

Bus reform in Seoul, Republic of Korea

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Case study prepared for

Global Report on Human Settlements 2013

Available from <http://www.unhabitat.org/grhs/2013>

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Nairobi, 2011

A special acknowledgement for the help of the Seoul Metropolitan Government Transport Office in the preparation and the provision of the photographs.

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Introduction

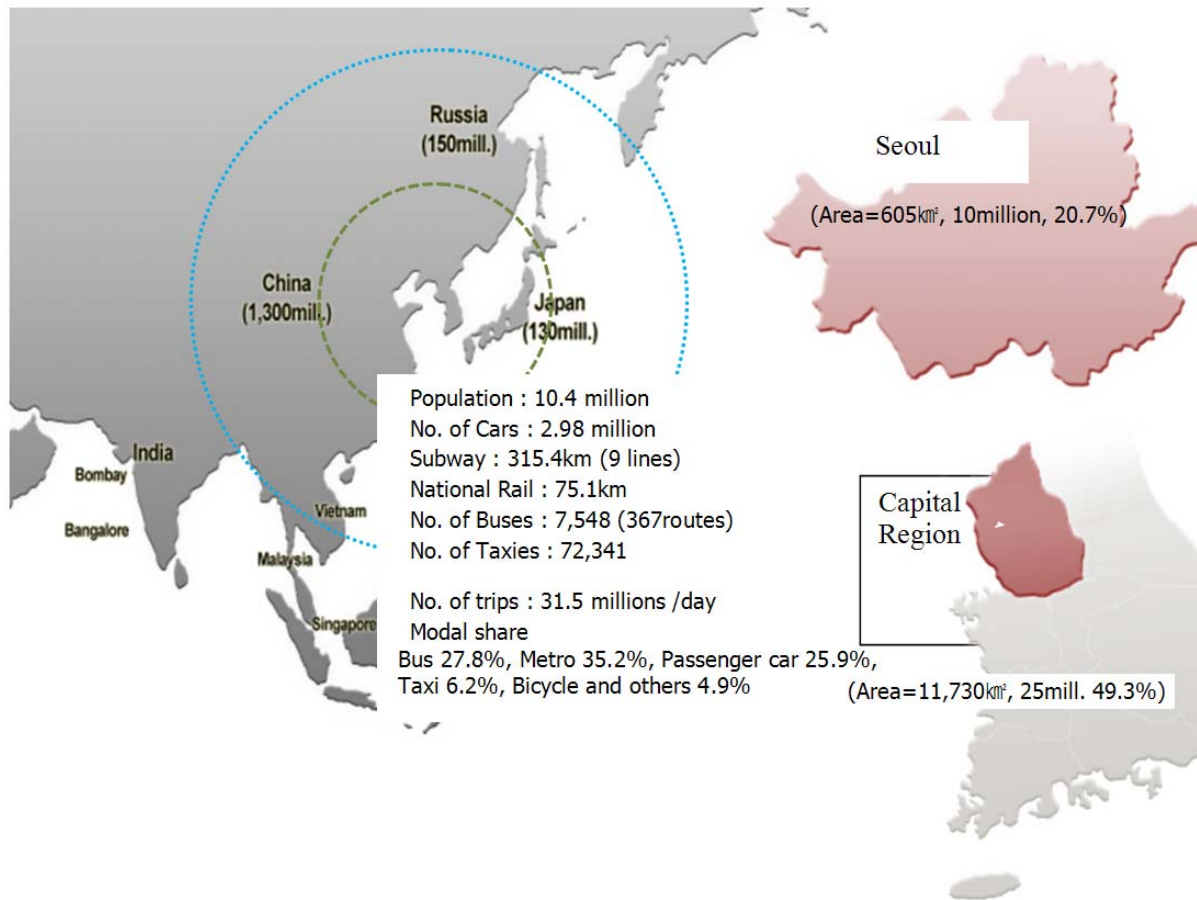
Seoul is the economic and political capital of the Republic of Korea and a growing force in Asia. The city and wider metropolitan area has seen significant growth during the past thirty years. In 1942 its population was around 1 million. Between 1960 and 2002, the Greater Seoul metropolitan area which includes the cities of Incheon and the Gyeonggi Province quadrupled in population (Korea National Statistical Office, 2005). Today it houses nearly half the national population (approximately 25 million (Kwon, 2010), and the average density is 17,275 people per km² (16,000 if Incheon city is included) making it 1.3 times more dense than neighbouring Tokyo city and the sixth densest urbanised centre in the world (Cervero and Kang, 2009).

The combination of its rapid economic growth, increased population and the corresponding increases in demand for transport in the early part of the twenty first century brought the metropolitan region and Seoul in particular significant transport problems. In constant, inflation-adjusted 2004 US dollars, per-capita income in the Republic of Korea rose from only US\$311 in 1970 to US\$2,044 in 1980, US\$7,378 in 1990, and US\$12,531 in 2002 (Korea National Statistical Office, 2005), representing a 40-fold increase in real per-capita income in only 32 years. Cars became more affordable and there was a 36 per cent increase in the number of vehicles from 1996 (2.2 million) to some 3 million in 2009 (Pucher et al, 2005). As the whole population became more educated and especially as more women entered the workforce a large number of extra trips were generated per household.

This case study highlights the deep reform of public transport in Seoul which was seen as being a major step towards Seoul retaining its competitive edge and overcoming these growing challenges. This reorganisation took place with the support and leadership of Mayor Lee Myung-bak, who went on later to become President of the Republic of Korea. The Seoul Metropolitan Government introduced a wide range of reforms across the whole public transport system stimulated by a growing financial crisis with increasing dissatisfaction from citizens and escalating subsidies to bus operations. The reforms included for example: completely reorganizing bus operations, introducing the first Bus Rapid Transit (BRT) corridors, better coordination of bus and metro services, improving the quality of the bus fleet, introducing natural gas buses to improve air quality and implementing a fully integrated the fare structure and ticketing system between routes as well as across modes. This article describes the major aspects of the public transport reforms in Seoul and assesses their impacts on safety, speed, costs, passenger levels, and overall customer satisfaction.

The key to success lies in the combination of policy reform, infrastructure and technology complemented by voluntary schemes such as 'no drive days', however its continued success has been due to the sustained efforts from the city authorities to remain focussed on making Seoul a 'green and clean' capital city. The integrated approach to reform started with the bus sector but has extended to institutional and organizational changes in transport, innovative technology and infrastructure development although not all topics are covered in depth in this paper. Seoul is one of the few cities to have implemented such a comprehensive bus reform simultaneously introduced on different levels (reform of institutional framework and major operational system changes, infrastructure construction and the introduction of integrated electronic ticketing and executed it in a short period of time.

Figure 1. The greater Seoul region



Source: Personal communication, Seoul Metropolitan Government, 2010.

Background: The Need for Transport Reform

Several important events stimulated the need for the complete and fundamental reform of Seoul traffic policies. Prior to 1974, Seoul was almost entirely dependent on bus transport services. Rising levels of traffic congestion, reduced bus speeds, higher passenger volumes, and longer trip distances started a debate on the necessity for an urban rail system. Private cars had started to become more affordable and from only 2 cars per 1,000 persons in 1970, the rate of car ownership rose to 215 per 1,000 persons by 2003 (Pucher et al, 2005). As roads became more congested bus transport became less attractive leading in turn to an increased use of private cars, this was especially apparent on the radial arterial highways connecting the suburbs to the central city.

In 1988 Seoul hosted the Olympics. The preparations required for the city to host such an event stimulated interest in rail-based urban transport, as access to the games by public transport is part of any prospective city's dossier. The first metro line was started in 1974 and was operational in 1980, in time to satisfy the need to be able to provide high quality mass transit to national and international visitors. From the modest 8 km of the initial line, the Seoul urban rail network has now expanded to nine metro lines with a total length of over 400 km carrying over 6 million passengers daily.

The introduction of the first metro line in 1974, however, made bus travel even less attractive to customers. At that time bus services were operated by various different and uncoordinated private operators who competed for passengers and their operations were basically unmanaged by the authorities. The increasingly congested roads slowed buses down even more than cars and greatly impaired overall the quality of all bus services. Due to a wide spectrum of origins and destinations, and as previously mentioned cars became more affordable, people switched to car travel. In many cases trips were shorter by car than public transport due to the disorganized and uncoordinated services offered by the diverse private operators. In addition, as the majority of trips required a transfer, and in the absence of any integrated fare policy, passengers had to pay for each leg of their journey making bus travel relatively expensive.

Traffic congestion, especially on the radial arterial highways connecting the suburbs to the central city meant that average speeds on the roads in the city centre then were 17 km per hour (on some major roads it was as low as 13.6km/hr) and only 20 km per hour overall. Prior to this the average in 1980 was 30.8 km per hour.

The increasingly high level of car use was also causing dangerously high levels of air pollution, noise, and traffic accidents as well as excessive use of land for roadways. Parking facilities removed green spaces and increased the built up area (Ahn and Ohn, 2001; and Hwang, 2001). It is estimated that the costs of congestion increased from 1.26 m US\$ in 1991 to 5.3m US\$ in 2004.

Initial measures were introduced to try to improve bus performance and the first curbside bus lanes were introduced in 1984. This had some limited success and 219 km had been put in place by 2003. However the measures proved not to be sufficient to turn around the declining bus ridership and more significant reform measures were required in order to stem the decline in bus patronage.

An Integrated and Visionary Approach to the Reform

Institutional reform – one seamless system approach and the reorganisation of roles and responsibilities

A combination of growing social dissatisfaction with the increasingly chaotic traffic situation, congestion, inadequate policy measures and responses with an acute funding crisis within Seoul's public transport system prompted a complete re-examination of ways to improve service quality while keeping costs and subsidies affordable. This was aided by the election of visionary and ambitious Mayor Myung-Bak Lee, who took on the challenge to improve transport as part of his mandate when elected in 2002. He piloted these changes and took a hands-on approach to the changes. For example, under the mayor's leadership a weekly transport policy meeting took place until the reforms were implemented.

The city itself undertook a visioning process to put transport policies and measures in place to make 'Seoul a clean and attractive city'. This revolved around three main pillars: environmental sustainability based on a low carbon transport system; social inclusion and a human orientated traffic system and economic growth by strengthening demand management.

The decision to introduce such a deep reform was not taken lightly as such a profound change was also a political gamble. Two years of preparation entailed the collect of data, scientific analysis of travel patterns and a series of studies and detailed reports was commissioned.

There was some considerable acceptance by the general public that something had to be done about the growing traffic problems but not everyone supported all the measures being put

forward. There were many challenges to overcome pre and post implementation. One major challenge was to get everyone to agree on an integrated fare policy (working with Korean Rail) and ensuring that the bus drivers were also on board (see later).

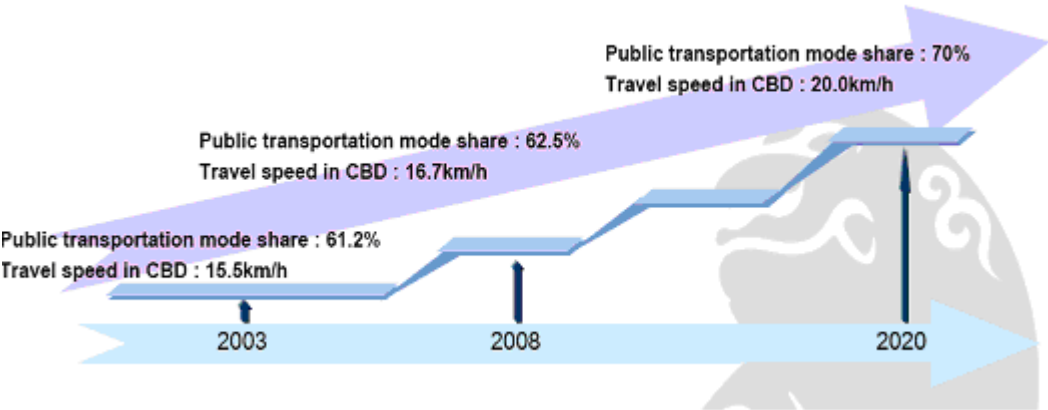
There was also a transfer of responsibilities from different agencies to the Seoul Metropolitan Government that would enable better a more integrated approach and improve strategic planning. Seoul Metropolitan Government (SMG) took the functions of strategic planning, infrastructure construction and maintenance, service and quality levels, public transport operational management. Subway operations were directly under their control and a semi-public model was developed for bus operations while keeping the responsibility for all common public transport facilities. Bus companies were responsible for operational maintenance of the buses and labour relations and management.

The 1 of July 2004 marked a milestone for Seoul’s new transport policy framework. SMG introduced a wide range of reforms to its public transport system and greatly increased its control over bus routes, schedules, fares, and overall system design. This entailed a complete reorganized of all bus services, the introduction of some of the first Bus Rapid Transit (BRT) corridors in Asia, and improved integration between the bus, metro and taxis services. This was rounded off with the implementation of a fully integrated fare structure and electronic ticketing system between routes as well as across modes. This was (and still is) one of the most ambitious and widespread reforms of a complete transport network across any metropolitan district in Asia. It has allowed Seoul’s economic development to be more resilient than other cities and also to cope, to some extent, with the increasing population and demand for travel in the region.

The approach of a ‘semi-public operation system’ retains private bus firms as operators but leaves route, schedule, and fare decisions to the Seoul Metropolitan Government was rather innovative for the time. At first there was some considerable conflict between bus companies and especially the bus driver unions, but with great determination Seoul pushed forward and succeeded in redesigning the bus route network with emphasis on passenger convenience rather than operator’s convenience. This resulted in better bus services into outlying areas that private bus firms had avoided because they were unprofitable.

In 2004, this city-wide approach rather individual service contracts was quite innovative, especially in Asia. Bus operators are reimbursed on the basis of vehicle km of service instead of passenger trips (gross contracts), and fares collected for the whole system. One of the advantages of this system is to provide guaranteed service and performance levels which

Figure 2. Transportation policy objectives 2004–2020



Source: Yoon, 2008.

enable social goals to be achieved, and also reduce any incentives for speeding, reckless driving, and discrimination against the elderly and disabled passengers (Eum, 2005; and Seoul Metropolitan Government, 2006).

In January 2004 an intensive media campaign was launched to explain to the citizens the changes via the mass media. This focussed on why it was important to make the changes, the proposed reforms and the expected benefits.

The date 1 July 2004 was set for the first phase of changes to be implemented. As one might expect the transfer was not entirely smooth. The first few weeks could be described as some sort of chaos with high levels of dissatisfaction – but the careful planning and media outreach eventually did pay off as the new system started performing within a six month period.

Bus services

The first public bus services in Seoul began in 1953 and bus usage rose rapidly with the growth of Seoul between the 1960s and early 1980s, but a long-term decline began around 1985 onwards until the end of century. During this time, bus services in Seoul were operated by a large number of private firms, with virtually no government control of routes, schedules, or other aspects of service. This meant that there were high levels on competition on the most profitable routes, and little or no interest in serving socially important, but less profitable routes. Most routes were planned to allow a maximum of passengers to be able to use the service but this made travel times unnecessarily long as few buses took the most direct route to their destination.

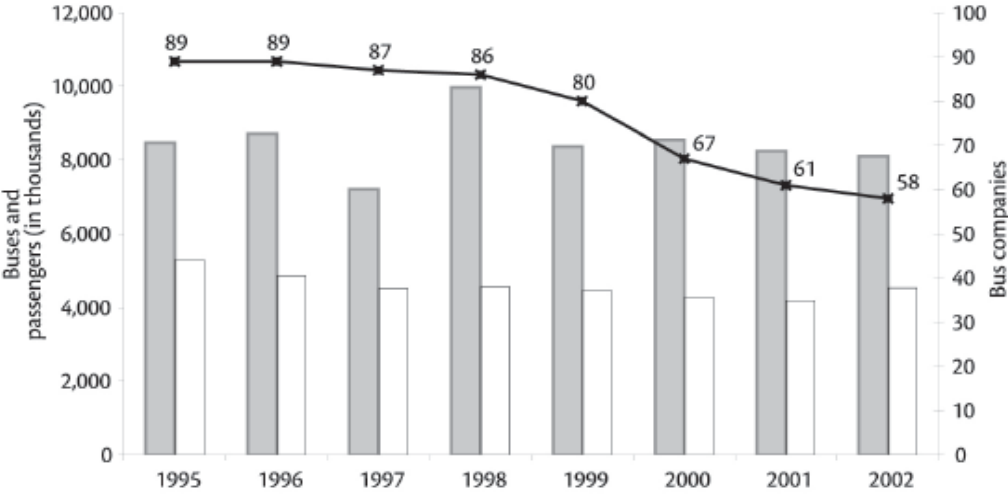
Unprofessional activities by bus drivers to attract passengers and stop and starts at bus stops often caused accidents or disrupted normal traffic. Bus companies engaged in overheated competition for the most profitable routes and cancelled routes in unprofitable areas without warning with little or no consideration for passengers. Service levels fell and bus drivers would often squeeze as many passengers as possible onto the bus, drive recklessly, avoid picking up elderly or disabled passengers and at times simply not stop at some stops if it did not suit them.

In addition, bus services had to compete with ever-expanding metro services, rising car ownership and increasing traffic congestion. It was inevitable that bus service quality declined and commercial speeds reduced due to the increasing congestion, operators went bankrupt and modal share slipped from 30 per cent in 1996 to 26 per cent in 2002 (while the subways share rose from 29 per cent to 35 per cent in the same period (Pucher et al, 2005; and Seoul Metropolitan Government, 2006).

Pre 2004, only the fares were determined by the Seoul Metropolitan Government (SMG), and contracts were revenue based. Therefore as revenues fell, the authorities also found themselves in a situation of having to provide increasing operating subsidies to cover operating costs and keep the operators afloat in order to keep the buses running.

The number of bus companies dramatically fell from 89 in 1995 to 58 in 2002 (see Figure 3). To some extent, this decline was due to private operators going bankrupt. Seoul Metropolitan Government also encouraged the consolidation of bus firms to eliminate duplication, reduce overhead costs, and improve coordination of services. This did not, however, solve the increasingly serious financial problems of the bus companies. As bus passengers continued to decline, there were fewer passengers per bus, less fare revenue per bus, and escalating operating deficits. For example, the average number of total daily passengers per bus fell from 1,093 in 1989 to only 494 in 2002 (Korea Transport Institute statistics, 2005).

Figure 3. Decline in bus passengers (despite the rise in population) and in the number of operators

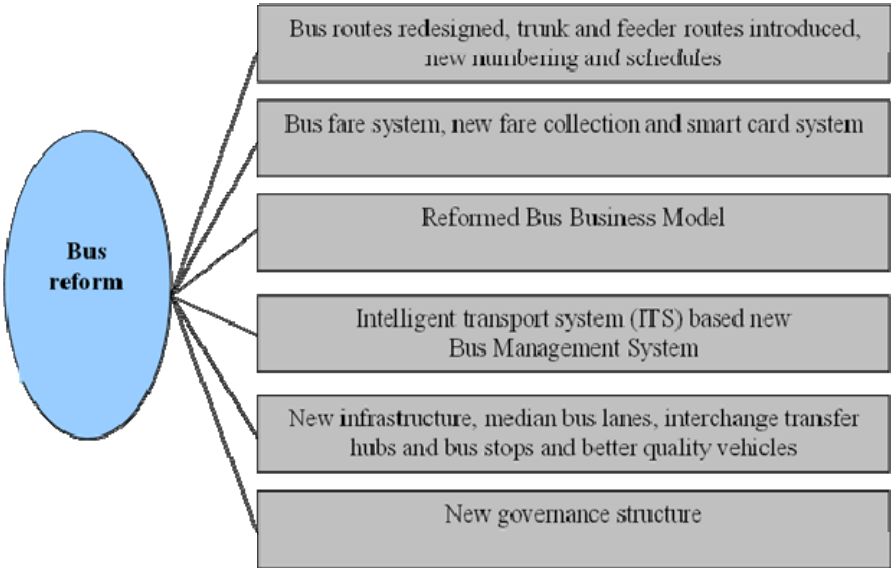


Source: Seoul Development Institute, 2003.

SMG’s local government subsidy required to keep private bus services running rose from around US\$9 million in 1999 to US\$110 million in 2002. This was paid in order to keep the buses running. Although bus services covered a higher percentage of operating costs from passenger fares than metro services (85 per cent against 75 per cent in 2003), the sharply rising subsidy for bus services became a grave concern. This extra financial burden for a diminishing bus services was especially problematic on top of the funding gap created by building the metro.

Despite the fact that bus business was declining, prospects of reform encountered strong resistance from the private bus operators and especially the drivers. Therefore, one of the

Figure 4. Significant reforms were implemented to improve Seoul’s bus system from July 2004 onwards



Source: Author.

most important tasks was to persuade the bus drivers to support any reform. The city sent a letter to 16,000 bus drivers explaining measures associated with the reform. It also organized 27 special briefings for the drivers, attended by the mayor and vice-mayor who provided reassurance that their rights were going to be protected. Indeed that they would receive better treatment as the government was promising to establish better wages, improved welfare and pension rights (Korea Transport Institute statistics, 2005; and Seoul Metropolitan Government, 2006).

All major bus routes were redesigned according to demand and to increase overall capacity using a trunk and feeder approach especially to serve the BRT lines. Overall, they were restructured to improve service levels with more regular frequencies and headways and also to integrate better with the metro. A new numbering system was introduced and the buses were grouped into easy-to-follow four colour coded types according to the type of service they offered. The total number of routes was also increased (from 365 to 411) and some lines were shortened to be more direct. This had the added benefit of reducing operating costs.

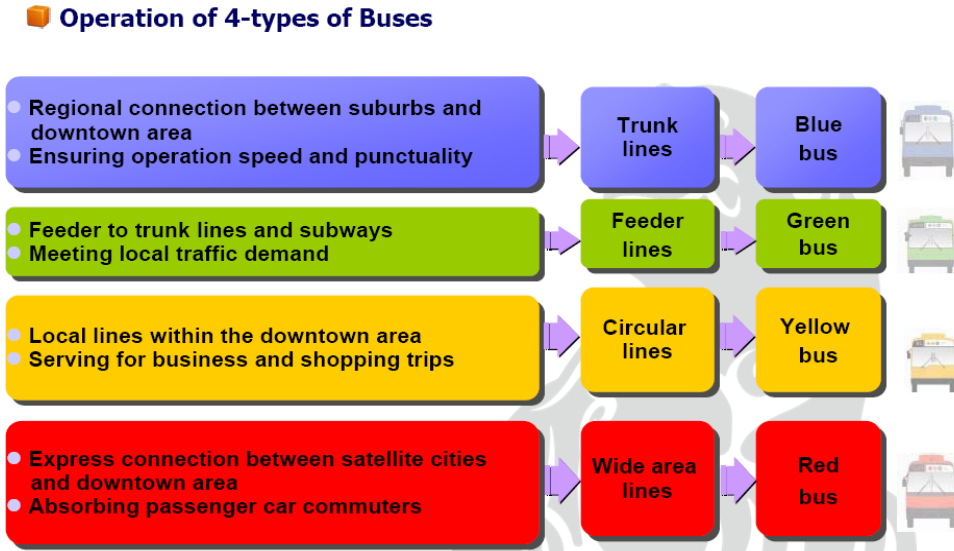
Infrastructure improvements included expanding the exclusive median bus right-of-ways for the BRT services. These now extend to 12 corridors and this expected to be expanded to 19 corridors and 214.7km of busways by 2011.

The number of dedicated bus lanes was expanded and upgraded. The length of curbside bus lanes was also increased to 294 km, but more significant was the development of a true Bus Rapid Bus (BRT) network with dedicated median bus lanes with high quality bus stops, real time passenger information and new state of the art buses.

By February 2005, there were already 36 km BRT services spanning 4 different corridors. During 2005 and 2006, an additional 62 km of BRT over 7 more corridors and more BRT route expansion continued after that.

The new business model was based on a strong management and overseeing roles of the Seoul Metropolitan Government and partnerships with the bus private companies. A combined bus operations council with representatives from 68 bus companies managed the joint revenues and distribution was based on the base operational cost plus incentives.

Figure 5. The use of colours to differentiate the bus and their operations, service functions



Source: Author(UITP).

Before reform

- Private bus company owned the routes
- Revenue managed by each company

After reform

- Public management of bus routes
- Revenue pooled from all routes and companies

The success of the reorganisation is also due in part to the Bus Management System (BMS) that was also introduced. This uses advanced intelligent transport system (ITS) technology and Global Positioning System (GPS) linked to the electronic fare system. Gradually all buses were fitted with GPS positioning systems that allow information on passenger boardings and individual vehicle performance to be collected.

The BMS (see Figure 7) is an integrated control centre that is able to monitor the system in real time. Via electronic exchange of information, the control centre gathers information on vehicle positioning (location and speed), which in turn is communicated to the information service panel at the bus stops and via various applications to passengers via mobile phone and internet. The number of buses assigned to any given route can be adjusted. Any disruptions in the network can be better managed as the control centre has direct communication with the individual bus drivers which again can be communicated quickly to passengers, keeping passenger satisfaction high.

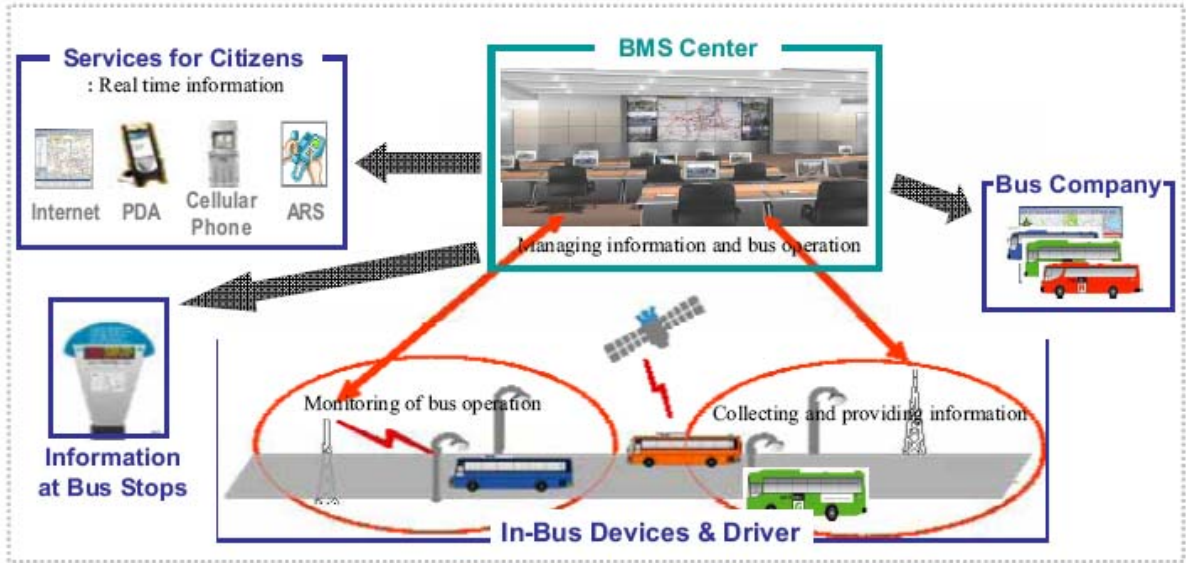
The introduction of this management system has also greatly improved overall system performance and allowed the optimisation of operations in terms of vehicle requirements and scheduling. For example, at peak hours in the heavily used central zones extra shuttle buses

Figure 6. Improved passenger information at bus shelters



Copyright: Seoul Metropolitan Government, 2010.

Figure 7. The bus management system



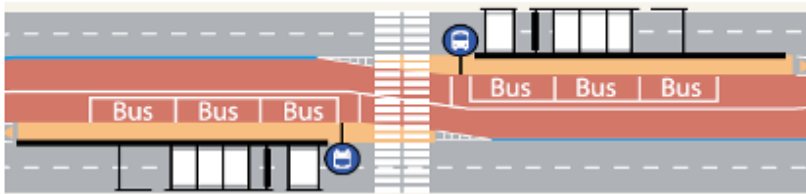
Copyright: Adapted from Yoon, 2008; and Kwon, 2010.

are able to be put into service to absorb the extra demand. This has been put in place on 11 routes with a passenger increase of 9.3 per cent and decreasing crowding by some 12 per cent. Express buses have also been introduced on 9 routes that skip stops reducing the travel time for passengers by 10–15 minutes.

Seoul’s BRT services benefit from an increasing number of new buses. There was a gradual turnover to low-floor buses, mostly running on CNG (compressed natural gas) and all inner city buses were running on CNG by 2010. The city fleet will be 100 per cent by 2013. In total 8,613 buses will have to be replaced.

Articulated buses are used on dense corridors and eventually all the blue and red express buses will also be CNG and low-floor. With level boarding platforms at BRT stops, getting on and off express buses became easier, faster, and safer. By 2009 around 7,548 buses were in operation on 367 routes and are being operated by 150 different bus companies. 5 million trips per day are made on the buses or 27.8 per cent of the total motorised trips.

Figure 8. Example of bus stop design showing how express buses could overtake the stopped regular buses if required



What the bus reform has delivered

The bus reform has delivered a number of initial and longer term benefits in bus operations some of which include the following (see also Table 1):

- Increased commercial speeds to 20 km per hour, on some routes this means an 80 per cent increase.
- An increase of 6 times more passengers than business as usual (BAU) case.
- 5 times more reliable services (before and after assessment).
- Bus commercial speeds changed from 11 km/hr to 22 km/hr.¹
- The quality and attractiveness of vehicles has improved. All buses will be run on CNG by 2010 and 50 per cent of buses will be low floor by 2013.
- A decline in bus related accidents from 659 per month in 2003–2004 to 384 in 2010.
- A new governance structure that included a Bus Reform Citizens Committee (BFCC) stakeholder group with representatives from civil society (citizens groups), the government (SMG), the bus firms and other professionals.

Table 1. Initial benefits from the reorganisation of the bus system

Pre reform	Post reform
Number of complaints received for timetable irregularities	Decrease from 75% to 25%
Numbers of passengers	Increase of 20%
Frequency and headways	95%
Punctuality	Increased by 18%
Operational costs	Decreased by 9% (maximum)

Source: Park, 2010.

Other co-benefits to improving the bus system

The bus reforms are contributing to the achievement of greenhouse gas reduction targets of a 20 per cent reduction from 1990 levels by 2020 put in place since the bus reforms. Seoul now has an ambitious low carbon green growth plan with long term aggressive greenhouse gas reduction targets. These include reducing energy consumption by 15 per cent by 2020 and by 20 percent by 2030 (using 2000 as the baseline) and reducing greenhouse gas emissions by 25 per cent and 40 per cent for the same periods (1990 baseline).² A large part of the efforts to achieve these reductions will need to come from transport and buildings.

Another benefit of the bus reforms has been an impressive decline in bus-related accidents and personal injuries. The number of bus accidents and the number of personal injuries in bus accidents have fallen by about a third since the implementation of the bus reforms (see Table

Table 2. Decline in monthly bus accidents and injuries in Seoul, 2003–2010

	2003	2004	2005	2006	2007	2008	2009	2010
Bus accidents	2,742	1,947	1,789	1,207	1156	1,080	1,114	1,038
Injuries	2,089	1,446	1,424	1,189	1,151	1,064	1,095	1,013

Source: Korea Transport Safety Authority 2010.

1. Note these figures refer to 2010 while the figures in Figure 2 refer to the estimations for 2008
2. The difference between the energy and GHG emission reduction will be offset by an increase in renewable energy consumption.

2). The improvement in bus safety is partly attributed to better driver performance and partly to more right-of-ways and the separation of buses in the BRT corridors from mixed traffic.

Lessons from the successful implementation

In the weeks immediately after the implementation of the July 2004 reforms, there was great disruption, confusion, and dissatisfaction among passengers. Roughly 70 percent of passenger said they were dissatisfied with the new fare structure, and about 60 percent were confused about the new bus routes.

The only aspect of bus services that appears to have immediately improved was the performance of bus drivers, since passenger satisfaction with driver behaviour almost immediately improved on 1 July, when the bus reforms came into effect. However, customer satisfaction dramatically improved in subsequent weeks and months, as passengers were better informed about the new bus routes and schedules, and technical problems with the new smart card were worked out.

Overall, passenger dissatisfaction fell from a high of 56 percent on 8 July to 44 percent on 29 July and it further fell to only 13 percent by October. Average bus speeds increased by 33 percent to 100 percent in the BRT corridors. Total bus accidents and injuries on all routes combined (express and local) have fallen by about a third. Thus, within four months of the thorough reform of bus services and fares, almost 90 percent of customers expressed general satisfaction with the restructured bus services and new fare system (Seoul Development Institute, 2004).

Only in the first month of the reform (July) was the number of bus passengers less than the same month a year earlier (in July 2003) prior to the reforms. That was due to the widespread disruption, confusion, and malfunctions as the new service and fare systems as they were introduced. Overall, daily bus ridership increased by 406,000 passengers per day between September 2003 and September 2004 (representing an increase of +9 per cent) and by 705,000 passengers per day between March 2003 and March 2004 (+14 per cent). Metro ridership was not affected and remained roughly constant before and after the bus reforms (Seoul Metropolitan Government, 2005).

The reforms considerably increased overall service quality, but they failed to curtail subsidy needs in the first few years. Indeed, as part of the bus system reorganization, the Seoul Metropolitan Government signed a contractual agreement with private bus firms to cover their operating deficits in full. This gave them an incentive to be part of the reforms and to comply fully with the new systems. But it also meant that SMG had to cover an operating subsidy of US\$135 million in the six-month period after the reforms. This meant that annually they would need to pay US\$270 million annually just for bus services, almost three times what they were paying prior to the reorganisation (Kim, 2005). Since then this has decreased as the system has settled in and ridership increased.

This initial increase in bus subsidy should be considered in the light of substantial increases in the overall quality of bus services, including new buses, new shelters at bus stops, and the installation of BRT services to augment the existing bus services. Moreover, the alternative would be expanding the metro services which would have cost considerably more, taken longer and required even larger subsidy increases.

Clearly, it could have been less risky to introduce the changes incrementally but it was still a relatively smooth transition to introduce the completely new bus routes, fare structure, and fare payment system. However, a trial period to test new technologies on a selective basis

Table 3. Increase in passenger ridership across the public transport system, 2004–2010

	Thousand/day						
	2004	2005	2006	2007	2008	2009	2010
Metro	4,567	4,540	4,533	4,532	4,577	4,730	4,835
Bus	4,782	5,451	5,662	5,603	5,647	5,681	5,719
Total	9,349	9,991	10,195	10,135	10,224	10,411	10,554

Notes:

Subway: passengers of national rail(operated by Korail) are not included.

Bus: passengers in metropolitan area(Gyeonggi-do, Incheon Metropolitan City) are not included.

Source Authors communication from Seoul Metropolitan Government 2011.

instead of immediately adopting them system wide would have been prudent as this is complex to change overnight. Transantiago (and the introduction of the BRT and new fare system in Santiago, Chile) did the same a few years later with dire consequences that included a public apology from the country's President and huge economic losses across the city until the system settled in. Even in the developing world there seems no easy answer and a new regional wide fare structure in Goteborg, Sweden has had its problems with a public that is well used to using public transport.

That said the reform and accompanying measures has delivered a highly performing bus system, and the today buses perform well compared to rail (Table 3).

Rail-Based Improvements

Today 9 metro lines operate in Seoul and it is one of the densest metro networks in Asia. Seoul Metro company operates 4 (lines 1- 4), Seoul Metropolitan Rapid Transit (SMRT 5678) operates a further 4 (lines 5–8) and Metro line 9 has been built and is being operated under private /public partnership arrangement. The 9 lines have a total length of 314 km with 290 stations and carry (2009) 6,267, 000 passengers per day. Lines 1–4 carry 3,953,000 and lines 5–8 carry 2,314,000 per day (39.9 percent compared to 22 per cent or the total rail based ridership figures for Seoul metropolitan region). This is completed by a further 387 km of regional rail.

Seoul Metro and SMRT 5678 (the numbers of the lines) although publicly owned also 'compete' against each other and are monitored for performance. SMRT 5678 has installed platform screen doors on all stations (completed 2010) which bring significant benefits in terms of safety, noise reduction and air quality improvements.

- Safety improvement 100 per cent
- Noise reduction of 36 per cent
- Air quality improvement 7.9 per cent
- Air conditioning efficiency improvement 35.3 per cent

Metro Line 9 opened for operations in July 2009. It is the first express metro line in Asia with 'omnibus' stopping services and express 'skipping' services. The omnibus service stops at every station (25) and takes 51 minutes while the express service stops only at 9, skipping stations and takes only 30 minutes for the same journey. Both have the same frequency of 9 minutes and it operates from 05.30 till 01.00. It was constructed and is operated under a private public partnership arrangement.

Innovation in all areas of metro management is encouraged to address the dominant trend for deregulation in the public sector. Targets to reduce manpower (Seoul Metro employs about 10,000 people) by 20 percent and increase productivity by 60 per cent are in place. The new management competence of the private sector operating Metro line 9 has shown that this can be made a reality.

Great efforts to rationalise working practices and outsource some key functions have brought significant benefits to all metro operations. Line 9, operating under contract to the private sector has shown the way and this has helped the public operators to also improve performance. Much of the maintenance is now outsourced even by the public sector operators as well as some parts of their operations.

All operators are taking steps to create a 'life style' environment when travelling on the metro.

SMRT have branded this as 'Happy Zones'. There are newly refurbished waiting areas in the station using idle space more attractively where passengers can either work or play using free internet and information services. Working with the local council in some districts that the metro travels through 'Happy markets' (temporary farmers markets selling fresh local produce) have been created and 'Happy bookstores' where people can either buy or simply se-spend time reading books have been set up in some stations.

Seoul Metro has free internet access anywhere, anytime on the metro. Digital multi media advertising is also installed in most metro cars. In addition, some 2000 cultural and art related events such as fashion shows, art exhibitions, concerts as well as special events with famous entertainers or sports heroes are supported annually by Seoul Metro. Lectures, open education classes, competitions and other activities all attract the public and make taking the metro an experience, not just a mode of transport. These events take place either in the stations themselves or very close and an advisory committee has been set up to help guide the management on this.

Further rail expansion is planned for the next few years such as eight lines of LRT (73.3km) by 2017, 34.3 km of metro lines to be built between 2003 and 2021 and 6 lines of regional rail totally some 161 km built between 1996 and 2015.

A fully integrated automatic fare collection system

In addition to these major service improvements, the Seoul Metropolitan Government introduced a unified, coordinated fare structure and collection system that integrates both bus and rail services (and more). This was very challenging to implement across such a wide area and to gain agreement from all the different actors. It is now seen as a world class example of integrating electronic money and public transport fares.

At its introduction the overall fare level was actually increased. Previously, distance based payment only applied to metro not bus trips, but with the integration of the system a flat fare (900 KW) for the first 10km was introduced for both. Transfers within a time limit were allowed and the fare increased over the 10km.

All fare collection is centralised through a clearing house from where the bus operators are paid. More than 25 million cards are now in use and 90 per cent of the transactions are processed by 9.00 am the following morning (see Table 4).

Equally important, there is now a multipurpose, stored-value smart card (called 'T-Money') that can be used for all bus and rail services, greatly enhancing ease of payment for the

Table 4. The electronic fare collection system in Seoul

Area	Item	Content
	T-money smart card issuance	<ul style="list-style-type: none"> • 8.5 Million • 25 Million Affiliated Cards in Use(Credit card included)
Seoul Metropolitan City	Card Validator	<ul style="list-style-type: none"> • Bus : 19,750 • Subway : 6,586 • Taxi : 73,000 (On-going) • e-money (Convenience stores, Parking, etc) : 8,800 • Vending Machine : 600
	Value Loading Machine	<ul style="list-style-type: none"> • Value Loader (Vending machine included) : 5,203
	Amount of fare settlement per day	<ul style="list-style-type: none"> • Bus : 3.2 Million USD • Subway : 4.2 Million USD
	Data Transaction per day	<ul style="list-style-type: none"> • Bus : 13.4 Million • Subway : 12.6 Million

Source: Park, 2010.

traveller. Koreans are in general accepting technology easily and it has not been shown that these services exclude any sectors of society. Using this smart card system, monthly discounts were able to be offered to regular travellers.

T-money electronic purse can also be used for small purchases at the shops in the metro/bus area, museums and cultural entrances, parking and taxis services (see Figure 9). It is also being extended to e-shopping in some metros, where purchases can be viewed in the stations, ordered and paid for electronically and same day (or 24 hours) delivery can be ordered for pick up at the station, office facilities or at home. The range of services is constantly being extended.

A choice of support for the electronic purse comes in the form of a regular credit card type as well as telephone toggle, watch or fashion accessory.

Figure 9. A range of examples of T-money toggles and cards. They are fast becoming a fashion accessory



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Other infrastructure improvements

SMG also committed to improving the transfers and interchanges between modes as with the new scheduling after the bus reform more transfers had to be made. These investments helped guarantee smooth and safe interchanges not only between bus services but also across modes.

Improving transit interchanges and hubs

The quality of the transport infrastructure at these interchanges is high. This photo shows the different types of bus, clear passenger information and comfort levels with quality waiting areas protected from the weather as well as clear traffic management and separation of regular traffic and buses. Bicycle racks are clearly visible as well as the small retail establishments surrounding the public transport stops, helping to increase the quality of journey experience for passengers.

Figure 10. Transfer centre at Cheongnyang-ri (before and after)



Copyright: Seoul Metropolitan Government, 2010.



Accessibility for the less-abled

Care is being taken to ensure that both the bus and metro is as accessible as possible to all. Now some 640 elevators, 1042 escalators, 18 moving walkways and 460 wheel chair lifts have been installed across the system (see Table 5).

Figure 11. Examples of the network – Many buses are now fitted with wheel chair ramps and the metro has installed special wider gates



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Table 5. The process showing the status and plans to achieving 100 per cent accessibility across the network

	As of 2010	2011	2013
Elevator	779	827	886
(No. of stations)	(280)	(282)	(284)
Escalator	1,682	1,800	1,940
(No. of stations)	(227)	(256)	(285)

Source: Authors communication from Seoul Metropolitan Government 2011.

Other infrastructure projects to increase the human dimension of transport included tearing down overpasses and flyovers where they created barriers rather than facilitate interchange. This included some overpasses in the CBD districts (Seoul has two).

Complementary transport demand measures

Since the bus reform SMG and subsequent political figures has shown considerable leadership and introduced transport demand management measures that combined leave make public transport as attractive as the private car. Taxis have also been upgraded and they are included in the common smart card T money electronic system. There are several different service levels (with appropriate pricing) that are targeted at different client segments such as business users (with guaranteed time arrivals), regular or occasional user. 72,341 taxis are in operation (2010).

Integration with softer modes

Ambitious goals to increase the use of bikes as a mode of transport have been set and the present modal share of less than 2 per cent is planned to increase to 10 per cent by 2020. Bike sharing, renting and secure parking programmes are in place and infrastructure is now on offer and being rolled out initially in 12 designated areas across the city. Here bike use is being integrated into land use and development with a focus on residential, business and tourism. These 12 bicycle-friendly communities will increase to 33 areas by 2030. These plans integrate with the national plans for improving cycling with better infrastructure and the promotion of this mode.

Weekly no driving campaign (voluntary measure)

Citizens may apply for an electronic tag to be attached to car and may choose which day they will not use their cars. RFID (*Radio Frequency Identification*) readers verify compliance and successful 'sincere' participants are given incentives, such as reduced prices for crossing certain important access entry points to the city. Measured effects (combined with other measures) include decrease in traffic volumes and a reduction of air pollutants. These efforts may appear small but they have generated an overall interest in the general public to be more environmentally conscious of their travel behaviour.

Low emission zones for heavy duty vehicles and congestion charging

A low emission zone is being introduced to allow older more polluting heavy duty vehicles out of the inner city area. Trucks over 3.5 tons are already fined for entering the zone and this will be extended to 2.5 ton trucks from 2011. A Smart congestion zone is also in consideration for the two downtown CBD areas. This is made more possible by the high level of IT technology already implemented for other purposes.

Integration of Urban Planning

Seoul has taken an integrated approach to addressing traffic challenges which include urban planning and transport demand measures to complement the supply measures previously mentioned. Several key locations in Seoul have been 'given back to the people' and a prime example of this is the restoration of the Cheonggyecheon Stream. A 6 km urban freeway was

Figure 12. The renovation of the Cheonggyecheon Stream



Before



After

Copyright: Seoul Metropolitan Government, 2010.

removed in central Seoul and the small stream that was always considered to be the soul of the city and of intrinsic historical value was restored. Public space around this tiny stream is now used for walking and recreation. It is also a symbol of the 'new' Seoul where people can live and work and enjoy life.

New projects

The battle is not won even with all the efforts that have been made. Plans are afoot to put much of the car traffic below ground. Today some 149 km of tunnels are planned, putting road based traffic, pollution and congestion underground.

Other restrictions and transport demand measures are being implemented to dissuade car use in the city. For example, cars are no longer allowed to park at the curbside for long periods and so more off-street parking is being introduced by imposing the conversion of back or front yards into parking spaces as. A subsidy or compensation payment of US\$6000 per house has been made available.

Conclusions: Learning from experience

Indeed, the deep reform caught the attention of many international organizations such as the International Association of Public Transport who honoured Mayor Lee and the Seoul Metropolitan Government with a special award for 'extraordinary success at implementing so many transit reforms in such a short period of time, integrating innovative technologies with new infrastructure'.

Thanks to the ambitious reforms, all modes of public transport especially the bus are now much better coordinated with each other and with Seoul's extensive metro rail system, both in their physical interchanges and in fare structures and ticketing procedures and all transport modes have benefitted. Seoul metro is now one of the largest in the world and more than twice the daily passenger volumes on the New York subways and the London underground. But the benefits are not just in transport alone and SMG have estimated that the social benefits of a better organized transport system in terms of better air quality, safety and accessibility for all are around US\$1.4 billion over the period 2005–2015.

Its success also rests on a strong and competent governance structure able to deal with fair and transparent contracts with the bus companies and Public Private Partnerships (PPP) such as the one established for metro line 9. Improving delivery of public transport with the involvement of the private sector is one of the long-term ambitions of the authorities. The commitment to the original concept of a seamless transport system across modes has been, plus or minus, adhered to and appropriate resources allocated for a long time for the effects to have become clear city wide. Seoul's transport is not fluid all the time even after all these measures but it would be unimaginable if the mass transport modes of bus, metro, light and regional rail services were not in place.

Seoul has charted its course for the future following a low carbon pathway for its transport and it has put ambitious measures and policies in place to prepare itself for green growth and development in the twenty first century. Transport is seen as a cornerstone of this development and key to Seoul playing a leadership role in Asia's future.

References

- Ahn, K., and Y. Ohn (2001) 'Metropolitan growth management policies in Seoul: A critical review', In Kwon, W. and K. Kim (eds) *Urban Management in Seoul: Policy Issues and Responses*, Seoul Development Institute, Seoul, Republic of Korea, pp49–72
- Cervero, R. and C. D. Kang (2009) 'Bus Rapid Transit impacts on land uses and land values in South Korea', Working Paper UC Berkeley Center for Future Urban Transport
- Eum, S. (2005) 'The Seoul bus system reform project', Metropolis award application document, Seoul Metropolitan Government, Seoul, Republic of Korea
- Hwang, K. (2001) 'Transportation policy in Seoul', In W. Kwon and K. Kim (eds) *Urban Management in Seoul: Policy Issues and Responses*, Seoul Development Institute, Seoul, Republic of Korea, pp107–124
- Kim, K (2005) 'Required operating subsidy of \$135 million in the 6-month period after the reforms'. *Pressian*, 7 May, http://www.pressian.com/Scripts/section/article.asp?article_num=20050506160224&s_menu=, last accessed 25 July 2011
- Korea National Statistical Office (2005) 'Korean statistical information system' Daejeon, Republic of Korea, <http://kosis.nso.go.kr/>
- Korea Transport Institute (KOTI) (2005) 'Korea transport database', KOTI, Goyang, Republic of Korea, <http://www.ktdb.go.kr>, last accessed 26 July 2011
- Kwon, Y-J., (2010) 'Seoul BRT – Innovative system of meeting the travel demand', presentation at the 5th Regional Environmentally Sustainable Transport Forum, 23–25 August, Bangkok
- Park, Y-W (2010) 'BRT system in Seoul and integrated e-ticketing', UITP Asia Pacific Symposium on Public Transport (with special focus on BRT), 20–21 January, Delhi
- Pucher, J., H. Park, M. Han Kim and J. Song (2005) 'Public transport reforms in Seoul: Innovations motivated by funding crisis', *Journal of Public Transportation* **8** (5):41–62
- Seoul Development Institute (2003) 'Guidelines for implementation of the transportation system reform in Seoul: Policy for public transportation fare', Seoul Development Institute, Seoul, Republic of Korea
- Seoul Development Institute (2004) 'Monitoring bus service systems: For Seoul bus system reform programs', Seoul Development Institute, Seoul, Republic of Korea
- Seoul Metropolitan Government (2005) 'Performance analysis of public transportation system reform', Seoul Metropolitan Government, Seoul, Republic of Korea
- Seoul Metropolitan Government (2006) 'Seoul public transportation reform – a brand new Seoul', Seoul Metropolitan Government, pp18–65
- Yoon, J. (2008) 'Transportation policies for sustainability', Presentation at the Sustainable Development Seminar, 3–4 June, Seoul, Republic of Korea