

Rail Transit Project Delivery in South Korea

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South Korea

Since 2000, South Korea has built four new light rail lines and 10 new heavy rail lines, in addition to extending four heavy rail lines, and has more expansion projects planned or under construction. The development of this new transit infrastructure is primarily underground and in dense urban areas, with some elevated and at-grade lines. The city of Seoul has a stated vision for rail stations to be located within a 10-minute walking distance of any location.¹ Line 5 and Line 9 on Seoul's subway system are among the 30 longest subway tunnel sections in the world (the vast majority are in China). Tunnel-boring machines are the country's most commonly used tunneling method.

Half of the nation's population lives in the Sudogwon capital region, which includes Seoul, Incheon, and parts of Gyeonggi province.² But other regions have expanded their rail networks, too, including with projects in Busan, Daejeon, and Daegu. The expansion of rail transit over the past 20 years was a result of government intentions to increase both travel efficiency for a growing population and access to parts of the Seoul region.³

Table 1: South Korean rail transit projects completed since 2000

Location	Project	Opened	Time to Construct (months)	Length (miles)	Percent Tunneler	Cost*	Cost per Mile*
Busan	Line 3 (Daejo-Suyeong Leg)	11/2005	96	11.4	80	4,530	399
Busan	Line 4	3/2011	87	7.9	60	2,566	326
Busan	Busan-Gimhae Light Rail Transit	9/2011	67	14.5	0	1,361	94
Busan	Line 1 Extension	4/2017	89	5.0	100	1,443	291
Daegu	Daegu Metro Line 2	10/2005	105	17.4	100	6,076	350
Daegu	Daegu Metro Line 3	4/2015	69	14.9	0	1,347	91
Daegu	Daegu Metro Line 1 Extension	9/2016	75	1.6	100	357	221
Daejeon	Line 1	4/2007	126	14.0	100	4,675	334
Gwangju	Line 1	4/2008	96	12.5	87	5,843	469
Incheon	Incheon Line 2	7/2016	85	18.1	79	3,400	188
Seoul	Line 9 Phase 1	7/2009	87	15.8	100	1,877	119
Seoul	Shinbundang Line Phase 1 (Gangnam to Jeongja)	10/2011	76	11.5	100	4,191	365
Seoul	Shinbundang Line Phase 2 (Jeongja to Gwanggyo)	1/2016	66	7.9	61	2,139	270
Seoul	Ui LRT	9/2017	107	7.1	100	1,399	198
Seoul	Gimpo Goldline	9/2019	66	14.7	100	2,198	150
Seoul	Line 7 Extension	5/2021	95	2.4	100	576	238
Uijeongbu	U-Line LRT	7/2012	60	6.9	0	674	97
Yongin	EverLine	4/2013	89	11.3	0	1,280	114

* = 2021 USD in Millions

Governance

South Korea is a presidential representative democratic republic. The president serves five-year terms and the 300 members of the National Assembly serve four-year terms. It is a civil law country.

The **central government** sets guidelines and laws stipulating planning, funding, technology, and construction rules for urban railway projects, and also provides funding for urban railways and bus rapid transit. The national Ministry for Land, Infrastructure and Transport (Molit) approves subnational master plans for provinces and metropolitan cities, and grants permits for construction activities.⁴ Molit also

establishes design requirements, conducts research, and manages privately funded projects.⁵

The South Korean government sponsors several science and technology research institutes, including the Korea Transport Institute (KOTI) and the Korea Railroad Research Institute (KRRI). KOTI and KRRI conduct research on transportation systems, safety, standards, policy, and technology.⁶ While both have similar outputs, the research emphasis at KRRI focuses on railways, including standardization of urban rail rolling stock and infrastructure, with the goal of reducing construction and operating costs.⁷

The national government funds and operates the Korean Railroad Corporation (Korail), a public corporation that operates seven heavy rail lines in the Seoul region and one line in Busan.⁸ Korail also operates intercity passenger rail throughout the country. Korea National Railway (KNR), another public corporation owned by the national government, is responsible for railway construction and track maintenance on Korail infrastructure.

South Korea has 17 first-tier subnational **administrative divisions**, including eight metropolitan cities (Seoul being among them) and nine provinces. These are further divided into cities, districts, and towns. The first-tier administrative regions play a large role in funding and planning rail transit development, along with administering other modes of transportation. Importantly, they assemble 10-year plans to guide urban railway development. These documents must be approved by the central government.⁹

Metropolitan and provincial governments build, own, operate, and maintain their own urban rail transit systems through **transit agencies**. Ownership and operation are most complicated for the Seoul Metropolitan Subway, a system that consists of 23 heavy rail, light rail, and commuter rail lines in and around the Seoul Metropolitan Area. Seoul Metro, a corporation owned by the Seoul Metropolitan Government (SMG), is the primary owner and operator of urban rail transit in the Seoul region.¹⁰ Seoul Metro is the sole owner and operator of lines 2, 5, 6, 7, and 8. Seoul Metro jointly operates lines 1, 3, and 4 with Korail. Line 9 and the Busan-Gimhae Light Rail are public-private partnerships (P3) designed, financed, built, and operated by private companies under the ownership of Seoul Metro.¹¹ For the lines that are jointly operated with Korail, the government of South Korea and the SMG share ownership.

Project planning and regulation

The national government establishes Comprehensive National Territorial Development Plans roughly once every decade. These plans, the first of which was written in 1972, establish long-term goals for land and transportation development, among other priorities.¹² South Korean provincial and metropolitan governments then create their

jurisdictional comprehensive plans based on the goals within the Comprehensive National Territorial Development Plan.¹³

The National Land Planning and Utilization Act (NLPUA) sets the statutory requirements for planning and developing rail transit projects, including transparency and public outreach.¹⁴ As part of the process, NLPUA requires opportunities for public input during the urban management plan drafting process, though there is no designated amount of time the public should be given to offer input.

Major rail projects must complete an environmental review mandated by national law. Consulting firms typically conduct environmental reviews, and the Korea Environment Institute (KEI), a government-sponsored think tank, provides a professional and “fair review” of environmental assessments.¹⁵ KEI also creates recommendations to improve environmental policy and strategies. Civil complaints sometimes delay project schedules. Many are filed by individuals looking to change the route or location of a line or to express concern over disruptions like vibrations, but they rarely result in significant changes to project scope.¹⁶

The central government’s Ministry of Economy and Finance approves projects with over \$40 million (50 billion won) in total cost that have more than \$24 million provided by the central government.¹⁷ After projects are deemed feasible, the head of the respective metropolitan government drafts a master plan. Molit then approves the construction master plan, at which point the ministry can request more specific information on project details like design plans and construction costs.¹⁸

A February 2003 arson incident that resulted in 192 deaths and 148 injuries led the South Korean national government to take a more direct role in safety regulation, including requirements for interior materials on urban railcars to be non-flammable and other safety standards and systems.¹⁹

Project funding

The national government and subnational province or metropolitan governments jointly share responsibility for project funding. Typically, project construction is funded with approximately 40 percent from national grants, 40 percent from provincial or metropolitan grants, and the remainder from bonds, which are sometimes repaid using future fare revenues.²⁰ The national government dedicates revenues from several taxes to transportation projects, including special consumption taxes on passenger vehicles and gasoline, diesel, and alternative fuel taxes.²¹ Since 1997, the national government has also levied a tax on developers for large housing projects that is then reinvested in metropolitan transit projects.²²

The Asian debt crisis in the late 1990s limited the national and local governments' ability to borrow, so rail projects in the past 20 years have used P3 financing to complete funding packages. For example, Line 9, which opened in 2009, was constructed as a design-build-finance-operate-maintain project managed by Seoul Metro.²³ The South Korean government provided 33.3 percent of the project's funds, the SMG 51 percent, and the private sector 15.7 percent with bonds. The P3 contract stipulated that ownership of Line 9 would transfer to the public sector upon completion of construction, and that the consortium would operate the line and collect fares for 30 years.²⁴

In other cases, South Korea has used non-traditional funding sources to build projects. For example, the Gimpo Goldline to Gimpo International Airport was primarily paid for by the Korea Land and Housing Corporation — a government-owned entity that develops housing — which covered 72 percent of the project costs. The city of Gimpo funded the rest of the project.²⁵ In Seoul, SMG collects a congestion charge levied on one tunnel and a traffic inducement charge on some owners of large commercial buildings, which it uses to help fund transit capital projects.²⁶

Project construction

South Korea's subway system began in 1970 with a small team of civil engineers and construction experts situated in the city of Seoul's Urban Planning Bureau. To boost its internal capacity, the bureau worked with local research institutions and sought financial and technical assistance from Japan.²⁷ The SMG's longstanding construction unit was merged with another city department in 2008 to become the Urban Infrastructure Headquarters, which now leads metro and light rail construction.²⁸ Other sub-national jurisdictions have an urban railway construction authority that is situated within the provincial or metropolitan government and consists of design, engineering, construction, and facility departments.²⁹ In P3 arrangements such as the Seoul Metro Line 9, the project is overseen by the construction entity but is managed day-to-day by a consortium of insurance companies and banks.³⁰

A range of construction methodologies have been used for tunneled projects throughout the country. The city of Seoul has counteracted geographic challenges like mountains, hills, and rivers with a range of construction technologies. Bored tunneling has been used for all underground projects since the beginning of Line 2's construction in the mid-1970s.³¹ Shield tunnel-boring machines were used on portions of lines 7 and 9 to reduce impacts to ground transportation, keep costs down, and minimize pollution.³² For the Busan Metro Line 1, the slurry wall method was used for the first time in Korea

due to the need to dig under reclaimed land beneath seawater. Shield tunnel boring was used in Gwangju to dig underneath the dense city development.³³

Land acquisition in Korea is straightforward due to the national Land Expropriation Act, which allows for the national government to acquire private land for public purpose. After the government designates an area for development, an appraisal of the land takes place and either the landowner agrees to a transaction with the government or the acquisition process is challenged if the owner disagrees on the price. In the event of a disagreement over the selling price, the landowner is still required to sell land under the law.³⁴ The national Urban Railroad Act states that project sponsors should compensate landowners based on a formula considers the value of land, depth from the surface, and negative effects on the land.³⁵ Since 2003, detailed digitization of land ownership and public utilities has allowed for better institutional cooperation and helped public entities with cost and time savings.

Takeaways

South Korea's rail network buildout over the past 20 years has established the country as a global leader in tunneled rail. Not only has the country built more than 100 miles of subway, but it did so averaging \$255 million per mile under dense, urban areas with complex topography and soils. The country also tends to build long projects: 11 of the 18 projects included in the above table include segments that are 10 miles or longer. That might bring efficiencies, particularly when using tunnel-boring machines.³⁶

Part of South Korea's success comes from a national strategy to invest in public transit systems reinforced by regional governance bodies that design and implement within the national framework. Similarly, rail transit construction is broadly popular with the public, which enables low levels of environmental or community pushback compared to in the United States.

¹ Andy Tebay, "Seoul Set for Urban Rail Expansion," *International Railway Journal*, August 16, 2017; Seoul Metropolitan Government, "Seoul Traffic Vision 2030," 2013.

² International Transport Forum, "Policy Directions for Establishing a Metropolitan Transport Authority for Korea's Capital Region," OECD, 2018.

³ Shin Lee and Yoo Gyeong Hur, "Three Innovations of Subway Line 9: Financing, Speed Competitiveness, and Social Equity," University of Seoul, 2017.

⁴ Jinsu Mun and Jun Kim, "Lessons from Korea's Railway Development Strategies," Korea Transport Institute, 2013.

⁵ *ibid*; In-Keun Lee, "Experiences in Seoul Subway Development," Proceedings from the International Tunnelling and Underground Space Association meeting, 2004.

⁶ Korean Railroad Research Institute, "General Info."

⁷ Il-Geun Oh, "Korea Railroad Research Institute," *Japan Railway and Transport Review* (36), September 2003.

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- ⁸ Gyengchul Kim and Jeewook Rim, "Seoul's Urban Transportation Policy and Rail Transit Plan—Present and Future," *Japan Railway and Transport Review* (25), October 2000.
- ⁹ Jinsu Mun and Jun Kim, "Korea's Railway Development Strategies," *The Korea Transport Institute*, 2013.
- ¹⁰ From 1994 to 2016, the Seoul Metropolitan Rapid Transit Corporation (SMRT) led construction and operations until it merged with Seoul Metro; See: Tebay, 2017.
- ¹¹ Lee and Hur 2017.
- ¹² OECD 2019; Korea Research Institute for Human Settlement, "National Territorial and Regional Development Policy: Focusing on Comprehensive National Territorial Plan," Ministry of Strategy and Finance, 2013.
- ¹³ OECD 2019.
- ¹⁴ Lee 2004.
- ¹⁵ See: Korea Environmental Institute, "Mission & Vision," 2022
- ¹⁶ Ibid.
- ¹⁷ Lee 2004.
- ¹⁸ Ibid.
- ¹⁹ Ibid.
- ²⁰ Lee 2004; Bhang 2003; Mun and Kim 2013.
- ²¹ Mun and Kim 2013.
- ²² Ibid.
- ²³ Seoul Metropolitan Government 2012; Seung-Jun Kim, "Construction of the Seoul Metro – the Driver Behind Sustainable Urban Growth and Change," Seoul Institute, 2015; Lee and Hur 2017.
- ²⁴ Lee and Hur 2017.
- ²⁵ David Briginshaw, "Seoul Gimpo Gold Line Automated Light Metro Opens," *International Railway Journal*, September 30, 2019.
- ²⁶ Haoran Chu, and others, "Funding Urban Public Transport: Case Study Compendium," International Transport Forum, 2013.
- ²⁷ Kim 2015.
- ²⁸ Ibid.
- ²⁹ Mun and Kim 2013.
- ³⁰ Tebay 2018.
- ³¹ Lee 2004.
- ³² Seoul Metropolitan Government 2012.
- ³³ Mun and Kim 2013.
- ³⁴ Ibid.
- ³⁵ Lee 2004.
- ³⁶ One study found increasing efficiencies of tunnel boring machines with distances longer than 5 km. See: Bill Grose and Aleister Hellier, "Case Study: Benchmarking tunnelling costs and production rates in the UK," UK Infrastructure and Projects Authority, undated.

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