-efficient design solutions, including innovative air-conditioning systems in subway stations, which have delivered energy savings of approximately 35%. The project received 15 awards in recognition of its innovation and strong technical capacity.

Independent evaluation by the NDB's Independent Evaluation Office confirmed that the project achieved its core development objectives, contributed to sustainable urban growth, and aligned strongly with China's low-carbon transport strategy and the Sustainable Development Goals.

4. SUCCESS FACTORS

Several factors explain the success of the Luoyang Metro Project, with the NDB playing an important catalytic role. The project aligned with national policies promoting green urban mobility and provided an opportunity for multilateral development financing to support sustainable infrastructure in medium-sized cities, an area where the NDB demonstrated impact.

The Whole-of-Government Approach: As this was the first metro line developed in Luoyang city, the project received strong commitment and oversight from both the municipal government and LRTC, with active coordination across relevant government departments. Critical implementation challenges, such as land acquisition, conservation of archaeological relics and cultural heritage sites underneath the metro line, relocation of municipal utilities, and associated reconstruction works, were effectively addressed. To benchmark against best practices in comparable cities, LRTC and its implementing partners undertook extensive learning through site visits, technical exchanges, and reviews of earlier metro projects, while also engaging experienced external consultants to incorporate proven construction and management good practices into the Luoyang Metro Network.

Demand-Responsive Design was another success factor. Station locations were chosen to serve dense residential areas, tourist nodes, and major inter-city rail stations. Line 1 transit corridor connects east and west Luoyang with the historical city centre. It serves as a main passenger transit corridor on the north bank of the Luo River, linking industrial zones under expansion, new residential areas, and universities with commercial centres, services, and historical and cultural sites in the city core. The integration with Luoyang Railway Station and Longmen High-Speed Rail Station significantly enhanced intermodal connectivity. After Line 2 was completed in 2022, the ‘network effect’ of Luoyang metro started to become visible with rise in daily ridership.

Strong Institutional Capacity within LRTC enabled effective project delivery. The implementing agency demonstrated sound project management, close coordination with municipal and provincial authorities, and the ability to work within China’s country systems while meeting NDB requirements. Owing to efficiency gains from strong local government coordination, accurate work planning by the LRTC, and the synergy of optimal engineering techniques in various stages of construction, the project was completed 9 months ahead of schedule. NDB’s training to LRTC on procurement and disbursement also helped accelerate loan disbursement to ensure implementation.

Energy Saving Innovation. The project incorporated innovative design and technology at Line 1 stations, where the cooling source of air-conditioning system and ventilation system are separated into public areas (large system) and equipment areas (small system). Different cooling technologies are applied in the two systems, and special hardware designs are devised in different areas of the stations to reduce air-conditioning refrigeration and increase utilization of train piston wind in the tunnel for temperature control purposes. This innovation led to more than 35% decrease in station energy consumption, leading to significant cost saving and GHG emissions reduction. The new technology has received 15 national awards and has been adopted in stations of Luoyang metro Line 2 and was recommended for sector wide scale-up in China.

5. KEY TAKEAWAYS

The project proved to be a success and was completed nine months ahead of its scheduled completion date. The project completed 25.342 km of Line 1 with 19 subway stations. The Luoyang Metro achievements are not just confined to the construction of a state-of-the-art metro line in record time but also demonstrated how institutional and operational structure created by the government ensures safe and efficient management of the system.

The project illustrates how strategic multilateral financing, combined with strong local institutions and sound urban planning, can successfully deliver high-quality urban rail infrastructure in a medium-sized city. The project significantly improved urban mobility and connectivity in Luoyang while contributing to sustainable economic development.

NDB showcased its ability to support green, inclusive infrastructure that delivers tangible development outcomes, reinforcing its mandate among emerging economies.

Key takeaways include the importance of early network effects, integration with land-use planning, easy connection with bus/shared bikes and other modes of public transit, realistic financial expectations, and strong public-sector leadership. For Global South peers and MDBs, Luoyang offers a replicable model: metros need not be confined to megacities, and when carefully designed and financed, they can serve as powerful tools for sustainable urban transformation.



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