Working Paper 2005-02

Recent Experience of and Prospects for High-Speed Rail in Korea: Implications of a Transport System and Regional Development from a Global Perspective

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I. Introduction

Korea[2] inaugurated KTX (Korea Train Express) services on the Seoul–Busan and Seoul–Mokpo lines on April 1, 2004, becoming the fifth country to run high-speed rail (HSR), following Japan, France, Germany and Spain.

KTX in service

I.1. Background and History

The concept of KTX grew from the recognition that chronic bottlenecks on the country's highways and railways, particularly on the Seoul–Busan corridor, not only caused traffic congestion but weakened the nation competitively. The Korean government also hoped that HSR would contribute to a balanced regional development by somewhat

mitigating the over-concentration of the nation's functions in the Metropolitan Capital Seoul Region (MCSR).

Preliminary feasibility studies, sponsored by the International Bank for Reconstruction and Development (IBRD), were undertaken in 1973–74 and continued with follow-up feasibility studies from 1978–1981. The basic business plan and route design for the Seoul–Busan line was unveiled in 1990. According to the business plan, the new line would be exclusively used for passenger services and the conventional lines mainly for cargo transport. In the early 1990s, a special task force was established in the Ministry of Construction and Transport (MOCT) to advance this national infrastructure project in cooperation and coordination with other government ministries. In addition, the Korean High-Speed Rail Construction Corporation was formed under MOCT to construct new lines and obtain vehicles.

A modification to the basic business plan was made in 1998, reflecting changing economic and social environments, including escalating construction costs during a financially difficult period[3] and a regional conflict between the southeast and southwest regions. In accordance with the modified plan, a new KTX line from Seoul to Daegu would be completed, and the Daegu–Busan sector would be electrified by 2004 (the first phase). KTX would also operate on the electrified Seoul–Mokpo line by 2004. The remaining work on the new Daegu–Busan line would be finished by 2010 (the second phase).

I.2. Costs and Finance

Costs were estimated to be 12 trillion Won (US$11 billion)[4] by the time the first phase was completed in 2004, and 20 trillion Won (US$18.2 billion) by completion of the second phase (2010). Actual costs greatly exceeded the original estimate.

Korea mobilized diverse financial resources to build its HSR system: 35% of funds came from the government budget, 10% from loans guaranteed by the government, and 55% from loans from domestic and foreign financial institutions. The loans would be repaid by KTX operating revenues in the coming years.

I.3. High-Speed Rail Overview

I.3.1. Benefits of High-Speed Rail

HSR is typically defined as heavy rail public transit (or transport) with speeds between 200 kmh (125 mph) and 300 kmh (187 mph).[5] It is widely accepted that high-speed rail confers many benefits. Figures

shown below are drawn from the actual experiences of France and Japan. First and foremost, high-speed rail provides large transport capacity with high speed. In Korea's case, HSR is nearly four times more efficient than highway travel. Comparing the three principal alternatives for increasing transit capacity on the Seoul–Busan corridor, HSR was deemed best in terms of transport efficiency.

Comparison of Alternatives for Capacity Increase on the Seoul–Busan Corridor (Ministry of Construction and Transport, Korea)

	High-speed rail (A)	Highway (B)	Double-track rail (C)	A/B	A/C
Construction costs	0.382 bil. Won	262	250	1.46	1.53
Transport capacity	520,000 passengers per day	25	27.5	2.08	1.89
Travel time	1 hour 56 min.	5 hours 20 min.	3 hours 50 min.	△27	△1.98
***Transport efficiency**	3.93	1	1.60	-	-

* Transport Efficiency: Transport Capacity / Travel Time x Construction Costs

HSR usually connects one city center to another, providing more convenience for travelers compared to airports, which are normally located on the outskirts of a city. The system, which relies on electricity, consumes less energy than the other alternatives (only 19% of the energy used by cars and aircraft). It also requires less land (29% of the land needed for a four-lane highway). It emits fewer pollutants like CO_2 and SO_2 (16%–18% of that from cars and aircraft). Moreover, HSR has an excellent record for safety and punctuality. It provides comfortable rides with less fatigue for passengers compared to other transportation modes. Finally, the introduction of HSR into a country facilitates the development of related technologies and industries, such as civil engineering, vehicle manufacture, industrial materials, and design. According to a survey, Japanese travelers take the Shinkansen mainly because of high speed, comfort, and punctuality of operation.[6]

I.3.2. Global High-Speed Rail Systems in Service and in Progress

With the advent of high-speed rail systems across the world during the last four decades, we seem to be witnessing a renaissance of the railway era that began in the late 19th and early 20th centuries.

Among the most distinguished high-speed rail systems presently in service is Japan's Shinkansen (sometimes called a 'bullet train,' its literal translation means 'new trunk line'), which was completed just before the Tokyo Summer Olympics in 1964. It currently maintains an extensive network of about 2,000 kilometers in a country with a population of 130 million. The Shinkansen has three classes of compartments: Nozomi (speed of hope), Hikari (speed of light), and Kotama (speed of sound). France's TGV (Train à Grand Vitesse) was launched between Paris and Lyon in 1981. It now has four lines (Northeast, North, Atlantic, and Alps) covering 1,500 kilometers. Germany's ICE (Inter City Express) began operation in 1988. It now has a network of 427 kilometers, linking Hanover and Würtzburg, and Manheim and Stuttgart. Spain's AVE was put into service in 1992 before the Barcelona Summer Olympics took place and now runs 417 kilometers between Madrid and Seville. Apart from the traditional high-speed rail systems mentioned above, there is a maglev (magnetic levitation) system that runs a short distance of 30 kilometers between downtown Shanghai and Pudong Airport in eight minutes. The system has been in service since 2003.

In the United States, several states have been preparing for the construction of high-speed rail. The state of California has already set up business plans to build a 700-mile network between San Diego and Sacramento that could transport up to 68 million passengers per year by 2020, and involves an investment of US$35 billion.[7] The proposed system stretches from San Francisco, Oakland, and Sacramento in the north to Los Angeles and San Diego in the south. With high-speed trains operating at speeds up to 220 mph, the express travel time from downtown San Francisco to Los Angeles would be just under 2½ hours. The system's design would enable intercity travelers (taking trips between metropolitan regions) and long-distance commuters to connect with existing rail, air, and highway systems.[8] A bond measure to mobilize financial resources necessary for construction will be decided by a state referendum in 2006.

Japan's Shinkansen

France's TGV

Along the Washington, DC–New York corridor, the Acela Project introduced a faster form of rail transit. The state of Florida, too, has concrete plans to build high-speed rail between Orlando and Miami.[9] Many recent studies conclude that US cities will see multiple economic, social, and environmental benefits from rail transit (including conventional heavy rail, light rail, metro, and high-speed rail).[10]

Planned high-speed rail network in California

II. KTX Operation

II.1. KTX Vehicles

The vehicles used for Korea's high-speed rail system were imported by Alstom (the French company that manufactured TGV vehicles) or manufactured in Korea under license by Alstom. In all, 12 vehicles were imported from the French manufacturer, and 46 vehicles were produced in Korean plants. The train's length measures 388 meters, with 20 fixed compartments and a total of 935 seats—127 first-class seats configured three to a row, and 808 economy-class seats configured four to a row. The train has a traction power of 13,560 kw (18,200 HP) and reaches its maximum cruising speed of 300 kmh (185 mph) in 6 minutes, 8 seconds.

II.2. KTX Lines

Because Korean topography is mountainous, many KTX routes pass through tunnels (46%) or over bridges (26%). The Seoul–Busan line stretches 412 kilometers and passes through 9 stations: Seoul, Yongsan, Gwangmyung, Choanasan, Daejon, Dongdaegu, Milyang, Gupo, and Busan. Three of the stations are located in the Seoul metropolitan area—Seoul, Yongsan, and Gwangmyung. The average distance between stations is 58.9 kilometers.

KTX Network

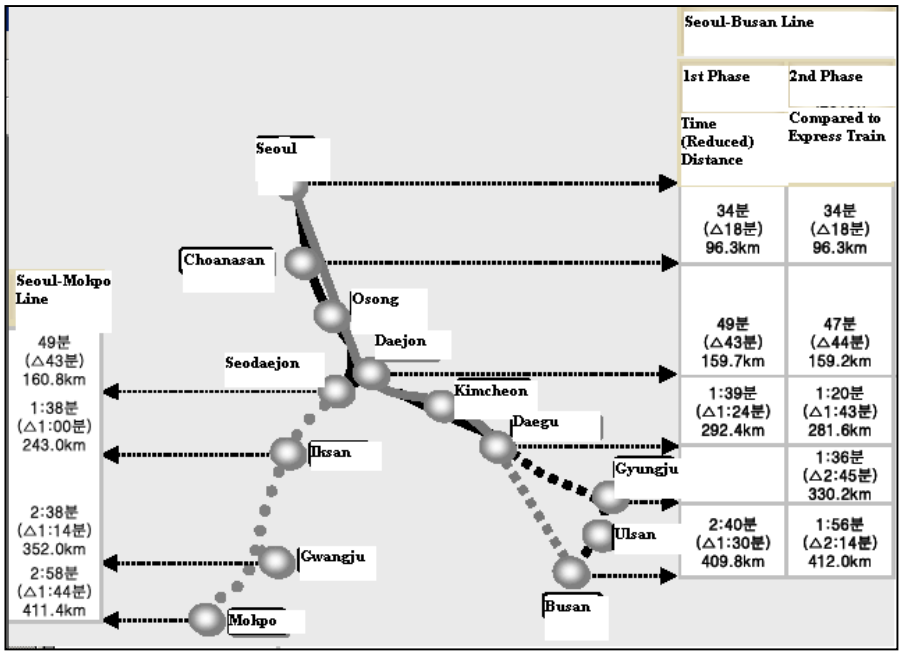
The Seoul–Mokpo line runs 407 kilometers and also has 9 stations—the same stations on the Seoul–Busan line from Seoul to Daejon, plus Seodaejon, Iksan, Songjongri, Gwangju, and Mokpo). The average distance between stations on this line is 58.1 kilometers.

II.3. Operation

II.3.1. Running Times, Fares, and Schedules

On the Seoul–Busan line, going from Seoul to Dongdaegu (222 kilometers) takes 1 hour and 40 minutes (down from 3h:3min) and costs 34,900 Won (US $31.70). Traveling from Seoul to Busan (412 kilometers) takes 2 hours and 40 minutes (down from 4h:10min) at a cost of 45,000 Won (US $40.90). On the Seoul–Mokpo line, the trip from Seoul to Gwangju (352 kilometers) takes 2 hours and 38 minutes (down from 3h:52min) and costs 36,000 Won; the trip from Seoul to Mokpo (407 kilometers) takes 2 hours and 58 minutes (down from 4h:40min) at a cost of 41,400 Won. The average KTX fare is 1.3 times that of conventional express trains.

Ninety-six KTX trains depart from and arrive at Seoul Station. Due to lesser travel demand elsewhere, fewer trains stop at the other stations—



KTX: Distance and Time

87 at Daejon, 80 at Dongdaegu, 64 at Busan, 16 at Gwangju, and 14 at Mokpo.

II.3.2. Management and Maintenance of KTX

In 2003, the National Assembly passed a law, as part of the railway reform package that had been pushed by the government since the early 1990s. Following the example set by most other rail-running countries of the world,[11] the law aimed to separate operation and maintenance of Korea's railways, as well as increase efficiency and secure accountability in management. The construction of KTX lines was undertaken by the Korea High-Speed Rail Construction Corporation, and conventional railways were managed and maintained by the Korea National Railway Administration.

Under the new law, KORAIL—a government agency slated for semi-privatization in 2005 in accordance with the legislature mentioned above—became responsible for the management and operation of KTX and conventional railways, while KR (Korea Rail Network Authority), which is also a semi-privatized entity, undertook the construction and maintenance of KTX and conventional rail facilities.

III. Transportation and Regional Development in Korea

III.1. Transport Condition

III.1.1. General

The nation encompasses 98,480 square kilometers (the Korean peninsula is 219,020 sq. km.), and in 2003, boasted a population of 48.5 million. In terms of population density, Korea currently ranks 11th in the world. Mountainous areas occupy more than 70% of the land. Its neighbors include China (population: 1.3 billion), Russia (population: 150 million), and Japan (population: 130 million), which rank among the larger countries of the world. Korea could well become a center for logistics, connecting huge markets, if it can improve its infrastructure—including higher-capacity ports and airports—and management to better accommodate passengers and freight from neighboring countries. Currently, Korea's railway network extends 3,125 kilometers and, due to rapid motorization and urbanization across the country over the last four decades, it also possesses a relatively extensive highway network of 86,900 kilometers. While no new rail lines have been added since 1945 (when the country achieved independence from Japanese colonial rule), the road network has expanded at an enormous rate.[12]

III.1.2. Two Main Corridors

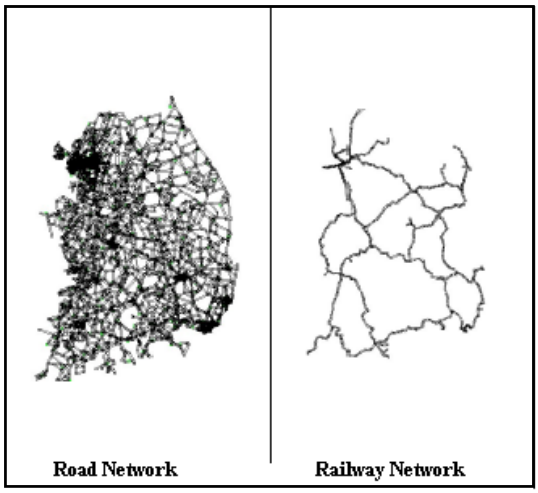
Korea has two main transport corridors and much of the country's development has occurred along them. The Seoul–Busan corridor runs southeast from Seoul. Over 70% of the population resides along the corridor, and over 70% of the nation's GDP is produced along it. In addition, about two-thirds of passenger trips and 70% of all cargo trips originate there, since most of the nation's industrialization and urbanization has been concentrated along this axis. The other corridor, Seoul–Mokpo, runs southwest from Seoul. More farming areas lie along this route and, hence, lighter travel demand.

III.1.3. Road-Oriented Transport System

In terms of total passenger transport, roads accommodate 55.9%, railway 20.6%, subway 17.4%, air 5.6%, and maritime 0.4%. As a percentage of total cargo transport (in tons), roads carry 70.7% of cargo transport, maritime 21.8%, railway 7.4%, and air 0.1%.

The road-oriented transport system of the country has brought about some negative effects. For example, chronic roadway congestion has resulted in high logistics costs (16% of GDP compared to 10.7% in US),[13] a high ratio of traffic accidents (250,000 fatalities of persons per

year, or 0.52% of the total population), and higher energy consumption (77.6% of total transport sector energy use), in addition to air pollution, noise, and other costs. In addition, a US report has suggested that urban pollution causing ozone-layer depletion is closely linked to higher death rates in cities and metropolitan areas.[14]



Korean Transport Network (Cho, Nam-Gun, KRHIS Report, 2003)

III.2. Regional Development

III.2.1. Over-Concentration in Metropolitan Capital Seoul Region

The Metropolitan Capital Seoul Region (MCSR)—Seoul, Incheon City, and Gyunggi Province—comprises only 12% of South Korea in terms of its physical size. However, the region's population is about 22 million, or 45.3% of the total population in 2002,[15] making it the third largest metropolitan area in the world, after Tokyo and Mexico City.[16] Moreover, its population density is higher than that of any other metropolitan area in the world, and its degree of population concentration is much higher—compared to 18% in Paris and 32% Tokyo. During the country's period of industrialization and urbanization, people in rural areas flocked to larger cities—mostly to the MCSR—due to labor surplus in the agricultural sector.

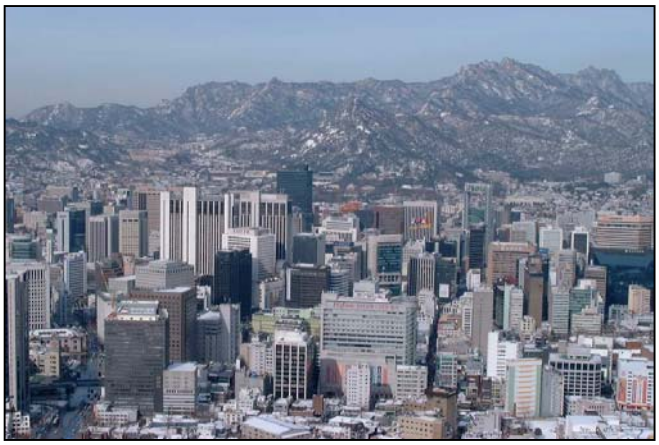
The nation relies heavily on the Metropolitan Capital Seoul Region in every respect. It is a super-hub of administrative, economic, and cultural activities. Located in this region are 84% of the country's public

Map of Metropolitan Capital Seoul Region

offices, 65% of its universities, and 91% of major corporate headquarters. The region's congestion exacts enormous socio-economic costs in transportation, housing, and pollution.[17] The MCSR, only an hour's drive from the Demilitarized Zone, is also a source of national security concern.

Deconcentration policies attempted by previous administrations over the last three decades—such as special incentives for industrial complexes built in other regions and annual quotas for factories in the capital region—have been neither successful nor effective. The policies were intended to constrain the MCSR's growth through a zoning system and move public agencies, universities, research facilities, and companies to other regions. However, without stronger policies and measures designed to both encourage relocating from the capital region and commuting from the local regions, deconcentration of the region is not likely to be achieved.

Though the government tried various means of implementing more effective policies, the MCSR continued to grow in population, activity, wealth, and power, while local regions saw continuing decline and shrinkage, creating a vicious cycle. Vested interests of the region's wealthy and powerful have encouraged staying with the status quo. Despite stronger government policies aimed at dispersing the population across the country, the elite will not be so quickly moved out of the MCSR.



Downtown Seoul

III.2.2. Regional Disparity in Development

From the 1960s to the 1980s, major infrastructure investment and development was concentrated primarily along the Seoul–Busan corridor, resulting in a great disparities in regional development. The MCSR, for example, produces 46% of the nation's GDP, the southeast region 23%, the southwest region 11%, and other regions 20%.[18]

Recently, the government embraced a firmer approach to achieve balanced regional development. Among the measures are plans to relocate government and public agencies to outlying regions, and even to transfer powers enjoyed by the central government to them.

IV. Actual Traffic and Services

IV.1. Traffic After Start of KTX Service

IV.1.1. Traffic Data[19]

A total of 6,415,000 passengers, an average of 70,000 passengers per day, rode the KTX since its inception April 1, 2004, through June 30, 2004—46.4% of the ridership forecasted by the Korea Transport Institute in 2003. This result, much less than expected, was attributed to the recent economic slowdown, inconvenience of getting to KTX stations, and only partial completion of the entire project. Because only the first phase was complete—a new line serving the Seoul–Daegu sector—KTX experienced some difficulty attracting passengers along the Daegu–Busan sector. Passenger load analysis might be premature at this stage, however, as other countries running high-speed rail experienced similar disappointment during their initial operations.

IV.1.2. Travel Patterns of KTX Passengers

The characteristics of Korea's high-speed rail travelers fall in line with those of other HSR-running countries. KTX riders are predominantly between the ages of 21 and 50 (83.9%); 14.3% are over 50 and a mere 1.8% are younger than 20. Many KTX passengers (36.6%) travel to visit families and relatives, 35.2% travel for business, and 19.5% for tourism. More than half (51.3%) of KTX passengers previously traveled by conventional express train, 18.7% by air, 13.2% by automobile, and 12.9% by intercity express bus. Riders reached KTX stations through various means: 49.6% arrived by subway, 13.9% by bus, 21.1% by taxi, and 12.7% by automobile. Compared to other countries, the share of taxi usage in Korea is larger due to low taxi fares—US$1.50 for basic distance by standard taxi—the ready availability of taxis, and the many different classes of taxis accommodating customers' needs.[20]

IV.1.3. Conversion from Other Modes of Transport to KTX

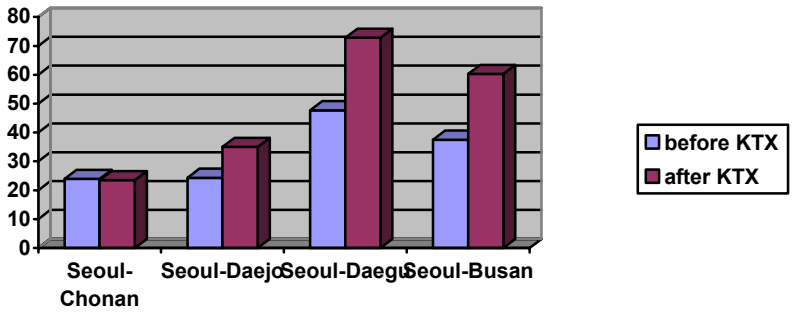
As other HSR-operating countries have experienced, Korea anticipates that the launch of KTX service will convert trips presently made by other modes of transport—conventional railway, intercity bus, automobile and airplane—to high-speed rail.

IV.1.3.1. From Conventional Railway to KTX

In the Seoul–Chonanasan sector, 3.4% of rail travel switched to KTX; on the Seoul–Daejon line, 14.1%; on the Seoul–Daegu line, 26.9%; and on the Seoul–Busan line, 36.2%. The percentage of total travel converted from conventional railway was higher for longer trips than shorter ones. After the inauguration of KTX service, average travel distance per passenger also changed: 282 kilometers by KTX and 120 kilometers by conventional rail, down from 182–210 kilometers.

IV.1.3.2. From Other Modes to KTX Plus Conventional Rail

30.4 % of travel on the Seoul–Busan corridor switched from other modes of transport to KTX and conventional rail, which means that newly introduced KTX services resulted in an overall increase in rail travel in Korea. On the other hand, there was a relatively small increase in travel by rail on the Seoul–Mokpo corridor.



Change of Transport Share by Rail
(Lee Chang-Woon, Research Report, 2004)

IV.1.3.3. From Inter-city Bus to KTX

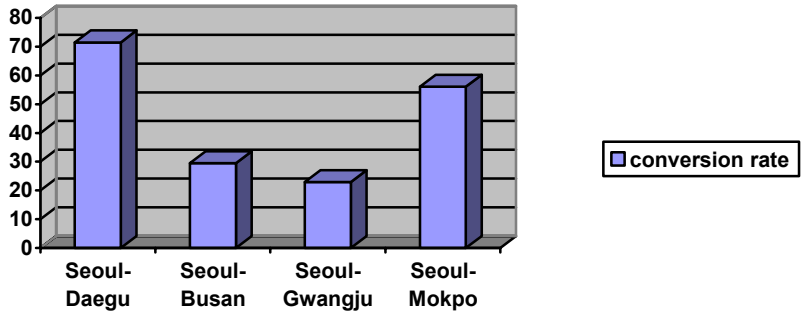
Of all travel in the Seoul–Daegu sector, 21.5% switched from inter-city bus to KTX; in the Seoul–Gwangju sector, 7.7% switched; and in the Seoul–Mokpo sector, 14.5% switched to KTX. However, for short trips to the Chonanasan area, travel switched from rail to intercity bus, probably because conventional rail service was curtailed with the introduction of KTX, and there are still relatively few KTX stations at present.

IV.1.3.4. From Automobile to KTX

Travelers also switched from automobiles to KTX in the Seoul–Daegu sector (15%) and in the Seoul–Busan sector (20%), which primarily reduced highway traffic.

IV.1.3.5. From Air to KTX

The most dramatic change after the inauguration of KTX was the mode switch from domestic air services, mostly on longer hauls. In the Seoul–Daegu sector, 71.5% of air travel switched to high-speed rail; in Seoul–Busan, 29.5%; in Seoul–Gwangju, 22.9%; and in Seoul–Mokpo, 56.1%. Flight times of less than one hour are not economically viable, even in such a small country as Korea. Except for services to and from Jeju Island, which is located about 200 kilometers from the peninsula, domestic air services will likely yield to KTX after the second phase is completed in 2010.



From Air to KTX

IV.2. Services

KTX has a reputation for good service, in general, although it encountered some minor delays and technical difficulties during its initial period of operation. Passenger dissatisfaction included reverse-direction seating, insufficient leg-room in economy class, malfunctioning audio systems inside compartments, and higher fares compared to other forms of transit.[21] About half of the seats in compartments are positioned in reverse direction, just as the French manufacturer places them in trains used in European and other countries. Though riders in other countries rarely complain about the positioning, many Korean passengers dislike the reverse-direction seating, allegedly due to cultural differences. Because of low demand for those seats, KORAIL is planning to reposition them to face forward to accommodate customer preference.

Another issue among riders is the difficulty of accessing KTX stations and the inconvenience of connections between KTX stations and other transport terminals such as bus, subway, and taxi. KTX stations currently lack bus terminals, and taxis are limited because of a licensing system that permits taxis to operate only in areas and stations for which they are licensed. In addition, the number of taxis is regulated by the annual quota system, which is administered by regional transportation authorities.

V. Impact on Transport System

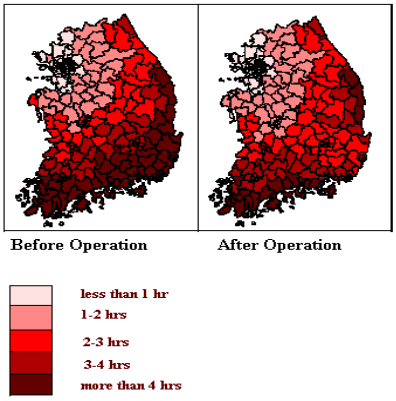
V.1. Capacity Increase

The capacity of Korea's railway transport system (KTX and conventional railway) will be dramatically increased when the second phase of the project is completed in 2010. Passenger transport capacity is expected to increase 3.4 times, from 180,000 per day in 2003 to 620,000

in 2010. Cargo capacity is anticipated to increase by 7.7 times when a new line on the Daegu–Busan sector is put into service in 2010. In addition, conventional wisdom asserts that many socio-economic benefits will result from mitigating congestion and saving travel time—amounting to an estimated $1,850 billion Won per year (US$1.68 billion) according to a study by the Korea Transport Institute, "Expansion of 'Daily-Life Zone' and Change in 'Equal Transport Time Zone.'"

Much as all roads lead to Rome, in Korea all roads lead to Seoul, its capital city. Since the introduction of KTX services, 60% of the country's total population now lives within a Daily-Life Zone, defined as the zone or area where one can commute up to three hours, round-trip, work for 6–8 hours, and return home the same day.[22]

KTX service also increased the size of the "Equal Transport Time Zone," defined as a zone one can reach in a given time from Seoul, regardless of transport mode. The zone mapped below, which can be traversed from Seoul in 3–4 hours, expanded from 72.4% to encompass 88.5% of the country. Subsequently, the size of the zone requiring more than four hours of travel from Seoul decreased from 27.6% to 11.5% after the introduction of high-speed rail services in Korea.



Equal Transport Time Zone (Cho, KRHIS Report , 2003)

Another change included the expansion of commute areas to and from the MCSR. According to a survey,[23] about 11% of the workers in Chonanasan region—96.3 kilometers from Seoul—who are now living separated from their families in Seoul, are likely to move to Seoul now that commuting has become possible. (Door-to-door travel now takes

only 1.5 hours, including 34 minutes for the KTX ride.) However, commuting from Daejon—159.7 kilometers from Seoul—is less likely due to a good two-hour travel time and high fares.

V.2. Cargo Transport System

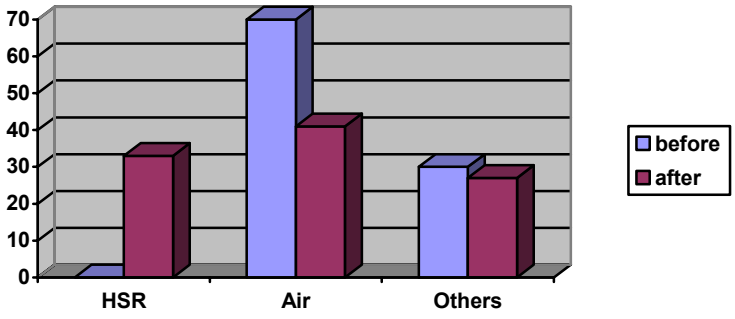
Because KTX presently serves only passengers and the Seoul–Busan line is only partially completed, cargo transport capacity by rail will not substantially increase until the second phase is completed in 2010. After that, conventional rail lines will be able to transport cargo solely, particularly along the Seoul–Busan corridor. More than 90% of cargo transport along the Seoul–Busan corridor currently moves by truck. A cargo trip on conventional railway lines in that sector takes about 10 hours; by highway, the same trip takes roughly 7 hours. Cargo transported by railway along the Seoul–Busan corridor is transferred from containers to trains at Busan Port, the world's third largest container port, unloaded at Euiwang ICD (Inland Container Depot), located in a suburb of the MCSR, and then delivered by truck to individual destinations.

Busan Container Port

Euiwang ICD: Inland Container Depot

V.3. Lessons from Other Countries Operating High-Speed Rail[24]

Soon after TGV services were launched in France, travel on the Paris–Lyon line increased 2.6 times between 1981 and 1985. A third of that growth came from the mode switch from air to high-speed rail, 18% came from former road travel, and 49% was attributable to newly generated travel demand. When Eurostar commenced service between Paris and London in 1995, transport mode shares changed dramatically: high-speed rail went from 0% to 33%, air from 70% to 41%, and others from 30% to 27%—indicating travel was diverted mostly from air service. TGV also operates on conventional rail lines to increase speed and expand service area. In Germany, travel more than doubled between 1988 and 1993, the initial period of ICE service. Twenty percent of this increase was diverted from road and air to high-speed rail.



Transport Share before/after Eurostar Operation
(Lee, Chang-Woon, KOTI Report, 2003)

In Japan, the Shinkansen brought about revolutionary changes in people's lives—in particular, a much-reduced travel time and the enlargement of the daily life zone, which in turn generated new travel demand. The conversion to high-speed rail from other transport modes was much greater for trips less than 800 kilometers than for longer trips, and as a consequence, air service between Tokyo and Nagoya was greatly reduced. The Shinkansen's operation resulted in increased investment in high-speed rail, encouraged by its great efficiency and rapidly growing travel demand. Indeed, the entire rail sector saw a large investment increase. The ratio of highway to high-speed rail investment tilted greatly in favor of high-speed rail: 260 times greater in 1966, 1.27 times in 1970, and 1.14 times in 1975.[25]

In sum, most high-speed systems in the world have been built along densely populated main corridors simply because they must meet high traffic demand to be economically and commercially viable. High-speed rail is more competitive than air travel on trips of up to three hours, or about 750–800 kilometers.[26] High-speed rail services have also changed people's travel patterns, particularly when using inter-modal connections between high-speed rail and air. For example, when traveling between Brussels and Rome, passengers now take the TGV between Brussells and Paris (a short haul), and then choose air services between Paris and Rome (a longer haul).

VI. Impact on Regional Development

VI.1. Deconcentration of the Capital Region

The KTX itself is not a cure for the concentration problem in the capital region. Without a more cohesive policy aimed at boosting regional development, reducing the region's concentration will be difficult, as commute zones are growing and much of Korea has virtually become a daily-life zone, thanks to KTX services.

VI.2. Stimulus for Development near KTX Stations

By facilitating nearby development, KTX stations could become foundations for new city development or revitalization. For example, before the arrival of KTX, the Yongsan district was sluggish and in decline. Now, in addition to the Yongsan KTX Station, the district boasts a complex with an electronic and computer center, cultural facilities, a shopping and fashion arcade, restaurants, and a parking lot. It has become a model for district development in Seoul. Moreover, development of cities and regions where high-speed rail stations are located will occur more quickly, with KTX stations becoming new multi-development

Yongsan KTX Station

centers of regional growth. New town development plans in the vicinity of the Chonanasan (70,000 acres) and Gwangmyung KTX stations (486 acres) are prime examples. Though high-speed rail may spur local regional development, it does not necessarily ensure balanced growth.

VI.3. Other Effects on Regional Development

Tourism and service industries along KTX corridors are expected to grow, just as they have in other countries operating high-speed rail. Land prices, however, will also rise in the areas along KTX corridors, particularly in areas close to the stations. KTX service will likely entice some people to move from remote rural regions (such as Gangwon and Chonbuk) to areas near KTX stations, mostly located in larger cities.

VI.4. Korea's New Policy for Balanced Regional Development

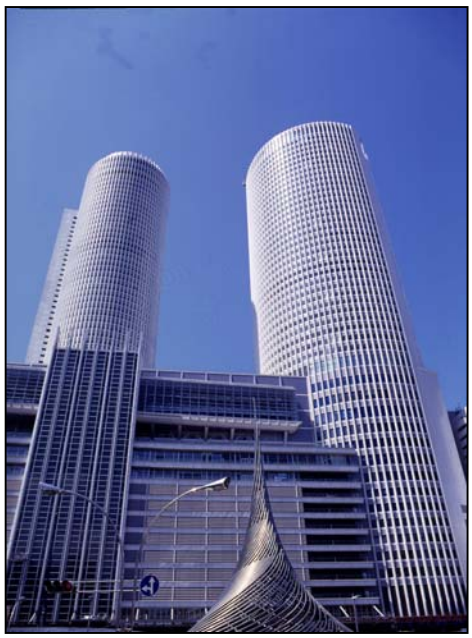
After the present government took office in 2003, it advanced a number of firmer policies intended to bring about balanced regional development. Among them was a government plan to move public agencies and private companies to nearby cities—especially to areas where KTX stations are located. As a result, a total of 268 agencies are slated to move to local regions by 2012.

The government also has been trying to establish regional innovative clusters—a complex task requiring industry, academia, and local government to cooperate closely to succeed. In addition, it has employed 'company city,'[27] 'compact city,' and 'new self-sufficient city' (e.g., with high-tech industrial complex) concepts in many projects to disperse functions from the capital region and achieve the balanced regional development objective.

Nevertheless, the government must proactively work to help less-developed areas grow. In order to reform the culture of governance in substantive ways, it must delegate authority from the central government to local governments and provide regions with additional manpower and financial resources.

VI.5. Experiences of Other Countries Operating High-Speed Rail

In Japan, most high-speed rail stations became city centers with transit terminals, hotels, offices, department stores, cultural facilities, restaurants, shopping arcades and parking, while also contributing to redevelopment of surrounding areas.[28] Osaka, Japan's second largest city, became a new regional center of growth as the Shinkansen's network expanded. Tourism and the service industry grew rapidly in cities, like Hiroshima and Fukuoka, where high-speed rail stations were located.



Nagoya Station

The Shinkansen also has influenced business activity; many companies have moved their branch offices to cities with high-speed rail stations. Among cities with high-speed rail stations, those that grew were better able to absorb the new growth and received a greater level of support from the central government. The Shinkansen seems to have alleviated overcrowding in the Tokyo metropolitan region, contributing to more balanced regional development in the country.In France, large cities with populations over 500,000 experienced growth. Le Mans, for example, successfully shifted to a high-tech industry base, and Lille became a transport hub. However, conflicting views have arisen about the deconcentration of the Paris metropolitan region after the introduction of TGV service. Many claim that a pull effect, a kind of centripetal force towards the Paris metropolitan region, has been working for short-distance areas, whereas a push effect—outward from the capital region—has been working for long-distance areas.

In short, high-speed rail service has worked as a catalyst to stimulate city growth, promoting development of areas adjacent to high-speed rail stations, additional high-speed rail stations along the corridor, increased commuting, and the development of service industries and tourism along high-speed rail corridors.[29]

VII. Lessons and Future Prospects

VII.1. Lessons from the Korean Experience

The decision-making process for the route along the Daegu–Gyungju–Ulsan–Busan sector was very complex. Strong opposition mounted against a proposed route through the outskirts of Gyungju, out of concern for environmental and cultural preservation of this UNESCO-designated cultural heritage. Civic groups, environmental and cultural heritage experts, government organizations, and lawmakers took part in this debate, which lasted nearly three years. In the end, a route around Gyungju City was adopted. Another debate revolved around whether the route should take a shortcut to Busan or go through Gyungju and Ulsan, an area known as the Southeast Coast Industry Base with heavy industry and a population of three million. The government finally settled for an economically viable alternative to the shortcut. The construction of that route is now underway as part of the second phase of the project.

Concern and criticism grew over the escalating construction costs of this huge national infrastructure project. During the first phase, costs ballooned from 585 billion Won to 1,074 billion Won, and finally to 1,274 billion Won, allegedly due to increasing costs of purchasing land from

private owners and to inflation of overall prices because construction was delayed longer than originally anticipated.

The original plans had to be modified during construction when closed mines were discovered underneath the planned route. Concern about the KTX's safe operation prompted the National Audit Board and other professional safety agencies to conduct thorough safety inspections and monitor construction.

Another conflict erupted over whether the Daejon and Dongdaegu stations should be built above or below ground next to present railway stations. The construction plans for these two stations have flip-flopped repeatedly over nearly a decade, from underground to surface and vice versa. Those who favor an underground station assert that it would mitigate a deepening city divide, whereas proponents of a surface station cite lower construction costs and increased safety. Conflicts of interest and differences of opinion still persist between central and local governments, local governments and district residents, and professional experts and politicians. Until construction of the two new stations is complete, however, the KTX must slow to less than 30 kmh as it enters the two downtown stations on conventional track.

Naming a KTX station at the border of two cities (Choan and Asan) also became a long and difficult process. After several years of regional rivalry and disagreement over the name, an advisory committee was established in 2003 under the Ministry of Construction and Transport to select names for some KTX stations. In this particular case, the committee deliberated for some months before deciding that the station's name would be Choan-Asan.

Also of note is a Buddhist nun who staged several hunger strikes in recent years to protest the construction of a tunnel under Mount Cheonsung, some 30–40 kilometers from Busan. She demanded an extensive and thorough environmental impact assessment around that area, to be made by a joint committee consisting of government-appointed experts and environmental NGOs. The environmental impact study, however, had been undertaken from 1992–1994, before the construction of the high-speed rail line was launched, and was followed by an official government promulgation of the decision to start construction.[30] Many tunnels have been constructed—underground, in the mountains, in waterways, and within cities, even during the first phase of the project. The High Appellate Court in the Busan district upheld a decision by a local court which gave the go-ahead for construction of the tunnel as planned. The protester ignored the court ruling and staged a second, longer hunger strike. Construction was once more stopped by this

incident, de facto nullifying the court decision, and consequently incurring large cost overruns and further delaying the second phase of the national project.

VII.2. Current Limitations and Difficulties

Partially opening the Seoul–Busan Line will not accommodate the transport demand along that corridor, especially for cargo. Electrifying the Daegu–Busan sector, where KTX and conventional rail run on the same track, will not reduce congestion there until the second phase of the project is completed in 2010. Although cargo will enjoy exclusive use of conventional railway lines when a new line has been completed on the Seoul–Busan corridor, it will suffer in the interim from shortage of travel time-slots. Another problem lies in the fixed number of compartments per train, which make accommodating fluctuating travel demand difficult. When Korea signed a contract for vehicle manufacture, it expected that travel demand would justify the design. However, during the week many seats remain empty.

VII.3. Future Tasks

VII.3.1. Completion of the Second Phase

Since cargo transport will use the conventional railway line when the new line has been constructed, on-time completion of the second phase is very critical for addressing capacity shortage. In 2010, cargo transport by rail is expected to dramatically increase by 7.7 times.

Many difficult issues remain to be solved during the second phase. As mentioned above, the first action is to decide as soon as possible whether Daejon and Daegu stations will be built above or below ground.

Also in the second phase, new stations will be added to existing KTX corridors. Additional stations will bring better accessibility, expanded KTX service, and regional development. However, the addition of more stations means the KTX must run at a slower speed, increasing passengers' travel time. As other countries with high-speed rail[31] have learned, though, trains do not necessarily have to stop at all stations; they can stop, for example, at odd-numbered stations or limit stops at stations with lower travel demand. Competition for new stations is stiff among cities along the KTX corridor; some even exert political pressure on decision-making bodies like the Ministry of Construction and Transportation. At present, 4–5 additional KTX stations are under consideration for the second phase of construction.

The development of a prototype Korean high-speed rail vehicle is nearing completion. When Korea began efforts to introduce high-speed rail service in the early 1990s, it also began to undertake the G-7 project, a collaboration of government, research institutes, academia, and industry to develop a Korean prototype high-speed rail vehicle. Overcoming many development obstacles, the consortium has tested the prototype successfully in recent years and has achieved a vehicle speed of more than 300 kilometers per hour. A few more years of work are anticipated before the system is fully stabilized and can be put into commercial operation. In contrast to current KTX vehicles, the Korean prototype has a unique design, which allows the number of compartments to be adjusted according to demand.

Korean Prototype high-speed rail (Korea Railway Research Institute)

Improving the accessibility and connectivity of high-speed rail stations is another pressing need—to provide travel convenience, attract more passengers and, ultimately, make the KTX economically viable. Good connections between KTX stations and international airports are important because they can drive more traffic to both airlines and KTX. Currently, railway connection work, scheduled for completion by 2008, is underway between Seoul and Yongsan KTX stations, at one end, and Incheon International Airport[32] at the other. Once completed, KORAIL and the airlines will likely draw up a mode-sharing agreement to their mutual benefit. In addition, inter-modal KTX stations—through which all transport modes (such as KTX, inter-city express bus, subway, and taxi) could be linked to each other—need to be expanded.

VII.3.2. Construction of New Lines

KTX service is in place on the existing electrified line along the Seoul–Mokpo corridor, but is hampered by serious limitations on capacity and speed. (Top speed is only 160–170 kmh.) For this reason, the Korean government is planning to build a new line to meet future travel demand. In addition to this was a plan in the mid-1990s to build high-speed rail with private capital along an east-west corridor, linking Seoul to the east coast—a major tourist destination for city dwellers. This project, however, has yet to materialize because private investors who can develop the areas along the proposed line cannot be found. When all planned lines are completed, Korea's high-speed rail network will extend nearly 1,000 kilometers.

VII.3.3. A Rationalized Future Transport System in Korea

Comparing its high-speed rail experience with that of other countries, Korea should rationalize its transit system in the following ways: emphasize urban rail and bus in metropolitan areas; conventional rail, KTX, and intercity express bus for distances between 100 and 200 kilometers; KTX for distances between 200 and 400 kilometers; and KTX and air services beyond 400 kilometers. France and Japan demonstrate similar emphases in their transport systems.

VII.3.4. Reconnecting the Missing Link between South and North Korea

A grand railway network linking Korea from Japan[33] to Europe via China and Russia—the so-called Eurasian Railway—has long been envisioned. By completing the 12-kilometer link between South and North

Eurasian Railway

Korea, cargo could be transported through either the Trans-Siberian or Trans-China Railway once it is shipped from Japan or Korea to Russia or China. A container freight train running from the Far East to Europe on the Eurasian Railway would make shipments less expensive and encourage competition between railway and maritime modes. Because many countries would benefit substantially from the link's completion, many attempts have been made to bridge the gap at both the international and the regional level. However, this issue likely will not be resolved without a genuine reconciliation or rapprochement between the two Koreas.

VII.4. Rethinking Sustainable Transportation and Regional Development

High-speed rail is an energy-saving and environmentally friendly mode of transit. Despite new investment by transportation authorities, highways and roads in dense metropolitan areas are becoming more congested. According to recent statistics, global oil demand amounted to 82.4 million barrels per day in 2004. The U.S. consumes 20 million barrels per day (about 25% of world demand), importing 56% of its total demand—20% of it from the Persian Gulf.[34] In addition, oil prices fluctuate wildly, partly due to the volatile situation in the Middle East. Unless oil consumption is reduced, energy independence cannot be accomplished. The development of alternative energies (e.g., hydrogen) is important in the event oil prices rise to unaffordable levels or world oil reserves are reduced or ultimately depleted.

The concepts of transit-oriented development (TOD)[35] and smart growth,[36] which encourage greater use of public transit as a means of achieving sustainable development, would go a long way toward solving the problems faced today. Integrating work with residential areas and city functions with business activity will reduce travel demand substantially. Korea would very likely follow such a trend in transport and regional development.

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www.abag.ca.gov/planning/smartgrowth

Notes

[1] This paper is based on a presentation given by the author at a Visiting Scholars Roundtable on November 17, 2004, under the auspices of the Institute of Urban and Regional Development at the University of California, Berkeley. The presentation of this subject matter is grounded in the author's professional experience as Director General in the Ministry of Construction and Transport in Korea, directing the nation's high-speed rail project during 2002–2003. The opinions expressed in this article are those of the author and do not necessarily represent those of the Ministry of Construction and Transport.

[2] The Republic of Korea (South Korea) is located geographically in the southern part of the Korean peninsula, as distinguished from North Korea.

[3] Korea experienced a financial crisis caused by the shortage of foreign exchange reserve in 1997.

[4] 1 USD was equivalent to 1,100 Korean Won as of November 2004.

[5] The International Union of Railway's high-speed task force provides definitions of high-speed travel, however, there is no single definition of the term, but rather a combination of elements—new or upgraded track, rolling stock, operating practices—that lead to high speed rail operations. http://www.uic.asso.fr/d_gv/toutsavoir/definitions_en.html

[6] Lee, Chang-Woon, 2003.

[7] During 1992–1993, the Institute of Urban and Regional Development at the University of California, Berkeley, undertook a research project on high-speed rail in California, which produced many workings papers; see references.

[8] California High-Speed Rail Authority: http://cahighspeedrail.ca.gov

[9] Railway Technology: http://www.railway-technology.com

[10] For example, Litman, Todd, *Evaluating Public Transit Benefits and Costs: Best Practices Guidebook*, Victoria Transport Policy Institute, Oct. 2004.

[11] In Japan, construction and maintenance are run by a state-sponsored organization, while the management of the lines is handled by many different companies, privatized many years ago as part of railway reform.

[12] In Korea, many contend that political figures representing the interests of particular regions have pushed for the expansion of road networks, whereas the railway network has suffered because it is not linked to parochial interests or benefits.

[13] Ministry of Construction and Transport, Korea, dealing with national, regional city development and planning, housing, construction and technology, water resources management, infrastructure and transportation issues.

[14] Samet, Jonathan M., *Fine Particulate Air Pollution and Mortality in 20 U.S. Cities, 1987–1994*, The New England Journal of Medicine, December 14, 2000, Vol. 343, No. 24.

[15] KRHIS and the Netherlands Institute for Spatial Research, Utrecht University, proceedings (edited by Kim, Won-Bae), International Conference on Urban Networks and Infrastructure Planning in the Metropolitan Region (Sep. 2002), Dec. 2003.

[16] Wikipedia, metropolitan areas by population.

[17] A two-million-unit housing construction project was pushed by the government from the late 1980s to the early 1990s in order to address worsening housing shortages and

skyrocketing home prices in five satellite cities adjacent to Seoul City in the MCSR. However, it brought forth a tremendous increase in traffic, resulting in severe congestion, since the five new cities were only bedroom communities from which most people commuted to Seoul for work.

[18] OECD, Territorial Reviews: Korea, 2001.

[19] Lee, Chang-Woon, *A Study on the National Transportation System in High-Speed Rail Era*, Dec. 2004, Korea Transport Institute (KOTI)

[20] Therefore, taxi is regarded as a type of paratransit in Korea.

[21] The fare level of transit is generally much lower than in most advanced countries—for example, the subway costs $0.60–$0.70, the taxi $1.50, and the bus $0.50–$0.60.

[22] Cho, Nam-Gun, KRHIS Research Report on *The Spatial Impact of High-Speed Rail and its Countermeasures*, 2003.

[23] Cho, Nam-Geon, *Surveys on the Regional Economic Impacts of High-Speed Rail*, Korea Research Institute for Human Settlement (KRHIS), July 2003.

[24] Cho, Nam-Gun, KRHIS Research Report on *The Spatial Impact of High-Speed Rail and its Countermeasures*, 2003.

[25] Lee, Chang-Woon, 2003

[26] In the Paris–Lyon sector, 90% of travelers use the TGV and 10% use air transport; Lee, Chang-Woon, 2003.

[27] In the course of developing a new city under a company's or companies' initiative, attractive incentives such as making land purchases easier and corporate tax exemptions are normally granted to companies. A 'company city' would combine business activities and city functions, and provide a business-friendly environment.

[28] The station is managed by a development company charged with securing public space such as cultural facilities and botanical gardens.

[29] Cho, Nam-Geon, *The Spatial Impact of High-Speed Rail and its Countermeasures*, KRHIS, 2003.

[30] Generally, people are given the opportunity to express views on proposed routes in terms of environmental concerns and other aspects affecting them. The government publishes proposed routes, together with their environmental impact assessment, in an official Gazette. In addition, the ministries responsible for such matters—for example, the Ministry of Environment and the Ministry of Construction and Transport—participate in the Cabinet's decision-making process.

[31] For example, there are many kinds of Shinkansen services: Nozomi, stopping only at very large cities like Tokyo, Nagoya, Kyoto and Osaka; Hikari, stopping at more stations than Nozomi; and Kotama, stopping at nearly every station.

[32] It ranked 9th in passenger traffic volume and 5th in cargo handling in 2002 (Airport Council International).

[33] The construction of a Korea–Japan Channel tunnel is required.

[34] International Energy Agency (IEA): http://www.iea.org

[35] "Transit Oriented Development (TOD) refers to residential and commercial areas designed to maximize access by transit and non-motorized transportation, and with other features to encourage transit ridership. A TOD neighborhood has a center with a rail or bus station, surrounded by relatively high-density development, with progressively lower density spreading outwards. For example, the neighborhood

center may have a transit station and a few multi-story commercial and residential buildings surrounded by several blocks of townhouses and small-lot single-family residential, and larger-lot single-family housing farther away." TDM Encyclopedia, Victoria Transport Policy Institute.

[36] "'Smart growth' means different things to different people. There is no single definition of smart growth; its meaning depends on context, perspective and timeframe. The common thread among different views of smart growth is development that revitalizes central cities and older suburbs, supports and enhances public transit, promotes walking and bicycling, and preserves open spaces and agricultural lands. Smart growth is not no growth; rather, it seeks to revitalize the already-built environment and, to the extent necessary, to foster efficient development at the edges of the region, in the process creating more livable communities." The website on Smart Growth Strategy/ Regional Livability Footprint Project.