05

Korea's Best Practices in the Transport Sector

Korea's Integrated Fare and Smart Card Ticket System
: Innovative PPP (Public-Private Partnership) Approach

by Jin Young Park, Dongjun Kim

THE KOREA TRANSPORT INSTITUTE

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Issue 5: Korea's Integrated Fare and Smart Card Ticket System: Innovative PPP (Public-Private Partnership) Approach

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ISSUE

KOTI Knowledge Sharing Report

05

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KOTI THE KOREA TRANSPORT INSTITUTE

• Preface

The use of public transport should be facilitated in order to increase the efficiency of urban transport and build a sustainable urban transport system. Today, relevant efforts are being exerted throughout the world. Particularly noteworthy is the application of Intelligent Transport Systems (ITS) based on the combination of the advanced ICT (Information and Communication Technologies) and public transport promotion policies.

The smart card tickets, one of the elements of the ITS, is considered a very effective tool for increasing the convenience of public transport. The smart card ticket system is in successful use in Korea and various other countries and cities. A number of other international cities are looking to follow suit and implement their own smart card ticket projects. The smart card ticket system can be used effectively in various aspects, particularly in cities of developing countries which transport infrastructure projects are underway or anticipated.

Korea is cited internationally as a nation that is successfully operating an integrated smart card ticket system. However, it also faced various problems in the early days of its smart card ticket system, which was introduced to the nation in 1996. The problems included user inconvenience due to the lack of compatibility, capacity shortages, and partial suspension of services. The nation has exerted continuous efforts to address such problems and improve related systems based on steady monitoring of card ticket usage. In particular, the top policy-maker's commitment played a decisive role in ensuring the stable operation of the smart card ticket system. Other contributing factors include amicable adjustment of differences among stakeholders, enactment of laws and regulations to realize nationwide interoperability of smart card tickets, improvements in financial and technological aspects, and efforts to increase user convenience. All of these efforts led to the promotion of easy-to-use public transport, increased user convenience, and expansion in demand for public transport usage. In this regard, the smart card ticket project implemented in Korea offers many implications for other countries and cities seeking to build their own smart card ticket system.

This successful experience has motivated us to collect various information of smart card ticket related practices. The goal of this book is to offer technical information and project development history of integrated fare and smart card ticket system in Korea. Particularly Public-Private Partnership (PPP) based innovative approach was implemented to create efficient smart card ticket system. But policy implementation does not always guarantee successful outcomes and intended consequences. However, we believe that understanding what kinds of efforts were missing or why certain policy measures were not as successful as others is equally important to understand the right ingredients of a success.

In this book, you will see the Korean transport experts' efforts to promote urban public transport through advancing ICT. We hope that the anecdotes and data in this publication will help strengthening and empowering better urban public transport measures in our fellow developing countries.

Gyeng Chul Kim
President
The Korea Transport Institute

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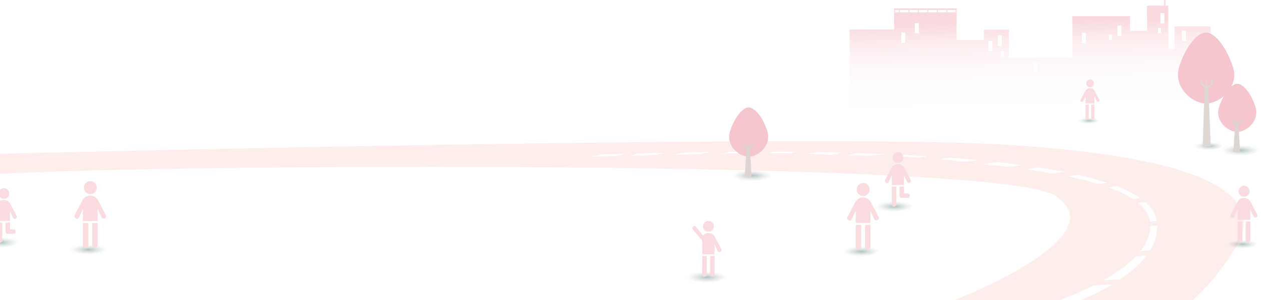

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• Abbreviations and Definitions

Terms	Definitions
Add Value Machine (AVM)	The self-service equipment to top-up money on cards
Automatic Fare Collection (AFC)	The equipment that automatically admit passengers on insertion of the correct fare in an acceptable form, which may be coins, tokens, tickets, or fare cards
Card Issuer	An organization which issues integrated smart card tickets
Card Reader Device	Fare and non-fare collection systems
Central Clearing House (CCH)	The central revenue management organization which is in charge of clearing and revenue settlement among members
Clearing	The process of exchanging and reconciling payment items that result in a transfer of funds from one financial institution to another
Clearing House	The revenue management organization that is in charge of clearing and revenue settlement among members
Contacted Smart Card	A smart card with a chip that makes contact with electrical connectors that can read and write information when it is inserted into a reader
Contactless Smart Card	A smart card that uses radio frequencies to provide a wireless connection to the card reader
eB card	Smart card ticket which issued in Gyeonggi province, South Korea
Integrated Fare Collection System	Integrated Fare Collection System is the collection of components that make smart transit cards own compatibility in more than using 2 public transportation modes.
Integrated Fare Structure	Integrated Fare Structure is the one public transport fare with using more than 2 public transportation modes.
Knowledge Sharing Program (KSP)	Knowledge Sharing Program is new project with an effort to share South Korean economic development experiences launched in 2004.
KORAIL	Korean National Railway Operator
Korea Exim Bank	The Export-Import Bank of Korea (Korea Exim Bank) is an official export credit agency providing comprehensive export credit and guarantee programs to support South Korean enterprises in conducting overseas business.
KSCC: Korea Smart Card Co., Ltd.	Smart card ticket company that operates T-money
Magnetic Strip Card	A magnetic strip card is a type of card capable of storing data by modifying the magnetism of iron based magnetic particles on a band of magnetic material on the card.
Near Field Communication (NFC)	A short-range high frequency wireless communication technology
PPP: Public-Private Partnership	Public-Private Partnership (PPP) describes a government service or private venture which is funded and operated through a partnership of government and one or more private sector companies.
Radio Frequency IDentification (RFID)	Radio frequency identification (RFID) is a generic term that is used to describe a system that transmits the identity (in the form of a unique serial number) of an object or person by wireless, using radio waves.

Terms	Definitions
Security Access Module (SAM)	Smart card is a reduced form factor similar to a Sim card. SAM cards are usually used to hold cryptographic keys inside point of sale terminal units.
Security Key	The user's private key to prevent other users of using the computer for unauthorized access
Seoul Metropolitan Area (SMA)	It is generally referred to as Su-do-gwon (capital area) in South Korea, and contains three different administrative districts; Seoul Metropolitan Government, Incheon metropolitan city and Gyeonggi province.
Seoul Metropolitan Government	Seoul Metropolitan Government is the administrative organization of Seoul Metropolis. Seoul Metropolitan Government deals with administrative affairs as the capital city of South Korea, so it is more centralized than that of most other cities with the city government being responsible for public education, correctional institutions, libraries, public safety, recreational facilities, sanitation, water supply, and welfare services.
Seoul Metropolis	Seoul, officially the Seoul Metropolis, is the capital and largest metropolis of the Republic of Korea (South Korea). The Seoul National Capital Area is the world's second largest metropolitan area with over 25 million inhabitants, which includes the surrounding Incheon metropolitan city and Gyeonggi province. Almost a quarter of South Koreans live in Seoul.
Service Provider	Providers of products and services that accept integrated smart card tickets for payment
Settlement	The process of making payments of the net amounts due to service providers as a result of transactions made by customers or between service providers
Single Journey Ticket/Token	A ticket/token with a stored value amount for a particular single journey that is captured and retained at the exit gate.
Smart Card Ticket	A Smart Card Ticket [chip card, or integrated circuit card (ICC)], is any pocket-sized card with embedded integrated circuits that can process data. It is also used as Smart Card.
Storage Area Network (SAN)	A dedicated network of hardware and software that is separate from LANs and WANs that is used to connect storage resources with servers.
T-money	T-money is a rechargeable series of smart card tickets used for paying transport fares in and around Seoul of South Korea.
Ticket Vending Machine (TVM)	A device installed at the un-paid area in the station that accepts payment, and issues tickets, including tops up stored value tickets
Token	A fare media used for single journey tickets
Transaction Fee	The fee charged for undertaking a transaction process
Transaction Processing	The process, by which customer payments and customer and service provider data, is recorded successfully or is cancelled if not completed successfully.

• Conversion rate: 1 US Dollar=1,000 Korean Won

• Summary

01
Concept of the Smart Card Ticket and Integrated Fare Collection

The smart card ticket is a form of electronic payment used to pay fares when using public transport. Based on information in digital form, the smart card ticket can be used instead of cash and magnetic ticket.

The smart card ticket system enables fast settlement of fares and small-amount payment, and contributes to reduce delays in bus operation as well as ensuring the financial transparency of public transport operating companies. For these reasons, it has gained attraction in the transport sector.

The smart card ticket system is largely composed of three parts: loading value, collecting fare and clearing revenue. The electronic fare payment system for public transport may vary in structure from region to region because of entangled interests of various organizations involved, such as local governments, public agencies, financial institutions, e-money corporations and bus/taxi companies.

Projects to build social infrastructure such as smart card ticket system can be classified into three categories: public project, public-private partnership project, and private project. The growing trend is to pursue public-private partnership project. However, it does not necessarily mean that this type fits all the cities: each city should make a choice depending on their respective situations. When selecting project type for a smart card ticket system, municipal governments need to consider various factors such as the incumbent government's leadership, the private sector's financial capability and its technological maturity.

02

Korea's Integrated Smart Card Ticket and Fare Collection Systems

Korea's first smart card ticket system was introduced in Seoul in 1996. The scheme, which was initially applied to urban buses in the city, was implemented to achieve the following purposes: ensuring the management transparency of bus operators; relieving the passengers' burden of paying fares in cash; and, addressing the problem of delays caused by fare payment. Busan, Jeju and Incheon followed suit and launched their own smart card ticket systems in 1998. It took several years before North and South Chungcheong provinces followed the example of other local governments; public transport riders there began to use smart card tickets in 2003 and 2004, respectively. smart card tickets have since become increasingly popular, being used mostly to ride Metros and city buses, which are the most prominent modes of public transport. Most noteworthy is the appearance of a new smart card ticket, called T-money, which was introduced as part of the public transport reform initiated in Seoul in July 2004.

As of 2010, Korea had seven smart card ticket operating companies. In terms of the sales-based market share, KSCC (Korea Smart Card Company) was the largest with 53%. It was followed by Lotte Group in second place. Having acquired EB Card and Mybi, then Korea's second and third largest card operators, in July 2010, Lotte showed a market share of 37%. None of the remaining five card operating companies had a market share exceeding 5%.

The Ministry of Land, Infrastructure and Transport regularly releases the results of its "Public Transport Status Survey," which includes statistics on the smart card ticket utilization rates. The survey conducted in 2005 revealed that Seoul recorded

81%, the highest among the cities using the smart card ticket system.

In 2006, the average smart card ticket utilization rate of all cities reached about 76%. Seoul showed a 90% rate, while Daegu and Daejeon recorded 76% and 68%, respectively. In 2009, the rate rose to 96% in Seoul, and surpassed 80% in all other regions, except for Ulsan which recorded 79%.

The survey revealed a significant disparity in the smart card ticket usage rate, depending on whether transfers are made during a journey. The rate was 78% among passengers using one mode of transport in their trips from origin to destination. In contrast, it reached 93.8% among riders making transfers during their trips. The higher usage rate among the latter group was apparently related to transfer discounts given to smart card ticket users.

In Korea, an integrated public transport fare system is in use in the nation's capital region, Seoul. A single-purpose trip may involve multiple rides of either the same or different modes of public transport. In such cases, the fares can be calculated and collected in an integrative way encompassing all the travel modes used, instead of being imposed separately for each mode. This scheme is referred to as an "Integrated Fare System." Public transport users can use various modes such as Metro, buses and taxis with a single smart card ticket.

03

Implications of Korea's Integrated Smart Card Ticket Operation

To be effective, an integrated smart card ticket system should be applied to all transport modes at the same time. However, it is difficult to do so because of conflicts of interests among various stakeholders. Reaching an amicable agreement among them is a prerequisite for implementing a smart card ticket project. In Korea, Seoul Metropolitan Government played a decisive role in hammering out such an agreement in 2004. Currently, efforts are being exerted to ensure the nationwide interoperability of smart card tickets.

An integrated smart card ticket system is a prerequisite for pursuing a reasonable reform of a public transport fare scheme. Smart card ticket system requires a vast amount of initial investments for building relevant facilities. So, endeavors should be made to secure profitability in order to provide stable smart card ticket services. Public transport ridership in Seoul averages more than 10 million rides a day. Such a high level of demand made the Seoul Metropolitan Government confident enough to decide that the smart card ticket system would have sufficient profit potential, eventually determining to purse its private promotion.

The smart card ticket system initiated by Seoul Metropolitan Government includes a variety of technologies. By establishing relevant technology standards, Korea has secured its stability and the interoperability of cards. The smart card ticket system is closely related to the daily lives of citizens to the extent that the number of daily smart card ticket transactions exceeds 20 million in Seoul alone. In this regard, the utmost emphasis in operating the system should be given to the maintenance of its stability.

Developing, implementing and monitoring effective transport policies requires the collection of relevant traffic data more than anything else. Data on transit use such as demand, usage by regions and hours of the day, and travel lengths are basically needed to devise effective public transport policies. It takes a lot of time and expenses to obtain information on such matters. Before the integrated smart card ticket system was implemented, questionnaire surveys were conducted to build a database of public transport statistics. However, the reliability of the data was constantly questioned.

The smart card ticket, one of the elements of the ITS (Intelligent Transport Systems), is considered a very effective tool for enhancing the convenience of public transport. The smart card ticket system is in successful use in Korea and various other countries and cities, including Hong Kong and Singapore. A number of other international cities are looking to follow suit and implement their own smart card ticket projects. The smart card ticket system can be used effectively in various aspects, particularly in cities of developing countries which transport infrastructure projects are underway or anticipated.

Korea is cited internationally as a nation that is successfully operating an integrated smart card ticket system. However, it also faced various problems in the early days of its smart card ticket system, which was introduced to the nation in 1996. The problems included user inconvenience due to the lack of compatibility, capacity shortages, and partial suspension of services. The nation has exerted continuous efforts to address such problems and improve related systems based on steady monitoring of card usage. In particular, the top policy-maker's commitment played a decisive role in ensuring the stable operation of the smart card ticket system. Other contributing factors include amicable adjustment of differences among stakeholders, enactment of laws and regulations to realize nationwide interoperability of smart card tickets, improvements in financial and technological aspects, and efforts to increase user convenience. All of these efforts led to the promotion of easy-to-use public transport, increased user convenience, and expansion in demand for transit usage. In this regard, the smart card ticket system implemented in Korea offers many implications for a number of cities seeking to build their own smart card ticket system.

CHAPTER 01

Concept of the Smart Card Ticket System


Windows Internet Explorer
Windows Internet Explorer
Windows Internet Explorer
Windows Internet Explorer
Windows Internet Explorer
Windows Internet Explorer

SECTION 01.

Concept of the Smart Card Ticket

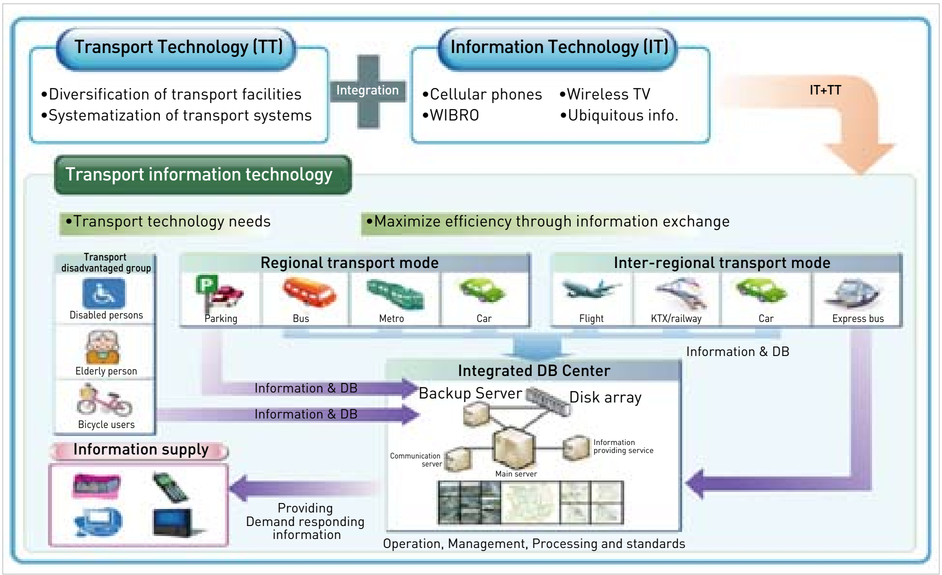
1. Intelligent Transport Systems (ITS) and the Smart Card Ticket

The Intelligent Transport Systems (ITS) can be defined as an environment-friendly transport system that enhances the convenience and safety of the citizens by applying the latest information and communication technologies to the transport system components.[1] The purpose of the ITS is to maximize the operational efficiency of the current road infrastructure and improve the drivers' convenience and safety. Social and economic costs associated with transport can be reduced through realization of a fast, safe, and convenient human-centered transport environment. In this regard, the ITS is being pursued as one of the most important transport policy objectives.

Private car ownership has increased significantly amid economic development over the past few decades, causing various problems such as traffic congestion,

1) A Dictionary of ITS·GIS Terminology, Korea Standards Association, 2005.

Figure 1.1. ITS: Integration between TT and IT



• Source: eB Corporation's internal data on AFC (Automated Fare Collection) system

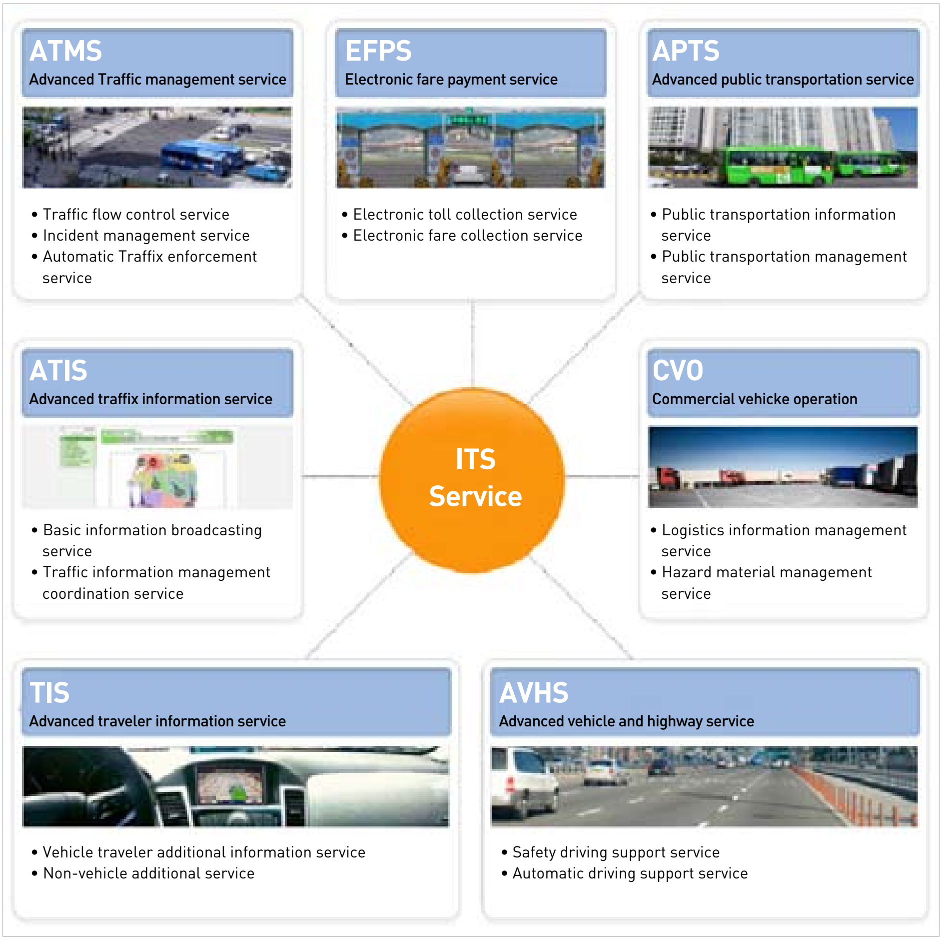
accidents and pollution as well as inconveniences to public transport users. Road construction did not help reducing traffic congestion because it led to a surge in demand for cars. The situation generated increasing calls for efforts to ensure effective management of the transport system and enhance traffic safety through the application of state-of-the-art information and communication technologies, resulting in the introduction of the ITS. The ITS is predicted to have impacts on the following matters:

- Demand for new transport policy paradigm
  - Increases in traffic congestion due to demand for car use rising at higher rates than new road construction
  - Increases in traffic accident and congestion costs as well as logistics costs
- Demand for increased efficiency of the current transport facilities
  - Transport facility construction costs constituting an unreasonably large portion of the city budget
  - Growing demand for budget in other fields such as welfare
- Demand for increased traffic safety

- A shortage of traffic safety facilities and the inadequate accident management system
- Application of cutting-edge transport technology in the field of traffic safety in response to soaring accident costs

- Demand for new transport policies
  - Increased demand for real-time provision of traffic information and realization of an environment-friendly transport system
  - Increased demand for a safe and convenient transport system, including an accident alert scheme

Figure 1.2. ITS architecture



• Source: Korean Agency for Technology and Standards, Ministry of Knowledge Economy

Figure 1.3. ITS service in Korea

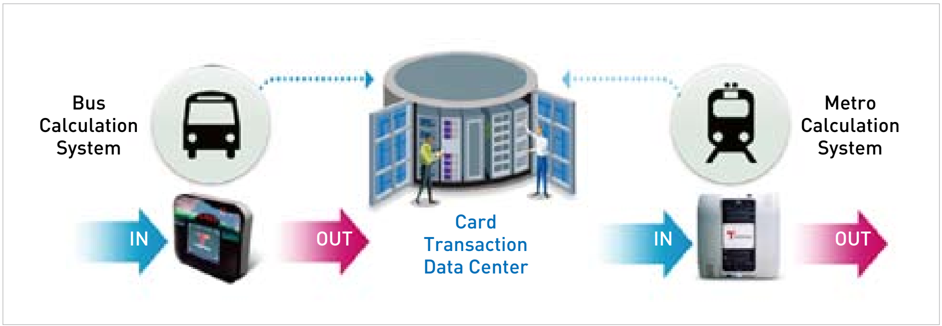
The ITS can provide a variety of services, which are classified into the following categories depending on functions: Advanced Traffic Management Service (ATMS), Electronic Fare Payment Service (EFPS), Advanced Public Transport Service (APTS), Advanced Traffic Information Service (ATIS), Advanced Vehicle and Highway Service (AVHS), Advanced Traveler Information Service (TIS) and Commercial Vehicle Operations (CVO) (Figure 1.2). The smart card ticket belongs to the category of EFPS, which may also be called AFC (Automated Fare Collection) service. smart card ticket details are described in the following sections.

2. Definition of the Smart Card Ticket

The smart card ticket is a form of electronic payment used to pay fares when using public transport. Based on information in digital form,[2] the smart card ticket can be used instead of cash. The basic smart card ticket system is shown in Figure 1.4. When public transport users pass their card over smart card ticket readers installed

2) Generally, smart cards with built-in CPU are used as smart card tickets.

Figure 1.4. Concept of smart card ticket system



on Metro, buses or taxis, fares will be paid automatically. The smart card ticket system has been actively introduced worldwide as it enables to use public transport in a fast and convenient way.

The smart card ticket system makes fast settlement of fares and small-amount payment, and contributes to reducing delays in bus operations as well as ensuring the transparency of public transport operators. For these reasons, it has gained traction fast in the transport sector.[3)]

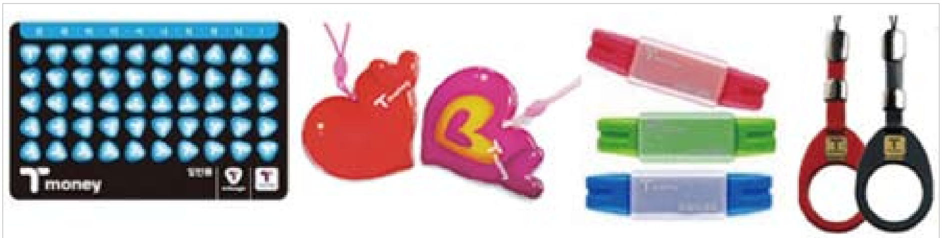
As reasons for the smart card ticket's rising popularity, EMTA (2008) cited the following factors: the existing fare structure's limitations and outdated functions, new fare policies, reductions in the use of fake tickets, increased utilization, reduced operating and maintenance costs, improved travel speeds, growing demand for integration, and improved image of public transport. In particular, the utilization rate of smart card tickets has steadily increased as they have removed the inconvenience of carrying cash around. Currently, smart card tickets are being used to pay road tolls and parking charges as well as public transport fares, and the range of their applications is continuing to expand. The smart card ticket comes in various shapes as shown in Figure 1.6.

Here, integration refers to a scheme that allows the use of various modes of public transport with a single integrated smart card ticket. It is a very convenient scheme because the card can be used to pay fares for a variety of public transport

3) Means of payment include cash, tokens, paper tickets, magnetic tickets, contact smart card tickets, contactless smart card tickets and mobile boarding tickets (EMTA, 2008).

Figure 1.5. Use of smart card ticket

Figure 1.6. Smart card tickets in various shapes

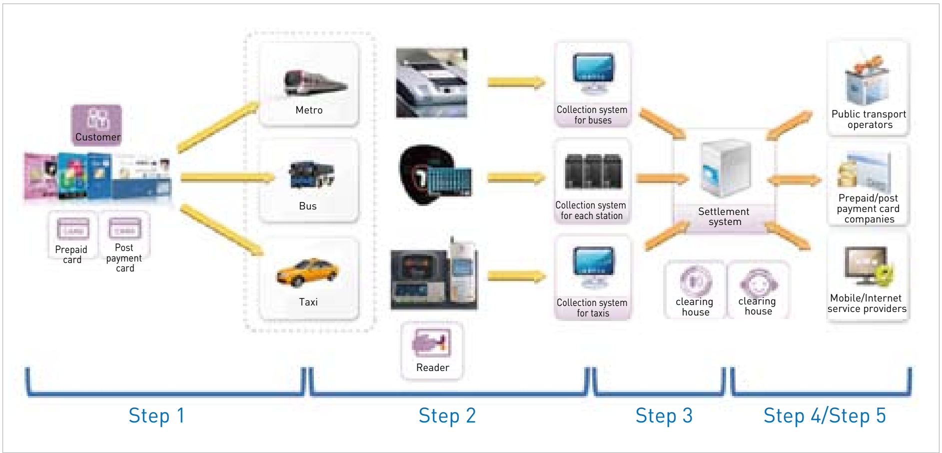


such as buses, Metros and taxis. Furthermore, recent trends show that once an integrated smart card ticket can be used in many areas, the range of its applications is getting expanded to the extent that it covers non-transport fields such as convenient store.

3. Process of Handling Smart Card Ticket Usage Information

Using a smart card ticket means paying public transport fares through digitalized information. When a smart card ticket is used, relevant information is processed sequentially through five steps as shown in Figure 1.7.

Figure 1.7. An information flow chart related to the use of smart card tickets



Step 1 is the process of a smart card ticket user's information being recognized by a card reader. When a user places his/her card near a card reader installed on buses, taxis or at Metro stations, the user's information is transmitted to the reader. Step 2 involves work to collect information on smart card ticket usage. The information collected via the card readers on transport modes is delivered to the collection system. At Step 3, the information is sent to a unified settlement/clearing system. Step 4 is a stage when the smart card ticket operators and relevant organizations use the information. Based on the information, the fares paid by smart card tickets are allocated to pertinent public transport operators. As for the fares paid by post payment smart card ticket such as credit card, the smart card ticket operators ask the pertinent organizations (financial institutions, mobile carriers, etc.) to pay the corresponding amounts. Finally, at Step 5, smart card ticket-related organizations deliver to the clearing house information on the valid and invalid smart card tickets, thus ensuring a smooth operation of the smart card ticket system.

4. Effects of Smart Card Ticket Usage

The effects of the use of smart card tickets can be divided into stakeholder-specific effects and technical effects. As shown in Table 1.1, the stakeholder-specific effects can be classified into three categories: users, operators and administrative agencies. The technical effects can be further divided into six categories: convenience of use,

Table 1.1. Effects of smart card ticket usage

Classification		Advantages
Stakeholder-specific effects	Users	• Remove the inconvenience of carrying cash around; Small-amount payment function removes the inconvenience of giving and receiving small change • Fast payment of fares increases passenger convenience when getting on and off vehicles • Can use multiple modes of transport with a single ticket • Makes it possible to apply fare discount policies, thus reducing transit users' travel expense burden • Usable for non-transport purposes
	Operators	• Ensures efficient management through reduction in manpower and time needed for selling tickets and settling revenues • Enables efficient and rational management through computerized fare collection • Removes labor-management conflicts over revenue leaks • Minimize drivers' fare collection business, thus ensuring safe driving and preventing traffic accidents • Possible to cope with various fare systems such as distance- and zone-based fares • Possible to increase operational efficiency based on correct computerized performance data
	Administrative agencies	• Electronic settlement of revenues helps to ensure income transparency of transport operators • Reduces administrative burden and budget waste related to the collection of basic data for fare readjustment • Possible to develop effective transport policies based on correct data and to implement various traffic fare policies • Improve the traffic environment and reduce environmental pollution through promotion of public transport
Technological effects	Convenience of use	• Card recognition possible in 10 cm distance from the sensor, so there is no need for the cardholder to stop • Possible to recognize a smart card ticket in a bag or a purse
	Security	• Codification of data prevents illegal use • Communication distance is restricted to 10 cm or less due to eavesdropping risks
	Reliability	• The life of a smart card ticket (4 times per day, about 70 years), and the reliability are guaranteed
	Collision prevention	• Only one card is processed when there are multiple cards within recognition distance from a card reader
	Multiple functions	• Possible to provide diverse services with one card because of increased memory capacity
	Various types of products	• Possible to make various types of products

security, reliability, anti-collision function, multiple functions, and various types of products.

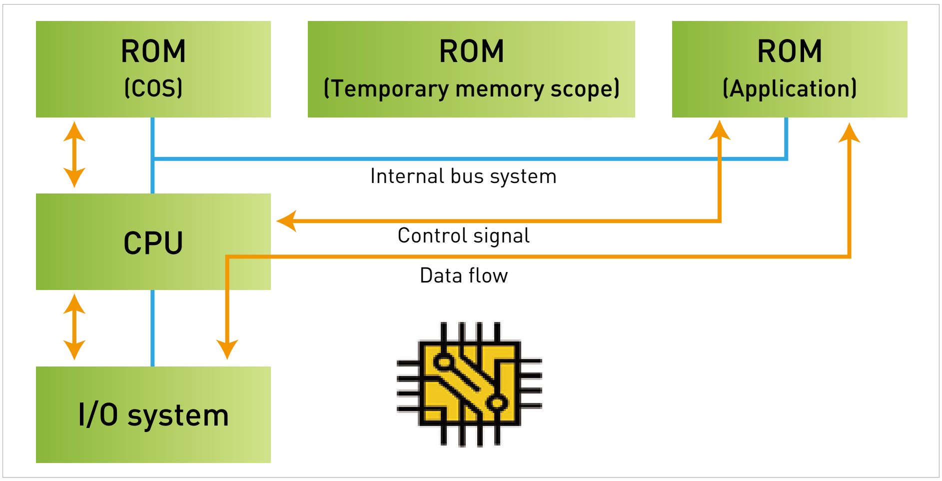
5. Classification of Electronic Tickets

Classification Based on the Technology

Electronic tickets are divided into MS cards (Magnetic Stripe cards) and IC cards (Integrated Circuit cards), depending on the system. MS cards are based on the magnetic recognition method. This system has limitations in the capacity to store information, and the stored information gets deleted when the card is near a magnet. There are also risks of fabrication and alteration because it is easy to decrypt or alter the memorized information or data arbitrarily. In contrast, IC card has built-in chips that can execute various functions such as information storage and computation, one of which is used in the smart card ticket.

IC cards can be categorized into smart cards and memory cards, depending on whether they are embedded with CPU (Central Processing Unit). Most of the smart card tickets currently in use in Korea are smart cards.

Figure 1.8. Smart card structure



• Source: Ministry of Land, Infrastructure and Transport, "A Mid/Long-term Roadmap for Facilitation of the Use of smart card tickets", 2008.

Table 1.2. Functional comparison of various types of electronic tickets

Classification	Magnetic card	Memory card	Smart card	
Computing function	Not available	Not available	Available	Built-in CPU
User certification	Not possible	Limited level	Comprehensive level	Cannot be used without password confirmation
Application	Single function	Limited level	Comprehensive level	Various functions accommodated in one card
Data storage	Low capacity	High capacity (8K)	High capacity (64K)	Over 100 times as large as magnetic card
Data security	Not available	Limited level	Comprehensive level	Possible to process codified algorithm
Program change	Not possible	Not possible	Alteration/deletion possible	Alteration/deletion possible after issuance

• Source: Ministry of Land, Infrastructure and Transport, "A Mid/Long-term Roadmap for Facilitating Smart Card Tickets", 2008.

Classification Based on the Communication Method and Operation System

Smart cards are divided into contact and contactless (RF) cards, depending on the interfacing method. The contact card, which focuses on security, employs a method of receiving and transmitting information through eight contact points. As such, it should be inserted to the card reader every time it is used. In comparison, the contactless card, which focuses on speed, uses a method of turning power and data signals into high-frequency electricity, and receiving electron or electrostatic bonds from the reader. The cardholder can use the card by simply passing it over the sensor.

Smart card tickets can be categorized into standard and non-standard types, depending on the method of wireless communication between the card and the reader. The standard type cards can be classified into Type A and Type B cards. The non-standard type cards can be divided into those employing the Mifare[4)] method and others using a method similar to Type A.

An operating system is needed to operate the CPU within a smart card ticket. Depending on the compatibility of the operating system, smart card tickets can be divided into closed and open types. Recent trends show a shift from closed types to

4) The Mifare chip is a smart card chip developed by Philips. NXP Semiconductors, spun off from Philips with the semiconductors business right, has so far supplied about 1 billion Mifare chips worldwide so far. The chip is used for smart card tickets used in Korea and the United Kingdom. It is also being used for employee identification cards and access security cards by major companies of the world.

open type cards that can execute a variety of functions.

Table 1.3. Operating system-based classification of smart card tickets

Classification	Closed type	Open type
Features	• The operating system developed for specific purposes	• The operating system developed for multiple purposes
Strengths	• Low price • Applicable for specific purposes (e-money, alliance points, etc.)	• A single card utilized for multiple functions (credit card, e-money, etc.) • Favorable future expandability
Weaknesses	• Low functional expandability	• High price • Immature technological stability

• Source: Ministry of Land, Infrastructure and Transport, "A Mid/Long-term Roadmap for Facilitating Smart Card Tickets", 2008.

Classification by Payment Method

Smart card tickets can be divided into prepaid and post payment cards, depending on the fare payment method. Cards issued by smart card ticket operators are mostly prepaid types. Prepaid cards contain electronic value worth the amount the users paid in advance to the smart card ticket operator. When using public transport, the fare is deducted from the electronic value put on the card. Prepaid smart card tickets have spending limits, so users need to periodically recharge them within the limits.

Post payment cards are based on a spend-first, pay-later approach. So, when card holders spend in excess of their financial capacity, they may not be able to pay the amount on the payment due date. Another serious disadvantage of this system is that there is a need to constantly renew the list of delinquents.

The post payment card provides a scheme under which the cardholder uses public transport first and is billed later on a monthly or other periodic basis. It is similar to that of credit cards. To promote user convenience, credit cards embedded with smart card ticket IC chips are mostly used as post payment smart card tickets. The credit card companies concerned pay fees to smart card ticket operators and use the operators' systems, without directly establishing smart card ticket-related components such as readers and operating programs.

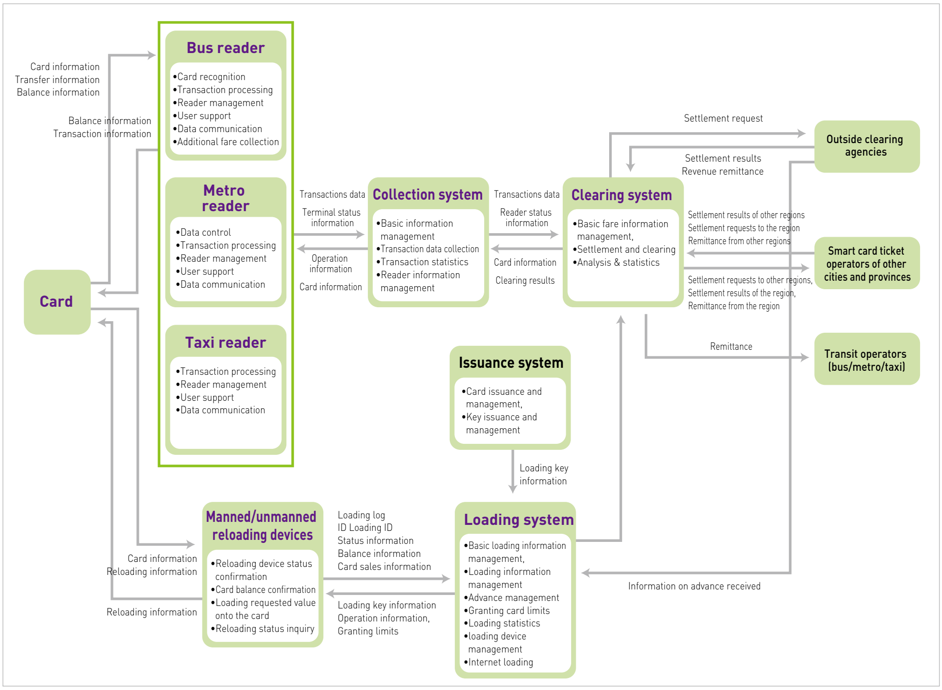
SECTION 02.

Smart Card Ticket System

1. Overall System Composition

Smart card ticket system is composed of three parts: charging, collection and settlement. It invariably employs the basic structure as shown in Figure 1.9, although its composition may vary from region to region because of entangled interests of various organizations involved in the system, such as local governments, public agencies, card operators, financial institutions, e-money corporations and bus/taxi companies. Depending on regional policies, a comprehensive management center and a relevant system may be established for supervision of overall traffic conditions.

Figure 1.9. A diagram of public transport fare payment system



• Source: Ministry of Land, Infrastructure and Transport, "ITS Education Essential for Urban Traffic Management", 2008.

2. Detailed System Functions and Composition

Collection System

The collection system is responsible for collecting all fare transaction records from the card readers installed on vehicles and at stations, and sending information on reader conditions to the clearing house. In addition, it provides support to verify transaction data and update information collected via the card readers in conjunction with the settlement and management systems. Collection systems for various public transport modes such as buses, Metro and taxis show slight differences, but they are almost the same in terms of structure and functions.

The bus collection system implements such functions as basic information management, statistics compilation and data collection on transactions, and management of status information on card readers on buses. It should provide a screen user interface for basic information management as well as compilation of statics and inquiry of transactions.

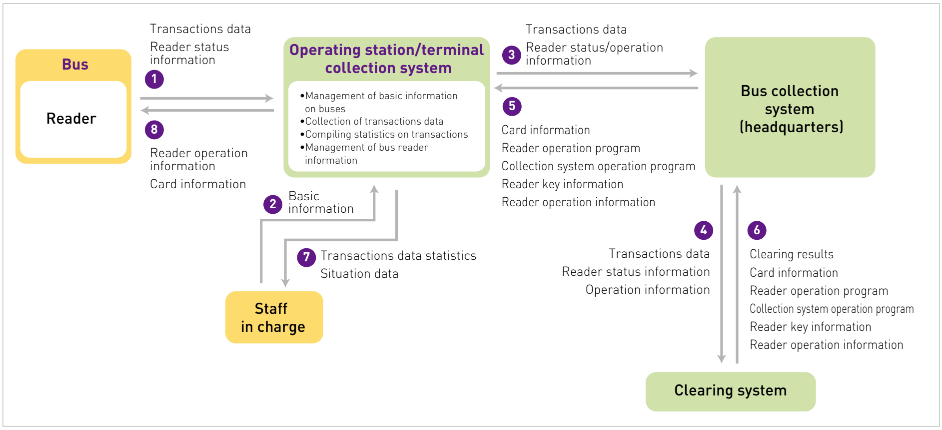
Table 1.4. Functions of the bus collection system

Classification	Details
Basic information management	Inquiry, registration and revision of information on all the buses operating within a district and their companies
Transaction statistics and inquiry	Confirm the collected transaction information and settlement results through various statistical data
Collection of transaction data	Collect transaction records through communication with readers on buses in operation, stores back-up files for each company within the system, and transmits them to the companies
Management of reader status information	Ensures that readers can automatically accommodate changes in information on credit cards, fare tables, reader programs and reader keys

• Source: Ministry of Land, Infrastructure and Transport, "ITS Education Essential for Urban Traffic Management", 2008.

Figure 1.10 shows a bus collection system composed in a way that can implement the above-mentioned functions.

Figure 1.10. A diagram of the bus collection system

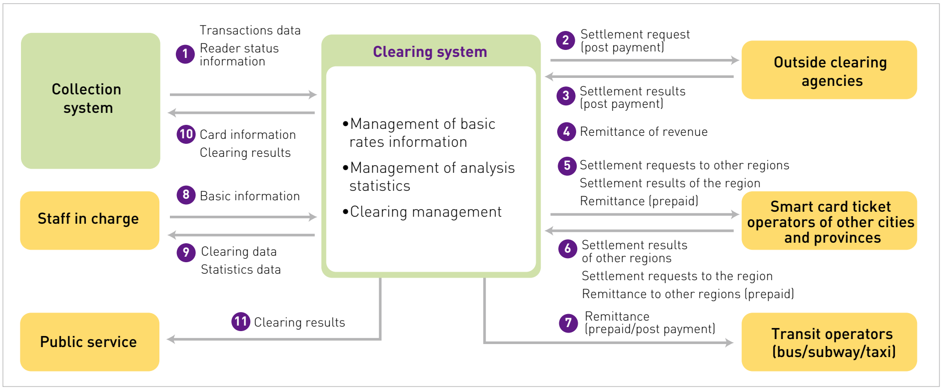


• Source: Ministry of Land, Infrastructure and Transport, "ITS Education Essential for Urban Traffic Management", 2008.

Clearing System

The clearing system is responsible for processing data related to settlement/clearing on the basis of basic fare rates and smart card ticket transactions data collected through the collection system. Based on the clearing results, fare revenues are alloted. This process involves transport operators, outside clearing houses and relevant agencies of metropolitan or provincial governments. The system's main functions include inputting of transaction data, billing card companies, processing returned data, clearing the transfer charge differences and allotting the revenues, compiling the allotment results, and commission processing. In addition, the settlement system is designed in a way that makes it possible to realize management of basic fare information, clearing of prepaid fares and deferred payments, and connections with settlement systems for other transport modes as well as with those of other metropolitan/provincial governments.

Figure 1.11. A diagram of the clearing system



• Source: Ministry of Land, Infrastructure and Transport, "ITS Education Essential for Urban Traffic Management", 2008.

Loading System

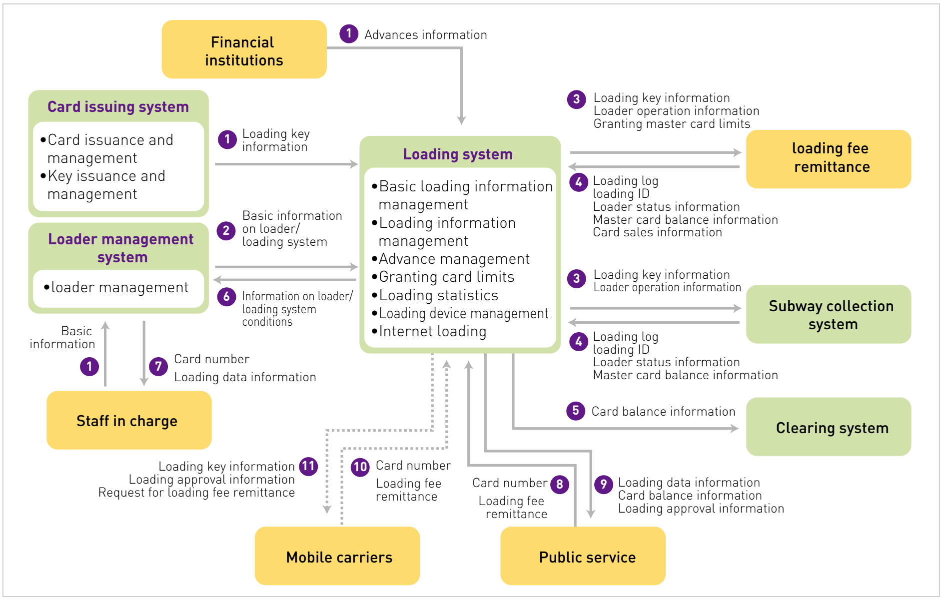
The loading system handles the task of loading prepaid cards with money values as requested by card users via manned/unmanned loaders, cell phones and the Internet. Information concerning the loaded credit is managed through the clearing and loading systems. When building a loading system, it is essential to ensure user convenience by enabling speedy and easy loading. It is also necessary to establish an automated scheme for loading information management and to consider introducing a diversity of means that can be used as loading facilities. The system is designed in a way that can process loading information, ensure data reception and transmission for loader operation, and manage charge deposit (advance fee) information as well as relevant policies and charging cards (see Figure 1.12.) In addition, the system collects normal charging log and error information from the chargers periodically or from time to time, and ensures that relevant information can be registered with or deleted from the management system.

Table 1.5. Loading system functions

Classification	Details
Basic loading information management	Manage information on loading policy, loading stations, loading master cards and loading SAM (Security Access Module) while operating loading system and machines
Loading data management	Collect normal loading log and error information from loaders periodically or non-periodically, and register/delete information on/from card and loading ledgers
Loading advances management	Information on advances deposited at banking accounts are transmitted to clearing and management centers in real time, charging information on advances table and putting the corresponding amount onto the loader master card
Internet loading	Loading and loading inquiry through the Internet
Loading via mobile phones	Provide online loading system using mobile phones through mobile carriers
Loading statistics	Confirm statistics and inquiries on loading data and advances management

• Source: Ministry of Land, Infrastructure and Transport, "ITS Education Essential for Urban Traffic Management", 2008.

Figure 1.12. A diagram of the loading system



• Source: Ministry of Land, Infrastructure and Transport, "ITS Education Essential for Urban Traffic Management", 2008.

SECTION 03.

Smart Card Ticket Projects

1. Smart Card Ticket Project as a Social Overhead Capital

Social overhead capital is public property that is essentially needed to produce and supply goods and services in the market. However, the private sector is showing a very low level of voluntary participation in social overhead projects because they require huge amounts of initial investments. Besides, such projects have monopolistic nature. So, the government needs to take steps to prevent the abuse of such status.

Public transport has the nature of public goods in that it is used by the majority of the citizens for the day-to-day economic activities. Smart card tickets help citizens paying fares conveniently and effectively when using public transport, so they can be considered to be part of the public transport system. In this regard, it can be said that a fare collection system involving the use of smart card tickets has the nature of public property.

An integrated fare system further expands the public service functions of a smart card ticket project. The system enables the citizens to use a diversity of transport modes with a single card ticket, and to make their usual trips at discounted rates under a distance-based fare scheme. To put it another way, an integrated fare system provides seamless transport to citizens by ensuring a wider range of intermodal connections. It also brings about a number of external effects such as the reduction of passengers' fare burden by not imposing surcharge on transfers. The level of private participation in smart card ticket projects may vary depending on their feasibility. However, a lot of investments are needed to build fare collection and clearing systems. So, it may be difficult to expect private corporations to voluntarily participate in such projects, particularly when the private market is not mature enough.

A smart card ticket project requires a unified regional clearing house because it involves an integrated fare scheme based on a distance-based fare system and transfer discounts. In this regard, it can be said to have monopolistic status. In case the private sector is given the responsibility for clearing fare revenues, the government should thoroughly supervise the performance of the service provider in return for giving it the business permit, thereby preventing it from monopolizing profits by abusing its exclusive business right.

2. Types of Smart Card Ticket Projects

As mentioned above, the fare collection system and the business of operating smart card tickets constitute social infrastructure that provides public services. Like various other social overhead capital projects, the enterprise to build a fare collection system and operate smart card ticket can be pursued as a public project, a public-private partnership project or a private project. The decision is dependent on "who provides financial resources and takes the initiative" and "who is responsible for the design, construction and operation of the project, and who has the ownership." The fare collection and smart card ticket business has the nature of social overhead capital. Thus, there should be a guarantee for regulatory oversight regarding the issuance of business licenses and the exercise of monopolistic business rights. This precautionary measure should be observed not only when the enterprise is pursued as a public or a public-private partnership project but when it is implemented as a private project.

Public projects are implemented by the government, which bears the entire burden of securing the financial resources, assumes full responsibility for the overall project procedures such as design, construction, operation and management, and possesses the ownership. Public projects represent a traditional type of business for the supply of social overhead capital. In this type of undertaking, the government should prepare all the needed financial resources and face risks related to investment recovery. Singapore's EZ-Link card business can be cited as a good example of a public project.

In comparison, there are public-private partnership projects (third sector) which are jointly financed and implemented by both the public and private sectors. The third sector approach represents a way to build social overhead capital through joint utilization of the government's initiative and financial resources and the private sector's funding capabilities and management know-how. Depending on the private sector's degree of participation and the transfer of ownership to the government, this approach can be further divided into the following methods: BOT (Build-Operate-Transfer), BOOT (Built-Own-Operate-Transfer) and BOO (Build-Own-Operate). Under this approach, the government and the private sector share risks related to the recovery of investment costs.

Depending on the project financing method, the third sector approach can be classified into two categories: Private Finance Initiative (PFI) and Public Private Partnership (PPP).[5] Since the 1980s, the PFI scheme has been increasingly used amid a worldwide trend toward privatization.[6] When carrying out a PFI project, the public and private sectors jointly establish a Special Purpose Company (SPC). SPC allows the two sectors to play complementary roles based on the government's long-term project operation capability and the private sector's agility. It also helps to ensure that risks are dissipated with regard to the recovery of investment costs. Depending on the extent to which private operators recover their expenses from the public sector, PFI projects can be largely classified into three types: projects for introduction of services, joint ventures and free-standing projects.[7] Hong Kong's Octopus Card represents a good example of a PFI project promoted through the establishment of an SPC.

Table 1.6. **PFI (Private Finance Initiative) project types**

PFI project types	Characteristics
Services sold to the public sector	Private-sector contractors provide services by building, managing and operating facilities. The costs are mostly paid by the public sector.
Joint ventures	Facilities are built with funds provided by both the public and private sectors, and operated by the private sector. After specified periods of time, the facilities are given a free-standing status.
Free-standing projects	Private-sector contractors who have received government permission maintain and operate the relevant facilities, assuming full responsibility for the project and recovering the investment costs through collection of usage fees.

• Reference: Environmental Management Research Center, "Introduction of PFI Projects for Improvement of Septic Tanks", *Cutting-Edge Environmental Technology*, June 2008 edition, pp.18-25.

Public-Private Partnership (PPP) projects are implemented by using the initiative and financial resources of the private sector. Compared to public projects, PPP projects generally have good prospects in terms of profitability and short-term recovery of investment costs. Private projects related to common goods and services that do not have the nature of public goods can be implemented without obtaining government permission. Private enterprises voluntarily participate in and finance such projects, and should bear the entire burden of recovering investment costs. Projects related to the fare collection system and smart card tickets have the nature of social overhead capital. As such, they are subject to government approval and regulatory supervision concerning their monopolistic status. Seoul's integrated smart card ticket project is a representative example of a PPP project based on the private sector's initiative and investment with government's supervision. The Seoul

5) Lee Kyu-hwang, "New Growth Strategy for Corporate Korea", SERI, 2008-1-21, pp. 215.

6) Environmental Management Research Center, "Introduction of PFI Projects for Improvement of Septic Tanks", *Cutting-Edge Environmental Technology*, June 2008, pp.18-25.

This system was launched in the United Kingdom in 1992 to pursue a further small government. It is aimed at increasing the value for money (VfM) without lowering the quality of public services. PFI projects should meet minimum requirements such as estimation of stably demand over a long-term period and a guarantee that grants or subsidies would not be reduced. Under this scheme, private operators build relevant facilities by using private-sector capital and know-how, and provide services by using the facilities.

7) ibid.

Metropolitan Government issued a project order after securing investment sources from the private sector. It then became the largest shareholder of Korea Smart Card Company, Ltd. (KSCC), thereby securing the means necessary for preventing the company from abusing its monopolistic business status as well as for maintaining the public service functions of the smart card ticket enterprise.

Table 1.7. Classification of project types depending on participation of public and private sectors

Public sector	←	Responsibility to recover investment costs	→		Private sector
Classification	Public projects	Public-Private Partnership projects (third sector)			Private projects
		BOT	BOOT (DBFO)	BOO	
Orderer (permit-issuing authority)	Government	Government	Government	Government/ Private sector	Private sector
Finance	Government	Joint investment by the government and the private sector	Private sector	Private sector	Private sector
Design	Government	Private sector	Private sector	Private sector	Private sector
Build	Government	Private sector	Private sector	Private sector	Private sector
Operate	Government	Private sector	Private sector	Private sector	Private sector
Ownership	Government	Transfer of ownership to the government after operation	Transfer of ownership to the government after operation	Private sector	Private sector

• Source: Seong Ung HONG, "Economics of Social Overhead Capital," 2006.

As explained so far, the social overhead capital projects can be broadly classified into three categories: public projects, public-private partnership projects, and private projects. The growing trend is to pursue public-private partnership projects. However, it does not necessarily mean that this type fits all the cities: each city should make a choice depending on their respective situations. When selecting a project type for smart card ticket system, municipal governments need to consider various factors such as the incumbent government's leadership, the private sector's financial capability and its technological maturity. In the next section, this paper reviews the smart card ticket projects of Singapore, Hong Kong and Seoul regarding their history, background, project types and each type's pluses and minuses.

3. A Study of Smart Card Ticket Projects of Three Cities: Singapore, Hong Kong and Seoul

Case 1: Singapore's Ez-Link Card

To implement its integrated fare system for buses and railways, Singapore in 1990 introduced a stored-value magnetic card called "farecard." For the operation and management of the card system, relevant private-sector operators launched a service company named Transit Link Pte Ltd. In 2002, Singapore's Land Transport Authority (LTA) founded a subsidiary, Ez-Link Pte. Ltd., to replace the farecard scheme with a smart card system, and established a contactless smart card, Ez-Link card, with S$300 million worth of investments. After inaugurating the subsidiary, LTA signed a contract with ERG Transit Systems, an Australia-based company, for design and construction of the Ez-Link system.

Under Singapore's integrated card system, the card-issuing function is differentiated from the settlement function. Ez-Link Pte. Ltd. has been serving as the card issuer since 2002, being responsible for the sale and distribution of the cards. It is also in charge of the operation and management of the card system, a function carried out by Transit Link Pte. Ltd under the farecard system. Despite the system change, however, the fare revenue settlement function remains under the control of Transit Link. The only organization that has conducted the task of clearing and settling the public transport fare revenues since the farecard system, Transit Link is serving as the central clearing house that processes fare revenue data from Ez-Link Pte. Ltd. and banks.[8)] In October 2009, the Ez-Link card was replaced with the "CEPAS Ez-Link card" after the InfoComm Development Authority of Singapore (IDA) introduced the CEPAS (contactless ePass application) technology to realize the interoperability of e-Purses. The CEPAS Ez-Link card was launched

8) Juliana Sutanto et al., "Change Management in Inter-organizational Systems for the Public", *Journal of Management Information Systems*, Vol. 25 No. 3, Winter 2009.
Transitlink was the only entity that processed PTOs' fare transaction information before issuing the claimed money. After the system change, PTOs' fare transaction information needs to be processed by two more entities (i.e., Ez-Link and a bank) before they can receive their claimed money. The role of Transitlink became that of a clearing house while Ez-Link took on the job of card issuer. <http://www.comp.nus.edu.sg/~atreyi/papers/change-manag.pdf>

as a means of small-amount payment not only for transport but for other sectors. The new card system is also being operated by Ez-Link Pte. Ltd. under the supervision of LTA (Land Transport Authority).

LTA led the entire process of establishing Ez-Link Pte. Ltd., exercising full authority over the project ordering, system design and construction, and its operation and management. It also assumed full responsibility for financing the project. As the superior organization of Ez-Link Pte. Ltd., LTA has the right to control the operation of Ez-Link and determine smart card ticket policies. These facts show that the smart card ticket project in Singapore is a public project implemented under the full responsibility of the government.

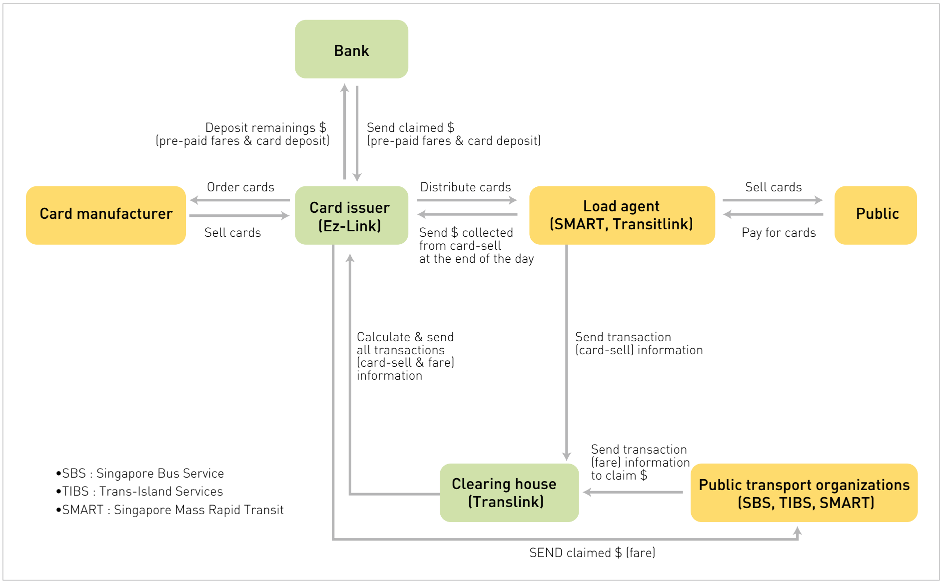
There are two major advantages when the smart card ticket system is established and operated as a public project as shown in the case of Singapore. First, the efficiency of the government's smart card ticket policy can be ensured. The Singapore government replaced the magnetic card, which had been used in the 1990s, with the contactless smart card, Ez-Link, in 2002. In 2009, it introduced the CEPAS Ez-Link card to ensure the smart card ticket's compatibility with all e-Purses in the region. These transitions could be smoothly carried out because the relevant tasks were implemented by organizations given full authority by the government. Had the private sector participated in the project or played a central role, the project might have faced serious trouble because of conflicts among the participants with different interests.

The second advantage is the easiness with which the public service functions of a smart card ticket project are ensured. In Singapore, the shift from the magnetic card to a contacless smart card was accompanied by the replacement of Trans Link Ltd. with Ez-Link Ltd. as the card issuer. Despite the change, Trans Link Ltd. is playing the role of the central clearing house. If these two organizations had been private enterprises, they might have been entangled in conflicts of interest, making it impossible to realize the current project structure. Under the integrated fare collection system, the central clearing house has monopolistic status. So, when a private company carries out its function, it must be subject to the government's supervision and regulatory measures. When a smart card ticket project is implemented by the public sector, it can be free from the adverse effects that can be caused by private enterprises pursuing excessive profits. In this regard, public projects are much more advantageous than private ones.

However, there are disadvantages of a public project. The most prominent one is the fact that the government has to make all initial investments needed to build the fare collection and clearing systems. Because of this financial burden, it would be desirable to induce the private sector's participation in case the government has not sufficient financial resources or the shot-term demand for project-related services is not expected to reach a sufficient level.

Another disadvantage of a public project is the lack of efficiency and managerial know-how that could be provided by the private sector. To private enterprises, profitability and the prospects of recovering investment costs are the most important factors in implementing a project. So, private companies normally try hard to develop and introduce new technologies, and to use management techniques to minimize costs and make the most out of their investments. In comparison, projects led entirely by the public sector have limitations in ensuring such managerial efficiency.

Figure 1.13. A diagram of Ez-Link stakeholders



• Source: Juliana Sutanto et al., "Change Management in Inter-organizational Systems for the Public", *Journal of Management Information Systems*, Vol. 25 No. 3, Winter 2009.

Case 2: Hong Kong's Octopus Card

The smart card ticket in Hong Kong is the Octopus card issued by Octopus Cards Ltd. (OCL). It is used 11 million times a day, and the daily transactions are worth about $128 million.

The Octopus card has been used since 1997 as a means of public transport fare payment in Hong Kong. Before its introduction, Hong Kong's state rail companies, Mass Transit Railway Corporation (MTRC)[9] and Kowloon-Canton Railway (KCR), had used contact-type magnetic prepaid cards since 1979 and 1989, respectively. In 1993, Hong Kong decided to use a contactless smart card by introducing more developed technology. The next year, four public transport operating companies - MTRC, Kowloon-Canton Railway Corporation, Kowloon Motor bus, Citybus, Hongkong and Yaumati Ferry (HYF) - launched a joint venture named Creative Star Ltd. for the operation of the Octopus card. This company changed its name to Octopus Cards Ltd. in 2002.

In 2005, Octopus Holdings Ltd. was inaugurated as a joint venture, and Octopus Cards Ltd. was restructured to become a subsidiary company of the holdings company. To identify the ownership structure of the holdings company, it is necessary to review its shareholders. Octopus Holdings Ltd., which secured its financial resources from Hong Kong's five major public transport operators beginning in 2007, has the following shareholder structure: MTRC 54.4%, Kowloon-Canton Railway Corporation 22.1%, Kowloon Motor bus 12.4%, Citybus 5% and New World First bus 3.1%.[10] The Hong Kong government has a 76.54% stake[11] in MTRC and a 100% stake in Kowloon-Canton Railway Corporation. In this regard, the Hong Kong government can be considered the largest shareholder of Octopus Holdings Ltd. This structure makes it possible for the Hong Kong government to exert the greatest influence over the operation of Octopus Cards Ltd.

To know about the approach taken for the implementation of the Hong Kong

9) Turned into a stock company under a privatization scheme on June 30, 2000.

10) Octopus Holdings Limited., "The Joint Venture of Five Major Transport Operators", Retrieved 2007-04-15.

11) Implemented beginning on Dec. 31, 2005.

smart card ticket project, it is necessary to take a look at both Creative Star Ltd. established in 1994 and Octopus Cards Ltd. which became a subsidiary of Octopus Holdings Ltd. in 2005. Creative Star Ltd. was founded in 1994 as a joint venture by mass transit operators led by MRTC. In this regard, the project can be classified as a PFI project. However, as shown by the fact that some of the operators belonged to the public sector, Hong Kong's smart card ticket project is based on a system that has strong public-sector characteristics. Since Octopus Cards Ltd. became a subsidiary company of Octopus Holdings Ltd. in 2005, the public sector has been playing a bigger role in terms of the ownership and operation of the company.

The method of implementing the fare collection and smart card ticket project in Hong Kong is close to the BOO scheme that involves capital investment from the private sector. The Octopus card was launched in 1997 as a joint venture by public-sector public transport operators like MTRC and private-sector mass transit companies. It was pursued under the initiative of the private sector, not the government. However, the situation changed in 2005 when Octopus Holdings Ltd. was founded as a joint venture in 2005. Although both the government and the private sector were involved in the holdings company, the public sector began to exert a dominant influence over its operation. Through such a structure, the Hong Kong government maintains the public nature of the smart card ticket system while preventing the private operators involved in the project from abusing the company's monopolistic status. This structure, however, may adversely affect the company's operation in terms of managerial efficiency and technological competitiveness.

As shown in the Hong Kong example, public-private partnership enables the government to be relieved of the initial burden in terms of financing and policy implications. It also makes it possible to introduce new technologies depending on market needs and the agility of the private sector. In addition, the public nature of the project can be secured over the long term through incremental participation by the public sector. As explained so far, the foremost strength of the public-private partnership scheme lies in the fact that it helps to implement a project efficiently through appropriate distribution of roles between the public and private sectors.

Proper division of roles and harmonious adjustment of differences are the prerequisites to successfully implementing a public-private partnership project.

If any of the two sectors plays an excessively dominant role in carrying out a project, it becomes difficult to make the most of the advantages of a public-private partnership scheme. Such a situation is happening in Hong Kong: the public sector becomes increasingly dominant over the private sector in the operation of the smart card ticket system. In the long term, such a condition might undermine the private sector's efforts to achieve technological and operational innovation.

Case 3: Seoul's T-Money Card

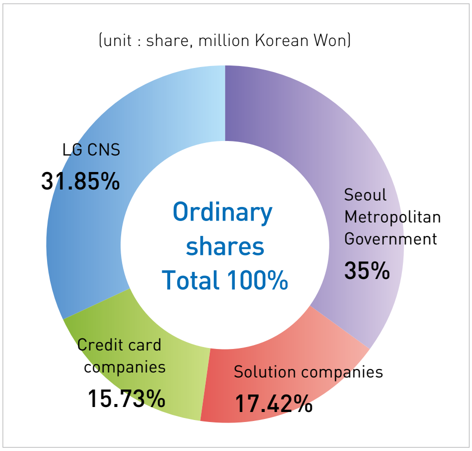
Seoul's integrated smart card ticket system was introduced in 2004 when the Seoul Metropolitan Government implemented a reform of the city's public transport system. The reform, initiated in July 2004, placed the utmost emphasis on restructuring the bus routes into trunk and feeder lines and implementing an integrated intermodal public transport fare collection system. An integrated smart card ticket system was an element vitally needed for the reform. Aware of this, Seoul Metropolitan Government began to promote the smart card ticket project in earnest around the end of 2003, selecting a consortium led by LG CNS as the main contractor.

The Seoul Metropolitan Government determined that it would be desirable to inaugurate the smart card ticket operator, Korea Smart Card Co. (KSCC), as a stock company under the Commercial Act. It also decided that the new corporation's capital should represent at least 35% of the total assets (capital + liabilities) in order to ensure its stable operation. Thus, KSCC was launched in November 2003 as a stock company with 30 billion Korean Won (30 million US Dollar) worth of capital investment from the private sector. As of November 2011, the Seoul Metropolitan Government had a 35% stake in KSCC (shares provided free of charge by the shareholders). The remaining portion was held by card companies, mobile carriers and IC card-related corporations (see Figure 1.14).

KSCC is practically operated and managed by its second largest shareholder, LG CNS. KSCC is in charge of developing and constructing a new smart card ticket system, issuing and loading cards, clearing services and system operation, and managing intellectual property rights such as key values and security algorithms. Although it is the company's largest shareholder, the Seoul Metropolitan

Government does not participate in its actual management. Instead, it is executing its supervisory functions to prevent the abuse of the company's monopolistic status in the smart card ticket market.

Figure 1.14. KSCC shareholders



• Source: Korea Smart Card homepage, as of Nov. 30, 2011.

The Korean example shown in this study can be classified as a PPP project. Although Seoul Metropolitan Government initiated the project and secured the largest stake in KSCC, the private sector took the initiative and provided all the financial resources in the early stages. In addition, the private sector is playing a leading role in carrying out all the company activities such as fare collection, clearing, operation and management. The Seoul Metropolitan Government's participation in this project can be regarded as a move to ensure the public service functions of the smart card ticket business.

A PPP project method can be employed when building a smart card ticket system. This approach has the following advantages: reducing the government's financial burden, utilizing the private sector's managerial know-how and efficiency, and accelerating technological development through competition among private-sector participants in the project. As for Seoul, the Metropolitan Government had no financial burden because the initial financial investment worth 30 billion Korean Won (30 million US Dollar) was made by a consortium composed of five private companies led by LG CNS. The investments were recovered within a short period time through efficient operation of KSCC. In addition, the maintenance of a competitive structure among consortia and relevant companies helped ensure continued development of technological and policy know-how regarding system design, construction and operation.

There are also disadvantages of such a private project. The biggest problem is difficulty in ensuring a project's public service functions. As for KSCC, it operates the fare collection system and executes the clearing function. This means that a private-sector operator has a complete control over a smart card ticket system which is meant to serve public interests. To prevent such powerful status from being abused, it is essential for the government to supervise and place restrictions on the operator's activities. Otherwise, the operator might abuse its status, thus penalizing card users through such acts as the charging of excessive fees.

4. Comparison of Project Approaches of the Three Cities

As explained so far, Singapore, Hong Kong and Seoul are implementing smart card ticket and integrated fare system through different approaches. Singapore is using a public project method based on government finance, while Hong Kong is employing a PPP approach. Seoul is using also a PPP scheme. Singapore's case represents a conventional and typical method used by governments that have sufficient financial resources to support social overhead capital projects. The smart card ticket project in Hong Kong is financed by a joint venture of the government and the private sector. However, the government exerts a predominant influence on building and operating the system. This structure may be related with the fact that some of the key promoters of the smart card ticket system were government agencies. The maturity of private-sector participants may be cited as another contributing factor. Seoul's case shows that the private sector can play a leading role in establishing and operating a smart card ticket system. Such a private sector-oriented approach can be pursued when the private sector assumes responsible attitudes and has sufficient financial capabilities. There are also other preconditions such as the accumulation of IT technologies as social capital and a sufficient level of demand for public transport services.

Project types suitable for cities may differ depending on their respective conditions. Cities that want to introduce a smart card ticket system need to think about the following questions: 1) Does the public or the private sector have sufficient financial resources and leadership to implement a smart card ticket project?, 2) To which sector, public or private, do the public transport operators belong?, 3) In terms of IT technology, are companies based on regions advanced enough to operate a smart card ticket system on their own?, and, 4) Is there a sufficient level of demand for the use of smart card tickets? Project design should be preceded by the process of selecting suitable project types based on careful consideration of these questions.

Table 1.8. Comparison of smart card ticket projects of Singapore, Hong Kong and Seoul

Cities	Singapore	Hong Kong	Seoul
smart card ticket name	EZLink (2009.10. New CEPAS Ez-Link card)	Octopus	T-Money
Common Ticketing Company (CTC)	EZ-Link Pte. Ltd.	Creative Star Ltd. (1997-2002) Octopus Cards Ltd. (OCL) (2002-present)	Korea Smart Card Co. Ltd. (KSCC)
Clearing house	TransitLink Pte. Ltd.	Octopus Cards Limited (since 2005)	KSCC
Types of CTC	Government subsidiary	Special purpose corporation (SPC) - Public company	Special purpose corporation (SPC) - Public company
Service launched	April 2002	1997	July 2004
Initiator	Land Transport Authority (LTA)	Major public transport operators, including public organizations	Local transport operators, including LG CNS
Orderer (permit-issuing authority)	LTA	Hong Kong SAR Government's Monetary Authority[12]	Seoul Metropolitan Government[13]
Financial Resource	LTA government budget	PFI: Joint ventures	Private capital
Design	LTA (Contractor: ERG Transit Systems)	Octopus Cards Ltd. (Contractor: AES Prodata)	KSCC (Contractor: LG CNS)
Build	LTA (Contractor: ERG Transit Systems, UK)	Octopus Cards Ltd. (Contractor: AES Prodata)	KSCC (Contractor: LG CNS)
Operate	EZ-Link	Octopus Cards Ltd.	KSCC
Ownership	LTA	Major transport operators in Hong Kong	KSCC
Project type	Public project	PPP project (BOO method)	PPP project

12) Legal Service Division Report on Subsidiary Legislation Gazetted on 29 September 2000.
"According to the Administration, the Monetary Authority authorized Creative Star Limited on 20 April 2000 to carry on business as a deposit-taking company to issue the Octopus Card as a multi-purpose card."

13) ibid.

CHAPTER 02

Korea's Integrated Smart Card Ticket System


Windows Internet Explorer

SECTION 01.

Smart Card Ticket Usage and Operation in Korea[14)]

1. The History of Smart Card Ticket in Korea

Figure 2.1. Card readers in city bus in Seoul

Korea's first smart card ticket system was introduced in Seoul in 1996. The scheme, which was initially applied to city buses in the city, was implemented to achieve the following purposes: ensuring the management transparency of transport operators; relieving the passengers of the burden of paying fares in cash; and, addressing the problem of delays caused by fare payment. Busan, Jeju and Incheon followed suit and launched their own smart card ticket systems in 1998. It took several years before North and

14) The status of smart card tickets in Seoul, the target area of this paper, is explained in detail in Chapter 3 (Section 2).

South Chungcheong provinces followed the example of other local governments; public transport riders there began to use smart card ticket in 2003 and 2004, respectively. smart card tickets have since become increasingly popular, being used mostly to ride Metros and city buses, which are the most prominent modes of public transport. Most noteworthy is the appearance of a smart card ticket, called T-money, which was introduced as part of the public transport reform initiated in Seoul in July 2004.

Table 2.1. Timeline of smart card ticket system in Korea (1996-2009)

Year	Smart card ticket-related activities
1996. 7.	Smart card ticket system introduced for city buses in Seoul
1998. 6.	Smart card ticket system introduced for phase-1 Seoul Metros
2000. 4.	Interoperable use of prepaid and post payment smart card tickets initiated between Seoul and Incheon Metros
2000. 6.	Post payment smart card ticket service expanded to cover buses (interoperable)
2000. 9.	Discount scheme for smart card tickets introduced (8% for adults, 20% for middle and high school students)
2001. 5.	Smart card ticket system expanded to include Mini buses
2001. 10.	Transfer discount scheme introduced for smart card ticket users (MetroÐbus)
2002. 2.	Increase in the number of companies issuing post payment smart card tickets (1Ð8)
2002. 4.	Transfer discount scheme introduced for Mini buses
2004. 7.	A new smart card ticket system launched for Seoul city buses and Seoul metropolitan Metros
2005. 12.	Replacement of smart card ticket readers on Gyeonggi buses
2007. 7.	Transfer discount scheme initiated for city/Mini buses and Metros between Seoul and Gyeonggi Province
2008. 9.	Transfer discount scheme initiated for metropolitan buses between Seoul and Gyeonggi Province
2008. 11.	Seoul Metropolitan Government begins issuing free-ride smart card tickets
2009. 5.	Single-use Metro smart card tickets introduced for use in the Seoul metropolitan area
2009. 10.	Transfer discount scheme for buses and Metros initiated among Seoul Metropolitan Government, Gyeonggi Province and Incheon City

• Source: Metropolitan Transport Association, "A Case Study of the Smart Card Ticket System", 2009.

As shown in Table 2.1, the history of smart card tickets in Korea can be divided into three stages: the introduction stage (1996-1997), the development stage (1998-2004) and the maturity stage (2005-present).

During the introduction stage, the idea of using smart cards as a means of payment for various activities, including transport, began to be seriously discussed.

Active research on the scope and functions of the smart card industry led to the appearance of various business ventures covering such areas as e-money, electronic passes and the smart card ticket.

During the development stage, which spans the period between 1998 and 2004, the smart card ticket industry achieved remarkable growth. The sector was keen on expanding its business scope based on new technologies developed by a number of venture firms. The most important changes included a significant expansion in financial settlement and clearing infrastructure, and growth in the supply of smart card tickets. Seoul Metropolitan Government's smart card project led to expansion in infrastructure for smart cards, mainly for the use of smart card tickets. In addition, regional smart card ticket projects secured solid bases for growth during this period.

Beginning in 2005 when the smart card ticket market entered its maturity stage, large-scale public projects, including those for restructuring smart card ticket operation systems, were implemented in various regions. At the same time, extensive research was conducted with regard to the smart card ticket and readers, resulting in the development of more sophisticated technologies and the initiation of interoperable smart card ticket services among regions. These developments helped the public pay increasing attention to smart card tickets. There were also growing

Table 2.2. Development stages of the smart card ticket industry in Korea

Periods	Characteristics	Details
Introduction stage (1996-1997)	Introduction and appearance of smart card tickets	• Introduction of smart card tickets • Initiation of smart card ticket services in Seoul • Appearance of various smart card ticket companies
Growth stage (1998-2004)	Distribution and development of smart card ticket-related facilities and technology	• Increase in the need to introduce a smart card ticket system and expansion in the cards' coverage areas • Nationwide spread of smart card ticket usage • Provision of various services by using new smart card tickets based on cutting-edge technologies • Promoting the use of smart card tickets and building relevant infrastructure facilities
Maturity stage (2005-present)	Maturity/stability of the smart card ticket industry and its shift toward a service industry	• Increased need for nationwide interoperability • Smart card ticket standardization • Multi-functional smart card tickets • Shifts in focus from manufacturing/development to services • Initiation of applied projects through technological conver-gence

• Source: Ministry of Land, Infrastructure and Transport, "Developing a Mid/Long-Range Road Map for Smart Card Ticket Promotion", 2008.

calls for nationwide standardization of smart card tickets and their compatibility. Related efforts led to the development of standards for payment SAMs and readers in 2006. In addition, application of leading-edge technologies made it possible to reinforce the card's security functions and provide a variety of other services aimed at improving user convenience.

2. Smart Card Ticket Operators in Korea

As of 2010, Korea had seven smart card ticket operators. In terms of the sales-based market share, KSCC was the largest with 53%. It was followed by Lotte Group in second place. Having acquired eB Card and Mybi, then Korea's second and third largest card operators, in July 2010, Lotte showed a market share of 37%. None of the remaining five card operating companies had a market share exceeding 5%. (see Table 2.3)

Figure 2.2. Distribution of public transport smart card tickets

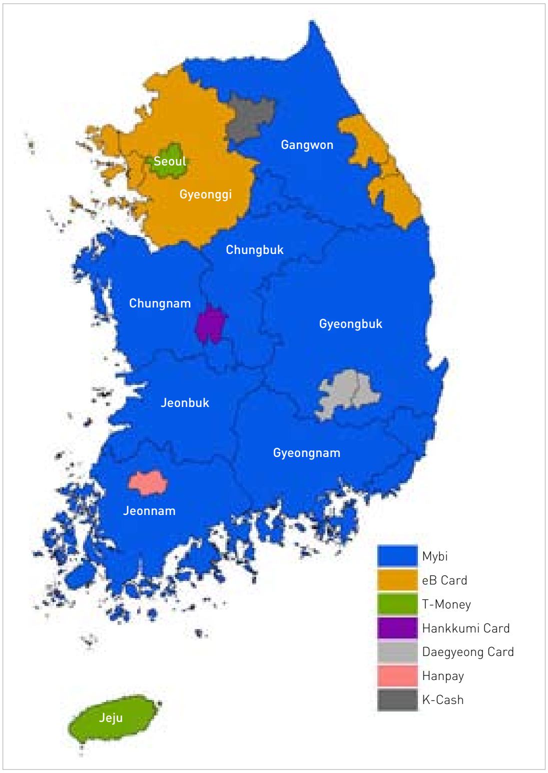


Table 2.3. Korean smart card ticket market status (as of 2009)

(unit: 1 million Korean Won)

Operators	Sales revenues	Market share (%)	Service regions
Korea Smart Card	118,436	52.94	Seoul, Daejeon, Pohang, Jeju Province
eB Card	48,038	21.47	Gyeonggi, Incheon, parts of Chungcheong provinces
Mybi (including Busan Hanaro Card)	35,360	15.81	Busan, South Gyeongsang Province, Jeolla provinces
Seoul Bus Transport Cooperative	10,509	4.71	Seoul, Gyeonggi Province
Kardnet	5,857	2.62	Daegu, North Gyeongsang Province
Hana Bank	3,359	1.50	Daejeon
Top Cash	1,674	0.74	Seoul, Pohang, Tongyeong, Geoje, Andong, Jeju
Korea Financial Telecommunications & Clearings Institute	474	0.21	Daegu
Total	223,707	100	-

• Note: In July 2010, Lotte Group acquired Mybi and eB Card (Lotte is ranked second with a market share of 37%)
Compiled based on Fair Trade Commission's press release (July 23, 2010)

Table 2.4. Domestic smart card ticket facility status

Classification	Issuance		Readers		Selling places		Loading stations	
	10,000 cards	Number of cards per person	Units	units/ 10,000 people	Number	Number per 10,000 people	Number	Number per 10,000 people
Total	5,780	1.18	54,646	11.15	13,214	2.70	15,736	3.21
Seoul	3,370	3.31	32,273	31.70	5,908	5.80	6,573	6.46
Busan	892	2.47	7,347	20.34	2,558	7.08	2,568	7.11
Daegu	376	1.51	2,432	9.74	675	2.70	1,034	4.14
Incheon	-	-	595	2.27	611	2.33	944	3.60
Gwangju	93	0.66	1,181	8.39	263	1.87	319	2.27
Daejeon	72	0.49	1,084	7.39	182	1.24	273	1.86
Ulsan	86	0.79	655	6.00	165	1.51	158	1.45
Gyeonggi	567	0.52	1,985	1.82	1,329	1.22	2,502	2.29
Gangwon	4	0.03	565	3.75	58	0.39	151	1.00
Chungbuk	50	0.33	704	4.71	147	0.98	146	0.98
Chungnam	34	0.17	1,084	5.49	168	0.85	229	1.16
Jeonbuk	66	0.35	970	5.19	405	2.17	400	2.14
Jeonnam	33	0.17	870	4.48	159	0.82	182	0.94
Gyeongbuk	14	0.05	859	3.19	202	0.75	107	0.40
Gyeongnam	101	0.32	1,608	5.07	304	0.96	248	0.78
Jeju	22	0.39	434	7.77	80	1.43	174	3.12

• Note: 1) Card and reader statistics are based on data compiled in April 2007. The figures for Seoul include the T-money and Upass statistics. Statistics for Incheon were included in those for Seoul and Gyeonggi Province. The number of eB cards and readers was included in statistics for Gyeonggi. Korea Expressway Corp. cards and KORAIL membership cards (X-cash) were not counted.
2) Statistics on card selling places and loading stations are based on data compiled in December 2006.
• Source: Ministry of Land, Infrastructure and Transport, "A Survey of Smart Card Ticket Operational Status", 2007.

3. Smart Card Ticket Usage in Korea

The smart card ticket system initiated in Seoul in 2004 provided further impetus for increasing the use of smart card tickets throughout the nation.

The Ministry of Land, Infrastructure and Transport regularly releases the results of its "Public Transport Status Survey," which includes statistics on the smart card ticket utilization rates. The survey conducted in 2005 revealed that Seoul recorded 81%, the highest among the cities using the smart card tickets ystem. In comparison, Daegu and Daejeon recorded just 46% and 44%, respectively. The rate in Incheon was found to be 80%, almost the same level as Seoul. This result proved once again that Seoul and Incheon have many things in common in terms of living patterns and lifestyles of citizens.

In 2006, the smart card ticket usage rate of the cities surveyed by the ministry averaged 76%. Seoul showed a 90% rate, while Daegu and Daejeon recorded 76% and 68%, respectively. In 2009, the rate rose to 96% in Seoul, and surpassed 80% in all the other cities, except for Ulsan which recorded 79%.[15]

The survey revealed a significant disparity in the smart card ticket usage rate, depending on whether transfers are made during a journey. The rate was 78% among passengers using one means of transport in their trips from origin to destination. In contrast, it reached 93.8% among riders making transfers during their trips. The higher usage rate among the latter group was apparently related to transfer discounts given to smart card ticket users.

15) Smart card tickets are also in active use on the nation's expressways toll payment. The daily usage rate of the expressway smart card ticket named Hi-pass was 54.5% on weekdays and 50% during weekends, as of the end of 2011, four years after the card was introduced. Analysis showed that vehicles using Hi-pass lanes could pass through a tollgate 39 seconds faster than cars using general lanes. The waiting time at tollgates on general lanes was also found to have reduced by 17 seconds. In particular, post payment Hi-pass cards began to be used in March 2009, removing the inconvenience of having to load cards in advance at designated places and consequently, appreciably increasing the expressway card usage rate.

Table 2.5. Trends in smart card ticket usage

(unit: %)

Regions	2005	2006	2008	2009
Seoul	81	89.6	93.8	95.9
Busan	70	74.6	82.3	88.3
Daegu	46	76.0	87.5	89.3
Incheon	80	86.2	89.0	91.3
Gwangju	64	72.6	80.0	81.9
Daejeon	44	67.5	72.3	84.2
Ulsan	68	68.3	71.4	79.1

• Note: Based on the 2005, 2007 and 2009 public transport status surveys (Ministry of Land, Infrastructure and Transport and Korea Transport Safety Authority) and public transport policy evaluation reports submitted by relevant local governments in 2009.

SECTION 02.

Integrated Smart Card Ticket Operation and Usage in Seoul

1. Integrated Smart Card Ticket System in Seoul

Seoul Metropolitan Government first introduced a smart card ticket system for the city buses in 1996. The system, however, had a number of problems such as increases in costs due to technology monopoly by operators, the lack of interoperability with other systems, and the operators' refusal to disclose relevant technological know-how. Because of these problems, the city government faced difficulties in operating and maintaining the system as well as in utilizing card usage-related data needed for the development of transport policies.

These difficulties led the Seoul Metropolitan Government to pursue a new smart card ticket project. In September 2003, it selected LG CNS as the company to carry out the project, which involved the task of replacing smart card ticket readers installed on buses and at Metro stations. The new system was completed in June 2004 (the project was estimated to have cost about 120 billion Korean Won (120 million US Dollar)). A total of 17,928 readers were installed on city buses. As of 2010, the transactions made through the readers on the buses reached about 2 billion in number. As for Metro, the readers were installed at 490 stations managed

Table 2.6. Statistics related to smart card ticket operation in the Seoul metropolitan area (2010)

Categories	Items	Unit	Current condition
Bus sector	Bus operators	EA	194
	Buses	EA	8,964
	readers on buses	EA	17,928
	smart card ticket transactions	occurrence	1,966,267,671
	Transactions amount	Korean Won	1,161,805,521,713
Rail sector	Rail operators	EA	4
	Gates	EA	9,778
	Stations	EA	490
	smart card ticket transactions	occurrence	2,324,549,702
	Transactions amount	Korean Won	1,670,849,599,088
Logistics sector	Affiliated companies	EA	78
	Affiliated stores	EA	21,350
	readers installed	EA	21,350
	smart card ticket transactions	occurrence	6,089,911
	Transactions amount	Korean Won	10,709,496,520
Taxi sector	T-money affiliates	EA	56,068
	T-money readers installed on taxis	EA	80,385
	T-money transactions	occurrence	98,885
	T-money transactions amount	Korean Won	877,400,572,123
Total	T-money card issuance	occurrence	5,091,431
	T-money card transactions amount	Korean Won	943,913,544,623
	KSCC transactions amount	Korean Won	3,720,765,189,444

• Note: 1) Numbers of bus operators, buses, readers on buses, rail operators, rail gates, rail stations, logistics affiliates, affiliated stores, readers installed in the logistics sector, T-money taxi affiliates and readers on taxis are based on statistics compiled as of June 2011.
2) Each bus is presumed to be equipped with two readers, one for boarding the other for disembarking.
3) Rail statistics on operators, gates and stations cover four major corporations: Seoul Metro, Seoul Metropolitan Rapid Transit Corp. and KORAIL. Transactions figures cover the four corporations plus operators of Metro Line 9, Incheon International Airport Railroad and Sinbundang Line.
4) Only recently loaded cards were counted in estimating the figure for T-money card issuance.
5) T-money card and KSCC transactions represent the transactions reported by the Metro, bus, logistics and taxi sectors.

• Source: Extracted from KSCC internal data.

by four operators, including Seoul Metro. The readers handled more than 2.3 billion transactions in that year. The new system cleared smart card ticket transactions worth over 3.7 trillion Korean Won (3.7 billion US Dollar) in 2010. The new prepaid T-money card transactions alone amounted to over 900 billion Korean Won (900 million US Dollar).[16]

Later, Seoul Metropolitan Government completed a project to ensure smart card

Figure 2.3. Smart card ticket readers installed on Seoul taxis

• Source: KSCC homepage (http://www.koreasmartcard.com)

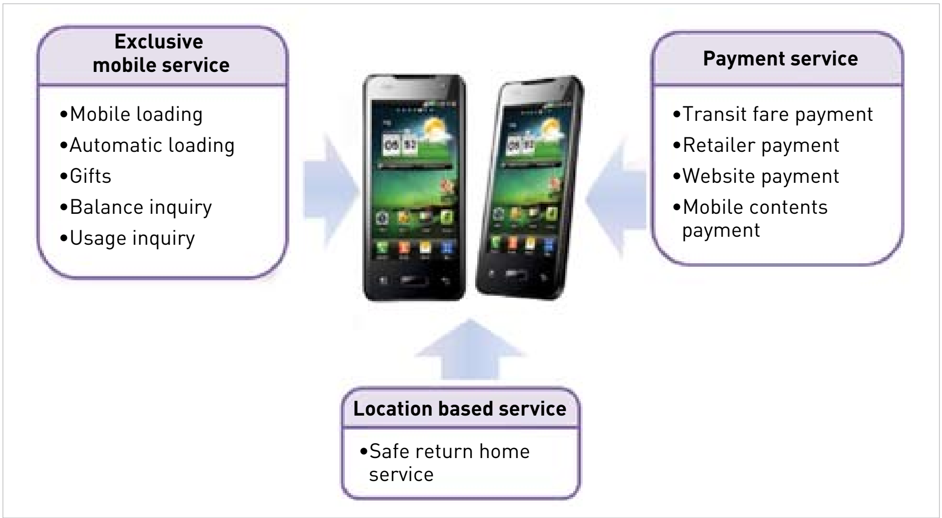
tickets interoperability between Seoul and its adjacent areas of Gyeonggi Province and Incheon. Making up the nation's capital region, these areas form a single living sphere with a population of over 24 million. Completion of the compatibility project enabled the residents of these areas to use buses and Metros with a single smart card ticket anywhere in the region. Incheon City, which has a population of 2.8 million, introduced its new smart card ticket system in 2006 through a BOT method agreed on between Incheon Bus Transport Cooperative and eB Card. The card company installed 2,228 readers with a cost of 5 billion Korean Won (5 million US Dollar) (about 2,500 US Dollar per a unit). The city introduced a fare collection device that can accommodate both cards and cash in February 2009 when it reorganized its public transport system.

In addition, the smart card ticket's scope of usage expanded to cover taxis as well, thereby increasing user convenience. In Seoul, the smart card ticket service began to cover taxis in March 2007. The rate of taxi passengers using smart card tickets rose from 23.3% in 2009 to 40.2% in March 2011.

Metro operators introduced in November 2008 free-ride smart card ticket for elderly citizens aged 65 or above, the disabled and persons chosen for their meritorious services to the nation. Thus, the smart card ticket system was

16) In accordance with a relevant agreement, KSCC is also providing fare revenue clearing services to Incheon City and Gyeonggi Province.

Figure 2.4. Mobile smart card ticket service offered by KSCC



• Note: Based on contents on KSCC homepage (http://www.koreasmartcard.com)

diversified to include credit cards, check cards and free-ride cards. They also introduced a single-use smart card ticket in July 2009. Single-trip users can use the card after paying a 500 Korean Won (0.5 US Dollar) security deposit, which is refunded upon return of the card. The introduction of the single-use card led to the disappearance of paper tickets with a magnetic stripe on the rear. Consequently, the smart card ticket usage rate reached 100%. In addition, the operators introduced an USIM (Universal Subscriber Identity Module) mobile smart card ticket system that

Table 2.7. Smart card ticket usage fees in Seoul

Classification		Items	Rates	Remarks
Bus	Prepaid card	• Loading fee • Clearing fee • Card management fee	• 0.7% • 1.0%/1.7% • 0.3-0.4%	• KSCC ⇒ affiliated stores • prepaid spending ⇒ KSCC • KSCC ⇒ bus cooperative
	Post payment card	• Card usage fee • Clearing fee	• 1.5% • 0.5-0.7%	• post payment spending ⇒ post payment card companies • bus/Metro operators ⇒ KSCC
Metro	Prepaid card	• Loading fee • Affiliate fee (including clearing fee)	• 0.3%/0.7% • 1.7%	• KSCC ⇒ Metro corporations (unmanned/manned) • prepaid spending ⇒ KSCC
	Post payment card	• Card usage fee • Clearing fee	• 1.5% • 0.5-0.7%	• post payment spending ⇒ post payment card companies • bus/Metro operators ⇒ KSCC

• Source: Metropolitan Transport Association,"A Case Study of the Smart Card Ticket System", 2009.

allows the use of mobile phones to pay fares. This card can be recharged through the wireless Internet. Smart card ticket usage fees in Seoul are shown in Table 2.7.

2. Implementation of the Smart Card Ticket Project in Seoul[17]

Overview of the System Building Process

As explained in the previous section, the Seoul Metropolitan Government decided to pursue a new smart card ticket project to overcome various difficulties related to the old system in 2002. First of all, the city government was acutely aware of the need to replace the old smart card ticket readers and the central computation devices,[18] which had reached their limits in their data processing capacity.

Another important factor was the need to secure intellectual property rights regarding the technologies necessary for the operation of the system. The city government had failed in its efforts to improve the performance capacity of smart card ticket readers installed at Metro stations, mainly due to arguments over pertinent intellectual property rights. There had also been conflicts between the city government and card operators over commission fees. In a bid to overcome these difficulties, the city authorities began to discuss the prospects of implementing a public transport reform, which would include a new smart card ticket system, an essential element for carrying out a new fare scheme envisioned by the city government.

The reform would lead to the introduction of a distance-based differential fare system. Further, the city government envisioned issuing free-ride cards for the elderly and disabled as well as student exclusive smart card tickets. To implement these policies, it was essential that every transit user should use smart card tickets. Against this backdrop, Seoul Metropolitan Government pursued the introduction of a smart card ticket system that would help ensure revenue transparency, expedite

17) Based on “White Paper on Public Transport Reform in Seoul (2006)” that explains the process of implementing the smart card project initiated in July 2004

18) Built since 1996.

the process of improving management conditions and realize a 100% smart card ticket usage rate.

The city government then began to collect relevant data and study measures to improve the existing smart card ticket system. In particular, it conducted research on the prospects of accommodating standard SAMs designated by the Ministry of Information and Communication to remove user inconvenience and avoid redundant investments. It also carried out research on standardization measures to ensure interoperability with other smart card tickets.

The city authorities were well aware that they needed support from the private sector in terms of technology, finance and other matters. Thus, they decided to build the smart card ticket system with private-sector investments. Upon making that decision, the city government set the project in motion by forming an advisory council composed of pertinent experts.

In May 2003, Seoul Metropolitan Government announced a plan to establish a new smart card ticket system, promising to offer a diversity of services through the use of smart card tickets. Disclosing a plan to ensure the new system's interoperability with other relevant systems, the city government said it would welcome any company participating in the project or forming relevant business alliance.

The city government then posted "guidelines on information proposal regarding the new smart card system," thus initiating the bidding process. A number of smart card ticket-related companies participated in the bidding by forming consortia. Of them, LG CNS was selected as the priority negotiation partner for the project.

Guidelines for Project Implementation

Seoul Metropolitan Government intended to build the framework facilities with investment from the private sector, while trying to ensure the stability and public service functions of the smart card ticket system. In particular, it held the view that it was very important for the city governmen to secure the intelligence property rights regarding the system. It also thought that it was essential to have the right to make decisions on such matters as card key values, settlement and alliance fees. So, city government decided to pursue a structure that would allow the public to take the ownership of the system-related intellectual property rights and to take a considerable stake in the envisaged smart card ticket operation company.

As for the range of card usage, the city government determined that the new smart card ticket should cover all the Metro sections in the nation's capital region (Seoul, KORAIL and Incheon). It also decided to allow KORAIL and Incheon Metro to voluntarily participate in the project, but made sure that it would entrust the task to install necessary facilities on Seoul Metros and Incheon Metros with the new smart card ticket operation company. As for buses, it was determined that the new card ticket system should apply to city and Mini buses in Seoul as well as the buses operating in the Gyeonggi Province area. Seoul Metropolitan Government decided to induce the application of the new card ticket system to taxis as well. Observing that the new smart card ticket operation company would build a clearing system for taxis, city officials said the inclusion of taxis in the company's business scope would help increase its profitability.

The initial funding of the project would be made by the private sector. To help the private-sector participants to recover their investments, Seoul Metropolitan Government decided to allow the smart card ticket operation company to take the settlement and clearing commission fees as it main source of income and to create profits by expanding the smart card ticket project to cover such areas as taxi fares, parking lot fees and civil document fees, and through various alliance projects.

In addition, the Seoul Metropolitan Government decided to encourage the main contractor to build the smart card ticket system through cooperation with the existing card ticket operators and to seek ways to ensure efficiency in its operation. Seoul Metropolitan Government decided to allow the use of the old card tickets for a certain period after the opening of the new smart card ticket system. It was decided that when the new card ticket's market share rose to around 90%, the new smart card ticket operation company would assume full responsibility for processing the fare revenue data. As for the post payment smart card tickets, the Seoul Metropolitan Government decided to allow their use for three years until 2006 when credit card standards were slated to be changed, thereby inducing their replacements through normal procedures.

Principles for Selecting the Main Contractor

Seoul Metropolitan Government maintained the position that the smart card ticket operator should be inaugurated as a stock company under the Commercial Act. It also decided that the operator would be entrusted with the tasks of developing and building a new smart card ticket system, issuing and loading smart card tickets, operating the clearing system, and managing intellectual property rights related to key values and security algorithms.

The Seoul Metropolitan Government also determined that the capital of the new corporation should cover at least 35% of the total project costs in order to ensure its stable operation. It also decided that the main contractor should secure financial resources needed to cover the remaining portion of the costs by drawing investments from credit card companies, mobile carriers, e-money companies and system integration (SI) enterprises.

The relevant authorities sought to eventually expand the new smart card ticket system to cover such areas as the payment of taxi fares and parking fees, thereby increasing the project's profitability. They believed that through execution of such lucrative business activities in addition to its original task, the new corporation would be able to recover its investment costs earlier than expected and to procure its operating costs.

The Seoul Metropolitan Government also decided to require that a company or a consortium to be selected as the main contractor should establish a corporation dedicated to building and operating the proposed smart card ticket system. It also set the selection criteria such as credibility, funding capability and prospects for securing technologies needed for the new system.

To devise project proposal guidelines, Seoul Metropolitan Government also launched an advisory council that included experts on smart card ticket system technologies as well as corporate establishment and operation. Through consultations with relevant city officials, the council prepared the guidelines and revealed them in July 2003.

Project Proposal Guidelines

Seoul Metropolitan Government decided to pursue the smart card ticket project with investments from the private sector, and to inaugurate a company that would be in charge of the system operation. However, it wanted to maintain the public service functions of the smart card ticket system. These intentions were clearly stated in its project proposal guide.

The guide, revealed in July 2003, showed the city government's specific policy directions regarding the smart card ticket project. It included guidelines on building and operating the proposed new smart card ticket system. Seoul Metropolitan Government made it clear that the guidelines would serve as the basis for signing a project contract.

Seoul Metropolitan Government decided to tentatively call the new smart card ticket "Seoul Smart Card." It stated in the guide that the card would be used for payment of bus, Metro and taxi fares, and eventually civil document fees. The city government also revealed a long term plan to further expand the scope of card usage to cover a variety of other areas. Regarding the card value loading question, the guide emphasized the need to secure various types of charging schemes, including those based on the Internet and mobile phones. It also called for efforts to ensure that a single smart card ticket can be used in a diversity of fields, thereby minimizing the inconvenience of citizens. The system operator would be allowed to conduct various alliance programs, and asked to exert efforts to address the problem of system obsolescence and capacity shortages and to cope with changes in global standards such as EMV (Europay, Mastercard and Visa). Seoul Metropolitan Government stated its principle that the main contractor should assume the entire responsibility for financing the system building project. In return, it suggested that the contractor establish the system operation company (a stock company), which would take the settlement and clearing fees and create profits through card ticket alliance programs and other subsidiary business activities.

To intensify the public service functions of the smart card ticket and to reflect transport policies on its operation, Seoul Metropolitan Government made it clear that it would have the right to make important decisions concerning the operation of the system and the operation company. It also made sure that other administrative agencies such as Incheon City, Gyeonggi Province and KORAIL would be able to clearly state their positions regarding the operation of the system that would affect their administrative jurisdiction.

The guide also presented requirements related to system design and construction. First of all, Seoul Metropolitan Government demanded that the system should be designed in a way to maximize the scope of its interoperability. Specifically, it suggested that the new system should be compatible with the standard SAMs designated by the Ministry of Information and Communication and the SAMs of the existing prepaid and post payment cards. The city government also demanded that the contractor analyze the prominent features of the existing systems such as mobile readers and fare adjustment machines, and reflect them in the new system through consultations with relevant organizations.

The guide represented the city government's position that the new system should accommodate Seoul Metropolitan Government's plan to restructure the bus routes into trunk and branch lines as well as its policy to introduce a distance-based fare scheme. It also included clauses designed to ensure the public service functions of the smart card ticket.

The guide included provisions aimed at ensuring the public service functions of the smart card ticket. According to the provisions, the main project contractor should allow the Seoul Metropolitan Government to have at least a 31% stake in the operating company. The provisions also required that the contract should improve and supplement the smart card ticket system, with funding provided by the operation company.

The Seoul Metropolitan Government also explained that the priority and next-ranked negotiation partners would be selected by a project plan evaluation team to be comprised of relevant experts and public officials. Regarding the submission of project plans, Seoul Metropolitan Government presented detailed guidelines that even included instructions on table of contents entries.

Selection of the Main Project Contractor

Announcing the project proposal guidelines, Seoul Metropolitan Government also launched a PR(Public Relationship) campaign on the new smart card ticket. The campaign focused on stressing new convenience features such as the prospects of using the card for payment of taxi fares and the Internet reloading scheme.

The main project contractor, to be selected through a bidding process, should make investments worth about 100 billion Korean Won (100 million US Dollar) to build the new smart card ticket system, and begin to recover the investment costs only after completing the system. Not many companies could afford to implement a project under such conditions. Only two companies, Samsung SDS and LG CNS, formed separate consortiums and submitted project plans to Seoul Metropolitan Government. To ensure fair appraisal of the project plans, the city government formed an evaluation team comprised of eight management experts and seven technological specialists.

Through this process, the LG CNS consortium was selected as the priority negotiation partner. The consortium eventually became the main contractor by amicably resolving problems with the existing smart card ticket system operators over such matters as intellectual property rights.

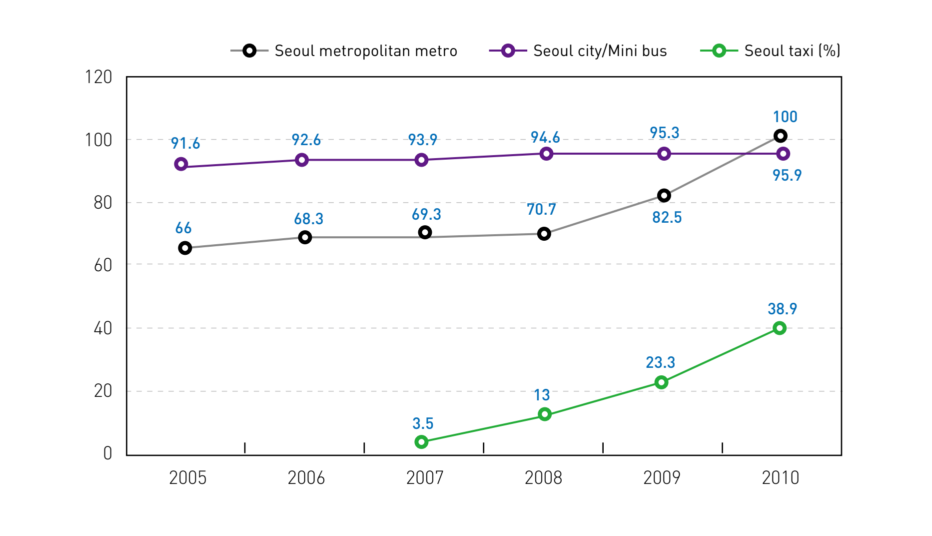
Smart Card Ticket Usage in Seoul

In Seoul, the percentage of Metro passengers using smart card tickets stood at 66% in 2005, one year after the new smart card ticket system was introduced. The percentage rose to 100% in 2010. As for buses, the rate reached 91.6% in 2005, rising to 96.1% in March 2011.

Smart card ticket users can be benefited from basic rate and transfer discounts. Adult users are given a 100 Korean Won (about 0.1 US Dollar) off the basic cash fare when riding city buses. Children and adolescents receive 50% and 20% discounts off the adult rate, respectively. Prepaid smart card ticket users can benefit from year-end income tax deductions for travel expenses paid by smart card tickets not only by themselves but by their dependents. In 2010, 1.45 million prepaid card users (10.42 million transactions) got tax deductions worth 261.6 billion Korean Won (261.6 million US Dollar).

In addition, taxi passengers in Seoul transferring to airport limousine buses are eligible for discounts under a scheme introduced in December 2010: a 1,000 Korean Won (1 US Dollar) discount for limousine buses and a 2,000 Korean WonWon (2 US Dollar) discount for luxury limousine buses. Statistics show that the taxi-limousine bus transfer discounts amounted to 22 million Korean Won (22

Figure 2.5. Trends in smart card ticket usage rates in Seoul



thousand US Dollar) in 15,481 cases between December 2010 and March 2011. For reference, statistics on Seoul city bus and Metro passengers are shown in Table 2.8.

Table 2.8. Seoul public transport ridership

(unit: riders, %)

Categories	Average in March 2011 (Feb. 27-March 19)		Average in March 2010 (Feb. 28-March 20)		Growth rate (%)
	Ridership	Percentage	Ridership	Percentage	
Total	13,065,998	100.0	12,708,413	100.0	2.7%
Bus	5,892,604	45.1	5,789,345	45.6	1.8%
Metro	7,173,394	54.9	6,919,067	54.4	3.5%

4. Operator of the Smart Card Ticket System in Seoul

KSCC (Korea Smart Card Company) Overview

Seoul Metropolitan Government has built its smart card ticket system with investments from the private sector. For recovery of their investment costs, the private-sector investors are relying on settlement and clearing fees and income from other sources.

The operator named Korea Smart Card Co. (KSCC) was launched in 2003 as a joint venture by LG CNS, credit card companies and system providers. It has been in charge of the operation of the smart card ticket system since the Seoul Metropolitan Government initiated a public transport reform in July 2004.

KSCC has used its smart card-related technological expertise to help more than 15 domestic and foreign cities, including Seoul, build integrated fare collection systems suitable for their respective wide-area transport networks. Based on this experience, the company is expanding the scope of its smart card-related technologies in the fields of public transport and electronic money.

KSCC is one of the world's largest companies providing automated fare collection services. It handles more than 35 million transactions a day. It is providing automated fare collection services to six Metro companies operating 12 routes with a combined track length of 600 km, and to 446 bus companies operating 12,000 buses.

The shareholding structure of KSCC shows that the Seoul Metropolitan Government has a 35% stake in the company as the largest shareholder, immediately followed by LG CNS with 31.85%. The remaining portions are held by solution companies and credit card companies, which have 17.42% and 15.73% stakes, respectively.

Table 2.9. KSCC business achievements

Items	Details
T-money cards issued	• 40 million • 28 million affiliated cards in use
Card readers (installed on transport modes)	• Bus: 24,000 • Metro: 10,000 • Taxi: 89,000 • e-money (convenience stores, parking, etc): 50,000
Card reloading devices	• Value loader (including vending machines): 20,000
Daily transactions	• 35 million transactions a day

• Source: KSCC homepage (http://www.koreasmartcard.com)

Table 2.10. KSCC business timeline

Year/Month	Activity
2011. 10	• Initiation of integrated transfer services for Sinbundang Line and the Seoul metropolitan Metros
2011. 09	• Initiation of T-money services at Metro stations
2011. 02	• Opening of T-money system in Daejeon (Shin-Hankkumi Card)
2010. 11	• Card payment scheme for taxis expanded to cover 50 autonomous regions nationwide, including six major metropolitan areas
2010. 09	• Signing of a contract for building CBTS in Malaysia
2010. 08	• Opening of New Zealand smart card ticket system III
2010. 07	• Release of Android smartphones installed with mobile T-money
2009. 10	• Initiation of integrated transfer serives for Incheon buses
2009. 07	• Initiation of integrated transfer services for Metro Line 9 and the Seoul metropolitan Metros
2009. 05	• Opening of international taxi services (tourist taxis for foreigners)
2009. 04	• Opening of New Zealand smart card ticket system II
2009. 02	• Initiation of settlement services for mobile T-money Internet member stores
2009. 01	• Initiation of SKT T-money T cash services
2008. 09	• Initiation of integrated transfer system for metropolitan/jwaseok buses in Seoul and Gyeonggi Province areas
2008. 04	• Opening of New Zealand smart card ticket system I
2007. 07	• Initiation of integrated fare settlement services for the national capital region (establishment of an integrated settlement system)
2007. 03	• Initiation of T-money taxi fare settlement service
2005. 11	• Initiation of interoperability services among Pohang, Geoje, Andong, Tongyeong and Jeju
2004. 07	• Initiation of Seoul's smart card system

The sales revenue of KSCC more than tripled to 150 billion Korean Won (150 million US Dollar) in 2010 from less than 50 billion Korean Won (50 million US Dollar) in 2006. During this period, the company achieved a turnaround from a 8.8 billion Korean Won (8.8 million US Dollar) deficit to a 14 billion Korean Won (14 million US Dollar) surplus in net income. The following factors contributed to such stellar performance: growth in public transport demand that arose from the implementation of the smart card ticket system (and the opening of new Metro lines), the initiation of smart card transaction services in the retail sector, and regional expansion of the system.

Table 2.11. Business performance of the T-money operation company

(unit: million Korean Won)

Classification	Accounts	Year 2006	2007	2008	2009	2010
Financial status	Assets	119,898	146,650	185,035	246,366	249,334
	Liabilities	119,633	132,655	167,887	207,063	196,037
	Capital	265	13,995	17,148	39,303	53,297
Income statement	Sales revenues	45,953	65,554	90,363	118,436	150,812
	Operating profits	-4,666	6,721	5,602	9,440	11,033
	Net income	-8,788	1,286	3,803	6,681	13,993

• Note: Based on KSCC homepage (http://www.koreasmartcard.com) contents

KSCC Performance Regarding Smart Card Ticket Transactions

KSCC's smart card ticket usage statistics show that the number of transactions rose from about 4 billion in 2006 to 6.7 billion in 2010. The value of total transactions cleared by the company in 2010 reached 5.6 trillion Korean Won (5.6 billion US Dollar) , which represented more than a two-fold increase from the 2006 level.

Table 2.12. Annual transactions cleared by KSCC

(unit: million transactions, million Korean Won)

Classification	2006	2007	2008	2009	2010
Number of transactions	3,690	4,187	4,990	5,873	6,679
Total value of cleared transactions	2,569,665	3,159,139	3,897,397	4,701,551	5,631,564

• Source: KSCC homepage (http://www.koreasmartcard.com)

Figure 2.6. Annual transactions cleared by KSCC

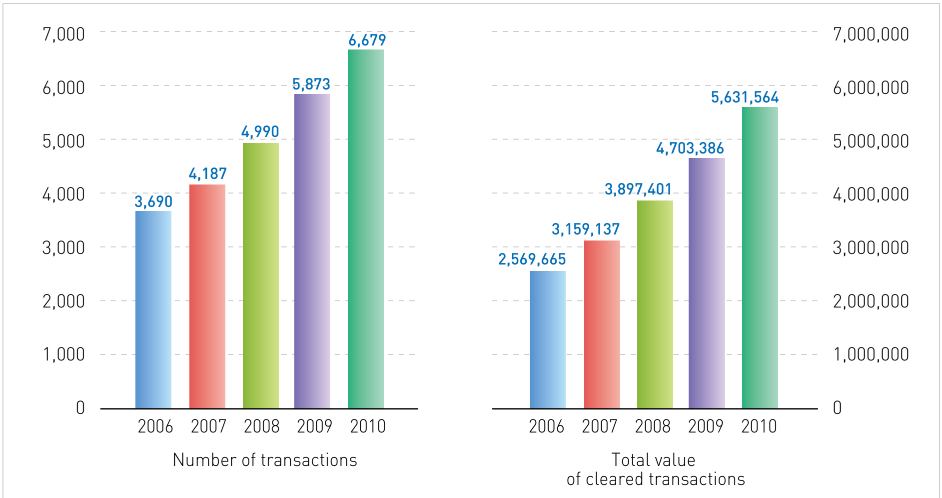
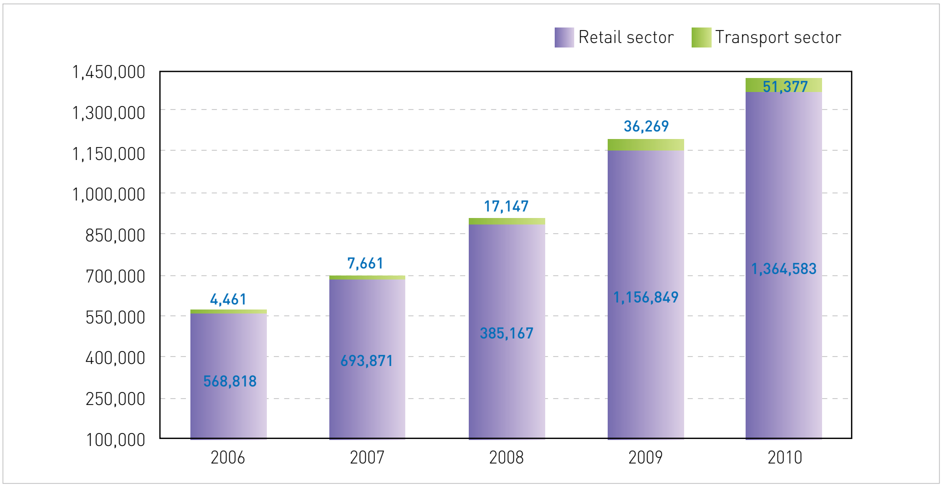


Figure 2.7. T-money usage amounts by year



Figures on the usage of KSCC-issued smart card tickets show that the amount of transactions went up from 570 billion Korean Won (570 million US Dollar) in 2006 to 1.4 trillion Korean Won (1.4 billion US Dollar) in 2010. Transactions made in the transport sector, which occupied a predominant portion of the total, jumped from 568.8 billion Korean Won (568.8 million US Dollar) to 1,364.6 billion Korean Won (1,364.6 million US Dollar). During the four-year period, transactions in the retain business sector jumped more than 10 times from 4.5 billion Korean Won (4.5 million US Dollar) to 50 billion Korean Won (50 million US Dollar). In terms of the transactions amount, the logistics sector's share showed a more than four-fold increase from 0.8% in 2006 to 3.6% in 2010, indicating an upward trend in the use of smart card tickets in areas other than transport.

Table 2.13. T-money usage statistics by year

(unit: million Korean Won, %)

Classification	2006		2007		2008		2009		2010	
	Value of transactions	Ratio	Value of transactions	Ratio	Value of transactions	Ratio	Value of transactions	Ratio	Value of transactions	Ratio
Transport sector	568,818	99.2	693,871	98.9	885,167	98.1	1,156,849	97.0	1,364,583	96.4
Retail sector	4,461	0.8	7,661	1.1	17,147	1.9	36,269	3.0	51,377	3.6
Total	573,279	100.0	701,532	100.0	902,314	100.0	1,193,118	100.0	1,415,960	100.0

• Source: KSCC homepage (http://www.koreasmartcard.com)

SECTION 03.

Latest Trends in the Smart Card Ticket System in Korea

1. Promotion of Nationwide Interoperability of Smart Card Tickets

Korea is steadily pursuing a project to ensure the compatible use of smart card tickets among all the public transport modes throughout the nation. smart card tickets have become a widely used means of transit fare payment. However, users are still inconvenienced by the lack of compatibility of the cards among regions, travel modes and operators. This problem needs to be addressed expeditiously to facilitate the use of public transport. As of 2011, smart card tickets were being used in the nation's seven metropolitan cities and 107 other areas such as counties and small-/medium-sized cities. However, the card tickets were being used compatibly only among some of the regions and transport modes through alliance programs among operators.

To address this problem, the central government and local administrations have devised measures to secure a institutional and technological basis for realizing nationwide interoperability of smart card tickets, making it obligatory for transit operators to take necessary steps. The measures include the provision of financial assistance designed to support chip replacement programs and help establish pertinent clearing systems. Activities implemented to realize the nationwide interoperability of smart card tickets are shown in Table 2.14.

Table 2.14. Timeline of the smart card tickets interoperability project

Year	Activity
1995	• Established a plan to implement a smart card ticket system (to replace the existing method of using tokens) (May)
1999	• Decided to promote cards interoperability based on regions (August)
2001	• The Ministry of Information and Communication began developing payment SAM standards in association with the Korea Electronics and Telecommunications Research Institute and five domestic e-money companies
2003	• Began developing relevant Korean standards through the Korean Agency for Technology and Standards by accommodating the views of the industrial community
2004	• Determined the standard method of communication between smart card tickets and readers (January)
2005	• Decided to promote nationwide compatibility instead of regional compatibility (March)
2006	• Began to develop standards for prepaid IC cards, readers, recharging SAM and devices, etc.
2006	• Posted KS (Korean Standard) regulations on the prepaid smart card ticket system (October)
2008	• Amendment of the Act on Promotion and Facilitation of the Use of Public transport by Ministry of Land, Transport, and Maritime Affairs (March)
2009	• Launched an R&D project for development of relevant standard technologies (led by the Korea Institute of Construction and Transport Technology Evaluation and Planning) (September)
2009	• Devised KS standards for contactless prepaid and post payment cards (December)
2010	• Posted guidelines on nationwide interoperability certification for smart card ticket-related devices (April)
2010	• Announced nationwide smart card tickets compatibility plans for specific areas (June)

In particular, the government devised technology standards to lay the basis for realizing nationwide smart card tickets compatibility and began implementing relevant plans. Such technological standards are the most basic elements for ensuring the interoperability of smart card tickets throughout the nation. Aware of this, the government has kept enacting and amending standards for smart card tickets and readers since the need for cards compatibility was first raised.

The standards on SAM (Security Access Module) are called KS X 6923, which are composed of four chapters. When they were first enacted in 2004, the standards defined payment transaction-oriented specifications, protocols for simple payment transactions, re-transactions and annulment transactions, and SAM commands. Then, in 2006 and 2009, these standards were amended to keep up with changes in relevant environments. The 2006 amendment was to expand the scope of definitions to cover the integrated fare system and to include SIGNIND for cards interoperability. The definition on post payment card tickets came to be included in the standards through the 2009 amendment. Other standards related to smart card tickets are shown in Table 2.16.

Table 2.15. Composition of KS X 6923

Classification	Contents
Chapter 1: Physical characteristics and basic structure of payment SAM	Define SIM(ID-000) Type and PLCC Type
Chapter 2: Commands and protocols	Define protocols and commands concerning transaction/re-transaction/annulment transaction
Chapter 3: Cryptographic algorithms of payment SAM	Define crypto algorithms of TDES and SEED
Chapter 4: Test methods and management of payment SAM	Define test methods for payment SAM

Table 2.16. Smart card ticket-related standards

Standard number	Standard name in English	Date of enactment (Date of last revision)	Composition
KS X 6923	Contactless Pre-Paid/ Post Pay IC Card - Purchase SAM	2004.1.26 (2009.12.8)	• Chapter 1: Physical characteristics and basic structure • Chapter 2: Commands and protocols • Chapter 3: Crypto algorithm • Chapter 4: Conformance testing
KS X 6924	Contactless Pre-Paid/ Post Pay IC Card - User Card	2006.10.31 (2009.12.8)	• Chapter 1: Physical characteristics and basic structure • Chapter 2: Commands and protocols • Chapter 3: Crypto algorithm • Chapter 4: Conformance testing
KS X 6925	Contactless Pre-Paid/ Post Pay IC Card - Purchase reader	2006.10.31 (2009.12.8)	• Chapter 1: Physical characteristics and basic structure • Chapter 2: Logical structure • Chapter 3: Security characteristics
KS X 6926-1	The Specifications of Value Loading reader for Pre-Paid IC Card	2006.10.31 (2006.10.31)	• Chapter 1: Physical specifications
KS X 6927-1	The Specifications of Load SAM for Pre-Paid IC Card	2006.10.31 (2006.10.31)	• Chapter 1: Physical specifications
KS X 6507	IDENTIFICATION CARDS -- INTEGRATED CIRCUIT(S) WITH CONTACTS	1995.1.3 (2008.6.30)	• Chapter 1: Physical characteristics • Chapter 2: Dimensions and locations of contacts • Chapter 3: Electronic signals and transfer protocol
KS X ISO IEC 14443	Identification cards - Contactless integrated circuit(s) cards - Proximity cards	2001.12.31 (2010.12.7)	• Chapter 1: Physical characteristics • Chapter 2: RF power and signal interface • Chapter 3: Initialization and anti-collision • Chapter 4: Transfer protocol
KS X ISO IEC 15693	Identification cards - Contactless integrated circuit(s) cards - Vicinity cards	2001.12.31 (2008.12.19)	• Chapter 1: Physical characteristics • Chapter 2: A-interface and initialization • Chapter 3: Anti-collision and transfer protocol

KS X ISO IEC 24727	Identification cards -- Integrated circuit card programming interfaces	2008.12.19 (2008.12.19)	• Chapter 1: Architecture
KS X ISO _IEC 7816	Information technology - Identification cards - Integrated circuit(s) cards with contacts	2001.9.26 (2007.10.31)	• Chapter 4: Inter-industry compatibility commands for exchange
		1998.12.31 (2008.12.19)	• Chapter 5: Application identifier numbering system and registration procedures
		1998.12.31 (2010.12.7)	• Chapter 6: Inter-industry compatible data elements
		1998.12.31 (2007.10.31)	• Chapter 7: Inter-industry commands for structured card query language (SCQL)
		2001.9.26 (2007.11.30)	• Chapter 8: Security linked to inter-industry compatibility commands
		2001.12.31 (2007.11.30)	• Chapter 9: Additional inter-industry compatibility commands and security characteristics
		2001.12.31 (2007.11.30)	• Chapter 10: Response to electronic signals and reset of synchronous cards
		2004.12.30 (2009.12.29)	• Chapter 11: Personal identification using biometrics
		2004.12.30 (2009.12.29)	• Chapter 15: Encrypted information application program
KS X 6922	Integrated Circuit Card Specification for Payment Systems	2003.12.30 (2008.12.19)	• Chapter 1: Application independent IC cards to reader interface requirements • Chapter 2: Security and key management • Chapter 3: Application specifications • Chapter 4: Cardholder, assistants and buying agency interface requirements

Furthermore, the "Act on Promotion and Facilitation of the Use of Public transport" was revised in March 2008, laying the legal foundation for establishing a master plan for nationwide interoperability of smart card tickets. The revised law included provisions that require the central government to formulate a master plan for the national interoperability of smart card tickets. The law also calls on the local governments to devise their own regional interoperability plans, while making it mandatory for public transport operators to establish and operate relevant systems. The law additionally stipulates the need for the government to offer necessary financial assistance and to develop a certification system. Pursuant to the law, the Ministry of Land, Transport and Maritime Affairs in December 2008 formulated a master plan for the nationwide interoperability of smart card tickets. The metropolitan and provincial governments followed suit, establishing their respective regional plans (see Table 2.17).

These moves were followed by the launching of the "One Card All Pass" project designed to make it possible to use all the public transport modes with a single card. The government is looking to complete the project by 2013. By 2011, programs to improve relevant infrastructure had been completed in Gyeonggi Province, Gwangju Metropolitan City and other regions, which account for 50.3% of the nation in terms of population.

Table 2.17. Legal provisions on developing a master plan for nationwide interoperability of smart card tickets

Act on Promotion and Facilitation of the Use of Public Transport
Article 10-2 (Formulation of Master Plan for National Interoperation of Smart Card Tickets)
① Minister of Land, Infrastructure and Transport shall formulate a master plan for the national interoperation of smart card tickets (hereinafter referred to as "master plan for national interoperation") to enable cards or other media (hereinafter referred to as "smart card ticket") enable anywhere in Korea, with which citizens electronically pay or settle transport fares when they use means of public transport. ② The master plan for national interoperation shall include the matters in each of the following subparagraphs: 1. General conditions, such as the actual condition of use and relations in use by regions; 2. Policy directions for national interoperation; 3. Details of major projects for national interoperation and directions for the promotion thereof; 4. Estimated expenses to be incurred in major projects for national operation, financing measures and investment plan; 5. Matters concerning the performance of pilot projects for national interoperation; 6. Other matters necessary for the interoperation of smart card tickets. ③ The provisions of Article 6 ① through ③ shall apply mutatis mutandis to the settlement or alteration of the master plan for national interoperation.

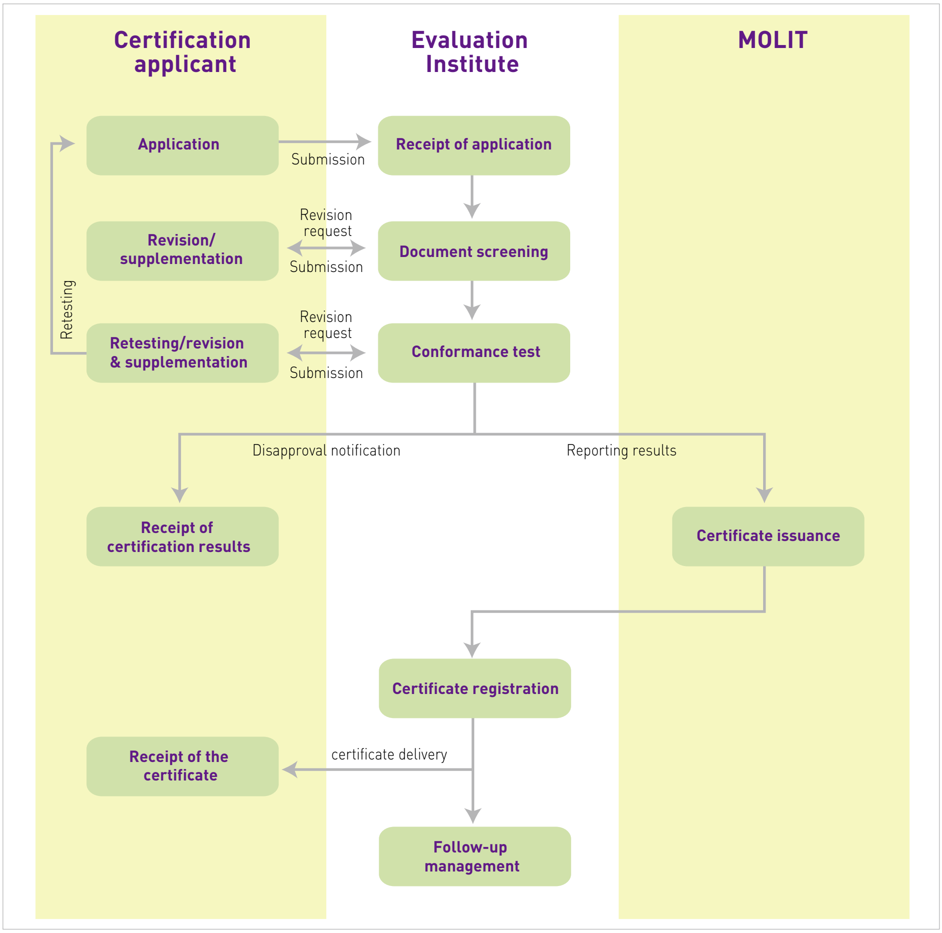
2. Certification of Smart Card Ticket-Related Devices

Ensuring the interoperability of smart card tickets requires technological unity that allows the compatibility of relevant cards and devices. To achieve this unity, the government is operating a certification system for devices related to smart card tickets. This system is aimed at securing the nationwide compatibility of relevant equipment distributed, installed and operated by public transport operators, thereby increasing the efficiency of the government's smart card tickets interoperability policy. In a related move, the Ministry of Land, Transport and Maritime Affairs prepared a provision on interoperability certification, and had it inserted in the "Act on Promotion and Facilitation of the Use of Public Transport" (see Table 2.18). The ministry also issued a relevant notice that offered guidelines on receiving certification on nationwide interoperability of smart card ticket-related devices.

Table 2.18. Legal provisions on smart card ticket-related interoperability

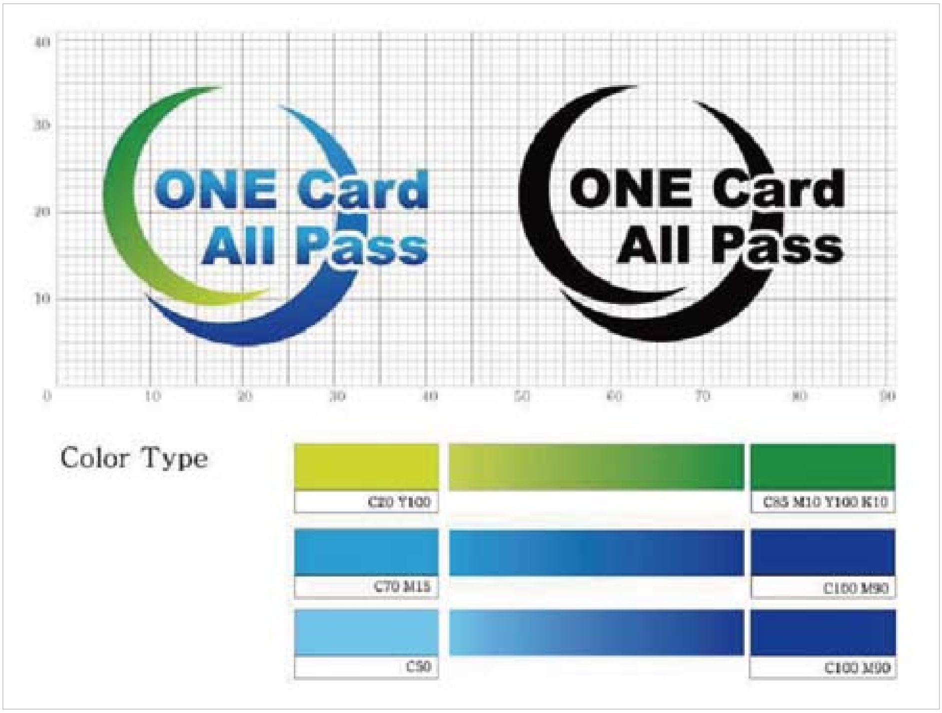
Act on Promotion and Facilitation of the Use of Public transport
Article 10-7 (Certification of Nationwide Interoperable smart card tickets, etc.)
① Minister of Land, Infrastructure and Transport shall conduct duties concerning certification necessary to ensure the national interoperability of relevant devices, such as smart card tickets and PDAs, installed and operated by public transport operators pursuant to Article 10-5. ② Minister of Land, Infrastructure and Transport may, for the efficient promotion of the duties concerning certification under paragraph ①, designate an institution or organization having the manpower and equipment determined by Presidential Decree to have it conduct such duties on his/her behalf. In such cases, such agency may receive the minimum funding necessary to conduct such duties from those who have smart card tickets, PDAs and other relevant devices certified under the conditions announced by Minister of Land, Infrastructure and Transport.

Figure 2.8. Procedures for handling smart card ticket interoperability certification business



• Source: Korea Institute of Construction & transport Technology Evaluation and Planning, "A Guidance Manual on Applying for Nationwide Compatibility Certification for Smart Card Ticket-Related Devices", 2011.

Figure 2.9. Interoperability certification marks that can be attached to relevant products



• Source: Korea Institute of Construction and transport Technology Evaluation and Planning, "A Guidance Manual on Applying for Nationwide Compatibility Certification for Smart Card Ticket-Related Devices", 2011.

There are three types of devices that are subject to certification: prepaid smart card tickets, post payment smart card tickets[19] and purchase secure application modules (PSAM[20]). Certification applications are mostly public transport operators, smart card ticket service providers (including the issuers), and developers and manufacturers of smart card ticket-related devices.

Certification procedures can be classified into three types: new certification, re-testing and certification renewal. New certifications are issued to those who apply for certification for the first time, or those who apply for new ones to replace their

19) "Smart card tickets" refer to cards or other media used for electronic payment/settlement of public transport fares. (Article 10-2-1, the Act on Promotion and Facilitation of the Use of Public transport)

20) "Purchase Secure Application Module (PSAM)" refers to a chip that serves as a small-sized authentication server. Attached to a payment reader, the module processes smart card ticket data using crypto and authentication algorithms whenever transactions occur. (Guidelines Article 2-2)

expired certifications. Re-testing refers to the process of screening re-applications submitted after initial failure to get certified. Renewal refers to the extension of the validity period of certification when requested by certificate holders.

The Minister of Land, Infrastructure and Transport is responsible for the development of the certification system. However, to ensure its efficient operation, the business of issuing certificates is entrusted to the Korea Institute of Construction & Transport Technology Evaluation and Planning.

Certification procedures are divided into four stages: acceptance of applications, document examination, conformance testing, and issuance of certificates. The procedures are shown in Figure 2.8. Certification marks as shown in Figure 2.9 can be attached to products that have passed certification testing.

Table 2.19. Organizations in charge of smart card ticket interoperability certification and their roles

Organizations	Ministry of Land, Transport and Maritime Affairs	Korea Institute of Construction & Transport Technology Evaluation and Planning
Duties	• Enact and revise certification-related laws and regulations • Improve certification-related systems • Appoint and manage certification agencies • Put up a notice about certification fees • Issue certificates • Form/operate a certification advisory committee	• Provide consulting services/receive applications • Administer certification tests • Report test results • Issue certificates • Manage the guidance manual on applying for certification • Manage certification testing equipment

• Source: Korea Institute of Construction & Transport Technology Evaluation and Planning, "A Guidance Manual on Applying for Nationwide Compatibility Certification for Smart Card Ticket-Related Devices", 2011.

3. Korean Smart Card Ticket Operators Pursuing Overseas Projects

Overview

Seoul has implemented a new public transport smart card system. It has enabled the operation of a distance-based fare system for public transport in the city, which is a metropolis with a population of more than 10 million. The scheme operates smoothly between travel modes as well as between the city and its adjacent areas. The system also involves the clearing function for processing the capital region's smart card ticket transactions, which are the largest in size in the world. As such, the system has been drawing increasing attention from various countries around the world. Korean smart card ticket operators have actively promoted overseas projects, publicizing the nation's public transport smart card ticket system through relevant international exhibitions. These efforts are beginning to bear fruit. A Korean smart card ticket operator is currently implementing a project in Wellington, New Zealand, and looking to make inroads into various other foreign markers.

Overseas Projects[21)]

① A New Zealand smart card ticket System and Clearing Service

KSCC has implemented a New Zealand project through a contract with a local company, building a smart card ticket system for a combined total of 1,100 transit buses. It is also providing clearing services, processing data for 5 million transactions a month. The first system built by KSCC in New Zealand opened in Wellington in April 2008, covering 400 city buses and 250 retail stores. The second system was launched in Auckland in June 2011, initiating smart card ticket services for 700 buses.

The project has been implemented with private-sector investments worth about 15 billion Korean Won (15 million US Dollar). The clearing business for the New Zealand smart card ticket system is conducted at the KSCC clearing center. Through the service, KSCC is seeking to save its clearing center maintenance and operating costs. The New Zealand project was carried out in four stages, the last of which was completed in April 2011. Through the stages, KSCC has continuously made technological improvements to the smart card ticket system in New Zealand. It is looking to expand the current system to cover other public transport modes that are not yet using smart card ticket services.

② Cashless Bus Ticketing System in Malaysia

KSCC has carried out a 12 billion Korean Won (12 million US Dollar) project to build a public transport smart card system in Kuala Lumpur. Targeting about

21) Based on KSCC projects conducted overseas.

1,600 buses operated by Rapid KL, the system performs payment, loading, sales, collection and clearing functions. The first system was opened for 1,100 buses in March 2011, and the second system began its services for 470 buses six months later.

The smart card system has been built only for some of about 10,000 buses running in the Kuala Lumpur metropolitan area. smart card tickets cannot be used on other buses. KSCC built the system, but its operation and revenue clearing business are handled by a local company. KSCC is promoting a plan to expand the smart card system to cover all the transit buses as well as Metros in Kuala Lumpur.

③ Other Projects

LG CNS and KSCC are carrying out a project to construct an integrated system for automated fare collection and bus management covering 10,778 buses and 36 BRT stations in Bogota. Colombia. LG CNS is implementing the project as the competent authority while KSCC is participating in it as part of a consortium. The project is estimated to be worth about 200 billion Korean Won (200 million US Dollar) – 100 billion Korean Won (100 million US Dollar) each for building and operating the system.

Pertinent Korean companies are also seeking to make inroads into overseas markets, particularly targeting the following projects: BRT in Jakarta, BTS in Russia (Bryansk, Khabarovsk), RTA (Roads & Transport Authority) AFC in Dubai, MRT in the Philippines, MTA in New York, and AFC in Bangkok.

4. Utilization of Data Obtained Through Smart Card Tickets

When passengers use their smart card tickets, information on their public transport usage is automatically generated and stored. As shown in Table 2.20, information on public transport usage includes 25 items, including boarding date/time, boarding stations, fares and transfers. The information is generated when the user passes the card over the reader. However, information on alighting is not generated if the user does not touch the card on the card ticket reader when getting off a bus. In Seoul, to receive transfer discounts, transit users should place their cards on the reader again when getting off a bus. So, nearly all the transit users tap their cards on the reader when alighting as well as boarding a bus. This ensures the collection of nearly all the data on public transport usage.

Table 2.20. Information stored on smart card ticket in Seoul

Number	Information stored on card	Contents
1	Card number	Fictitious card number given to protect personal information
2	Boarding date/time	11:43:20 a.m., Oct. 27, 2004
3	Transaction ID	Classification by boarding type
4	Transit mode CD	Classification by travel mode
5	Number of transfers	Number of transfers
6	Bus route ID	Serial number given to each bus route
7	Bus route name	Bus route name
8	Transport operator ID	Serial number given to each transport company
9	Transport operator name	Transport company name
10	Car ID	Serial number given to each car
11	Car registration number	Car registration number
12	User classification code	Categorized as adults, students or free riders
13	User classification title	Based on user classification codes
14	Bus departure date/time	Time when the vehicle left the garage
15	Boarding station ID	Serial number of the boarding station
16	Name of boarding station	Station name other than boarding station ID
17	Alighting date/time	Alighting date/time (the same type as the boarding date/time)
18	Alighting station ID	Serial number given to the alighting station
19	Name of alighting station	Station name other than alighting station ID
20	Number of users (multiple boarding)	Number of riders who boarded the bus using a single smart card ticket
21	Fare at boarding	Amount used
22	Boarding violation amount	Boarding violation amount
23	Fare at alighting	Additional fare according to the distance-based fare system
24	Alighting violation amount	Alighting violation amount
25	Bus run completion date/time	Time when the bus run is completed

• Source: Korea Transport Institute, "A Study on Using Smart Card Ticket Data in Developing Public Transport Policies", 2006.

Table 2.21. Traffic indicators that can be obtained through smart card ticket data

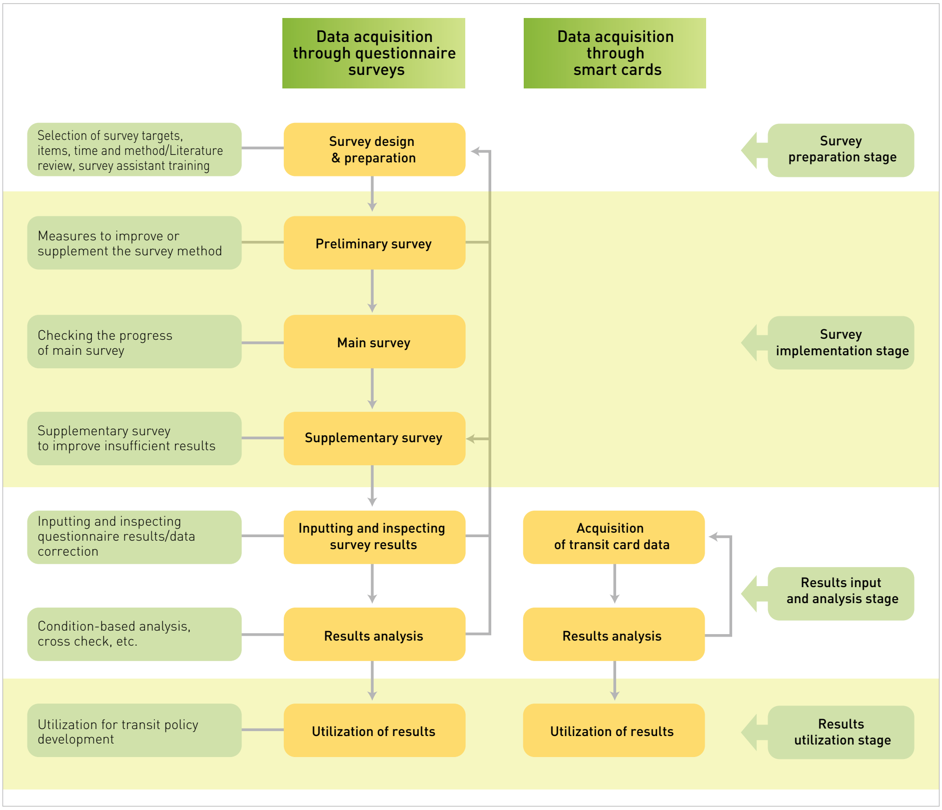
Classification	Indicators	Estimation method
Travel elements	Ridership by station	Number of passengers boarding and alighting by station
	Ridership by route and mode	Number of passengers boarding and alighting by route and mode
	Number of rides by passenger type	Number of passengers boarding and alighting by passenger type
	Transport performance per vehicle	Total ridership/number of vehicles
	Average number of in-vehicle passengers per vehicle	Total of in-vehicle passengers by section/number of sections
	Average travel time per passenger	Average time interval between boarding and alighting
	Average travel distance per passenger	Average distance between boarding and alighting areas
	Average number of rides per passenger	Total rides/number of users
	Average time of usage per mode	Average time of usage of each mode
	Congestion rate	Present number of passengers+number of boarding passengers-number of alighting passengers
Fare revenue	Average fare paid per passenger	Average fare paid by passengers
	Fare revenue per vehicle	Total fare income per vehicle
	Fare revenue of each route	Total fare income per route
Transfer	Average number of transfers	Total rides/total ridership
	Average transfer time	Average time taken to get on a new means of transport after getting off a vehicle (in case a transfer occurs)
	Average fare of trips involving transfers	Average fare paid for trips that include transfers
O/D traffic volume	O/D traffic	Travel data of boarding and alighting areas

• Source: Korea Transport Institute, "A Study on Using Smart Card Ticket Data in Developing Public Transport Policies", 2006.

Information on travel elements such as ridership by station, route and mode as well as travel frequency and length by passenger types can be obtained through the use of smart card ticket data. Besides, the most fundamental data such as revenues, transfers and O/D traffic volume can be collected as well.

Conventionally, data on public transport usage were collected through questionnaire surveys. Compared to this, the method of collecting automatically generated information of smart cards is economical and efficient in terms of time and costs. Figure 2.10 compares the processes of obtaining and utilizing information through the use of questionnaire surveys and smart card tickets. Information based on smart card ticket is collected in real time and automatically. Thus, it can be used very effectively in developing transport policies and conducting relevant research. The Seoul Metropolitan Government and various other local governments are analyzing the smart card ticket usage data, utilizing the results in devising and implementing their transport policies.

Figure 2.10. Comparison of the processes of obtaining traffic information through questionnaire surveys and smart card tickets



• Source: Korea Transport Institute, "A Study on Using Traffic Card Data in Developing Public Transport Policies", 2006.

CHAPTER 03

Integrated Fare System in Korea


Windows Internet Explorer

SECTION 01.

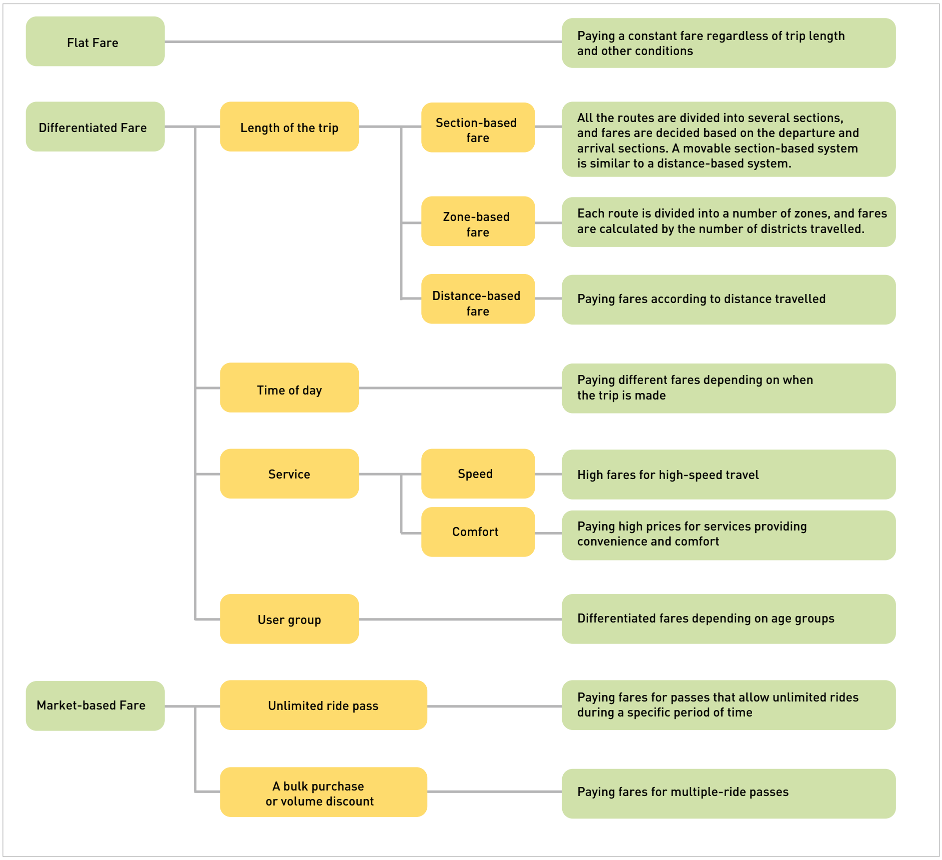
Definition of the Integrated Fare System

1. Public Transport Fare System

A public transport fare system is determined by a diversity of factors such as the level of service, costs, demand, and conditions and expenses for using other modes of transport. Figure 3.1 shows various fare systems classified according to the structure. Fare systems can also vary depending on the public service functions of the operating organizations as well as transport policies designed to offer free rides to specific classes of people.

A single-purpose trip may involve multiple rides of either the same or different modes of public transport. In such a case, the fares can be calculated and collected in an integrative manner encompassing all the travel modes used, instead of being imposed separately for each mode. This scheme is referred to as an "integrated fare system."

Figure 3.1. Various types of public transport fare systems (for single modes of transport)



CHAPTER 03

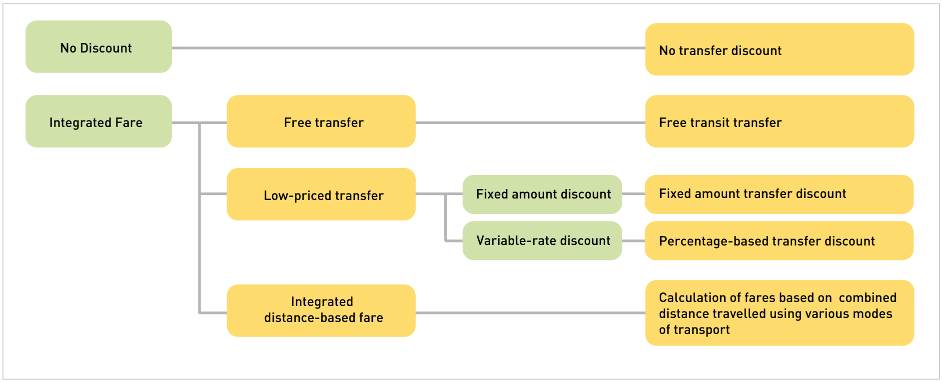
2. Integrated Fare System

Various discount policies can be applied to transfers, that is to say the multiple use of public transport on a single trip.

An integrated fare system has significant impacts on efforts to promote public transport. First of all, it helps transit operators increase their operational efficiency. It also helps transit users save their travel expenses. In addition, the system can increase user convenience and improve the competitiveness of public transport by combining various transit modes under a new fare scheme.

Imposition of fares based on total distance travelled can ensure a rational fare

Figure 3.2. Public transport transfer discount policy



structure for public transport users, minimizing the burden of paying additional fares for transfers. Table 3.1 shows various types of an integrated fare system classified according to the mode, space and the discount method.

Table 3.1. Classification of integrated fare systems according to mode, space and discount scheme

Classification	Name	Details
Mode	Intra-modal integration	• Method of integrating fares for the same modes of transport (e.g. bus-bus)
	Intermodal integration	• Method of integrating fares for different modes of transport (e.g. Metro-bus)
Space	Intra-regional integration	• Method of integrating fares within one area
	Interregional integration	• Method of integrating fares in various areas
Discount schemes	Free transfer	• Free transfer to the next travel mode allowed within a specific time span after the use of the initial mode
	Low-priced transfer	• Method of offering fixed-amount or fixed-rate discounts
	Integrated distance-based fare	• Calculating the fare based on the combined distance travelled by all the modes used by a rider

In case there are high volumes of traffic between regions and there is a need for transfers between modes, implementing intermodal and interregional integration systems can increase the convenience of using public transport. However, an integrated fare system requires the acquisition of information on previously used travel modes and areas. Thus, it may cause operational difficulties such as the need to hire more staff.

However, smart card tickets, which can hold information on previously used travel modes, have made it possible to implement an integrated fare system without much difficulty, as shown in Seoul, the transit fare system of which is based on intermodal and interregional integration. Table 3.2 shows various integrated fare systems (transfer discount systems) now being used in major Korean cities.[22]

Table 3.2. Integrated fare systems in use in major Korean cities

Regions			Seoul, Incheon, and Gyeonggi (capital region)	Busan	Daegu	Gwangju	Daejeon	Nonsan
Transfer conditions	Target modes		bus, Metro	bus, Metro	bus, Metro	bus, Metro	bus, Metro	bus, bus
	Number of transfers		5 times	2 times	No restrictions	No restrictions	No restrictions	1 times
	Time regulations		Within 30 minutes after disembarkation of each mode	Within 30 minutes after disem-barkation of each mode	Within 30 minutes after disem-barkation of each mode	Within 30 minutes after disem-barkation of each mode	Within 30 or 60 minutes after disem-barkation of each mode	Within 60 minutes after disem-barkation of each mode
	Fare discounts		Calculation of expenses based on total distance travelled	200 Korean Won for adults	Free	Free	Free	Free
Classification of integrated fare system	Mode	Within mode						●
		Between modes	●	●	●	●	●	
	Space	Within region				●	●	●
		Between regions	●	●	●			
	Discount method	Free transfer			●		●	●
		Fixed-amount discount		●		●		
		Integrated distance-based system	●					

• Note: 1) Details on Seoul Metropolitan Government's integrated fare system are described in the following section.
2) Discounts are based on adult fares.

22) It is necessary to tell the difference between a unified fare collection system and an integrated fare collection system.
- Unified fare collection system: A system that allows the use of multiple modes of transport with a single means of payment
- Integrated fare collection system: A system that allows integrted calculation and payment of fares for multiple trips

SECTION 02.

Seoul's Public Transport Fare System: Integrated Distance-Based Fare Scheme

1. Public Transport in Seoul

Metro Operation

Metro has played a central role in public transport in Seoul over the past 40 years. Its history started with the construction of Seoul Metro Line 1, which began in 1974. As of 2011, Seoul had nine Metro lines, which measured 315.4 km in total length and had 293 stations.

Statistics on Seoul Metros, Line 1 through Line 8, show that trains run 4,389 times a day, carrying approximately 7.4 million passengers on weekdays. Their revenues reach 3.4 billion Korean Won (3.4 million US Dollar) a day on average. The congestion rate is about 167%, which represents a situation in which the passenger seats are all taken, with eight passengers standing at each door section and two rows of standing passengers holding handles positioned in the middle of the car floor. The phase-1 section of Metro Line 9, built as a PPP project, opened in July 2009. One year later, this line's daily ridership was reported to be 319,000.

Metro are managed by various organizations: Metro Lines 1 through 4 by Seoul Metro; Lines 5 through 8 by Seoul Metropolitan Rapid Transit Corp.;

Figure 3.3. A route map of Seoul metropolitan Metros

• Source: Seoul Metropolitan Government's City Transportation Headquarters (http://www.smrt.co.kr).

Gyeongbu/Gyeongin/Gyeongwon/Ansan/Gwacheon/Ilsan/Bundang lines and Incheon International Airport Railroad by Korea Railroad Corporation; Metro Line 9 by Seoul Metro Line 9 Corporation; and, Sinbundang Line by DX Line. Metro projects were mostly financed by the state, except for Line 9 (opened in 2009) and Sinbundang Line (opened in 2011) which were built as PPP projects.

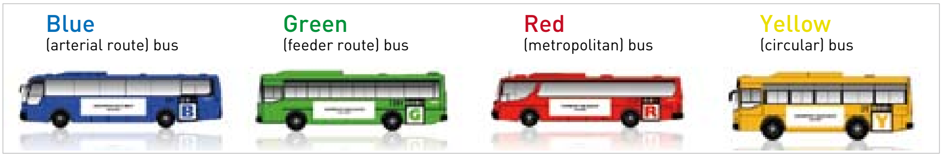
As of 2011, Metro in Seoul charged the basic fare of 900 Korean Won for distance of up to 10 km. Outside the basic fare range, 100 Korean Won was levied in additional fare for every 5 km up to 40 km, and every 10 km for distance exceeding 40 km.

Bus Operation

With a modal share of about 27%, buses play a pivotal role in public transport in Seoul along with Metros. As of 2011, the buses in operation in Seoul were categorized into four types, depending on function. They employed different colors: blue for trunk route buses, green for feeder line buses, red for metropolitan buses, and yellow for circular buses. There were 116 trunk routes, 225 branch routes, 13 metropolitan routes, and 6 circular routes.

The city buses are operated on the basis of a semi-public operation system. This system features a joint management of fare income, under which the Seoul Metropolitan Government pools all fare revenues from buses and allocates them depending on operational performance. In return, Seoul Metropolitan Government provides subsidies to make up for any shortfalls. Bus operators for trunk routes (blue buses) are determined through a bidding system. This scheme allows the government to sign operating contracts with bus companies chosen based on open, competitive tenders.

Figure 3.4. Seoul city bus types



As of 2011, the basic bus fare was 1,000 Korean Won (1 US Dollar) for adults. smart card ticket users were given a 100 Korean Won discount off the basic fare. The 100 Korean Won discount was also offered to smart card ticket users riding Mini and metropolitan buses.

Changes in Transfer and Fare Collection Systems

Buses are serving as the backbone of Seoul's public transport, along with Metros. According to the 2006 household travel survey, the buses had a market share of approximately 27%. Following the bus route restructuring initiated by the Seoul Metropolitan Government, the number of bus routes rose from 367 to 419. The number of city buses fell from 8,146 to 7,984.

Table 3.3. Details of Seoul bus route restructuring (before and after the July 2004 reform)

Type	Before July 2004	
	Number of routes	Number of buses
Regular city bus	255	6,644
Jwaseok bus	46	943
Local circulation bus	66	559
Total	367	8,146

⇨

Type	After July 2004	
	Number of routes	Number of buses
Trunk route	90	2,855
Feeder route	285	4,335
Metropolitan	39	754
Circulation	5	40
Total	419	7,984

• Source: Seoul Development Institute, "A Case Study of Public Conflicts Management in the Process of Promoting Bus Reform", 2005, re-quoted.

Before the reform, there were four types of city buses: regular, jwaseok (express), Mini (community) and circulation buses. Their operations were based on routes, which could be divided into profitable and unprofitable ones. Unprofitable routes were often abolished, thus causing the occurrence of "blind spots" in public transport services.

To rectify this problem, Seoul Metropolitan Government reorganized the bus routes into trunk and feeder routes when it implemented a public transport reform in 2004. Trunk route buses were deployed along the major corridors of the city, while feeder route buses were placed along other corridors. By so doing, the government could reduce bus running time, making it possible to handle the same

Table 3.4. Seoul's public transport reform measures

Major reform measures	Details
Bus route restructuring	• To maximize the efficiency of the bus route system, the bus routes were reorganized into trunk and branch lines. The city also shortened the irrationally long routes, straighten the circuitous routes, and unified the overlapping routes.
Operation of median bus lanes	• The existing curbside bus lanes cannot ensure smooth flow of traffic for buses because of its operation being hindered by cars parked or left standing on the roadside as well as by cars entering or leaving the roadway. To overcome these problems, mid-road bus-only lanes were introduced.
Operation of transfer centers	• To ensure that transfer centers can serve as transit hubs, they were built in places where more people are likely to transfer from bus to bus and from bus to Metro than in other areas
Introduction of transfer discounts	• Discount benefits were introduced for bus-bus and bus-Metro transfers in order to reduce the fare burden for captive riders, who have to transfer multiple times, and facilitate the use of public transport.

• Source: Seoul Development Institute, "A Desirable Seoul Metropolitan Transport System: Transport Conditions in the Capital Area Based on Transport Survey Results", 2008, re-quoted.

number of passengers with a smaller number of buses. The bus travel speed increased, and the problem of overlapping routes was relieved.

In July 2004, Seoul Metropolitan Government initiated a public transport reform aimed at increasing the use of mass transit. Particularly designed to overhaul the transit bus system, the reform included a number of measures such as the integrated fare system, operation of median bus lanes and the introduction of transfer centers.

Figure 3.5. Transit center at Seoul railway station

The “integrated transfer and distance-based fare system,” which was introduced in 2004, allows public transport users to make transfers up to four times without paying any additional fares, regardless of modes. Under this scheme, even for long-haul travel, the final fare is not higher than the sum of fares for each mode. Because of such characteristics, the system has received favorable responses from public transport users. To receive free transfer benefits under this system, a rider should transfer from one mode to another within 30 minutes. If this time limit elapses, the basic fare is newly imposed.

The Metro fare criteria became simplified with the introduction of the integrated distance-based fare system. Previously, there had been various methods based on

Table 3.5. Changes in Metro fare systems (based on smart card ticket-using adults, before and after the 2004 reform)

Fare structure before reform			Fare structure after reform
Zone-based fare system (within city limits)	Movable section-based fare system (beyond city limits)	Link fare system	Integrated distance-based fare system
• 640 Korean Won for 1 section (basic rate) • 740 Korean Won for 2 sections	• 640-Korean Won basic rate for distance up to 10 km • 8% discount for every 5 km outside the basic fare range	• A scheme for mixed use of the zone-based and movable section-based systems • Zone fares are calculated first, and 80 Korean Won is added for every 5 km travelled from the boundary station	• Within 10 km: 900 Korean Won • 10-40 km: 100 Korean Won for every 5 km • Beyond 40 km: 100 Korean Won for every 10 km

sections, movable zones or connection schemes. The distance proportional fare system was introduced in the bus transport sector as well, replacing the previous 650 Korean Won flat rate scheme.

2. Pre-Reform Fare Collection Systems

Before the reform, the Metros used a zone-based fare structure for rides within the city area and a movable section-based system for travel beyond the city limits. Under the zone-based fare scheme, the city area was divided into seven zones. Riders paid the basic rate when their departure and arrival zones were located next to each other. Travel through more than two zones required the payment of an additional fare. Outside the city limits, travellers paid the basic rate for distance of up to 10 km, and additional 80 Korean Won for every 5 km outside the 10 km range. Basically, the zone-based system was applied within the city area, and the movable section-based system was employed for rides outside the city boundaries. When it was necessary to apply both systems, a connection scheme was used. This scheme required the application of the zone-based fare system first, and the movable section-based system next.

As for the buses, flat rates were applied to rides within the city area, and a zone- or section-based system was used to calculate fares for travel outside the city limits. When deemed necessary, a distance-based scheme was employed. For jwaseok and non-stop jwaseok buses, flat rates were applied even for rides outside city limits. Zone- or section-based systems were allowed to be used exceptionally,

Figure 3.6. An Metro fare zone map

• Source: Seoul Metropolitan Government·Seoul Development Institute, "Action Plans for Restructuring the Seoul Transport System", 2003.

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depending on regional particularities.

To promote the use of smart card tickets, smart card ticket users were given discount benefits. When paid by card, the fares were up to 100 Korean Won lower

Table 3.6. Metro fare systems (before implementation of the integrated fare scheme)

Classification		When using regular tickets (Korean Won)	smart card ticket		Multiple-use tickets (5,000/10,000/20,000)	
			Aults	Middle and high school students	Adults	Middle, high school and college students
Zone-based fare system (within city limits)	Basic rate (1 section)	700	640	560	10% discount (excluding 5,000 Korean Won ticket)	20% discount (excluding 5,000 Korean Won ticket)
	2-section rate	800	740	640		
Movable section-based system (outside city limits)	Basic rate up to 10 km	700	640	560		
	For every additional 5 km	80 Korean Won in additional fare	8% discount	20% discount		
Link fare system	A system that is applied where both the zone-based and movable section-based system are used. Zone-based fares are calculated first, and 80 Korean Won is added for every 5 km travelled from the boundary station.					

• Note: The connection system requires the calculation of zone fares first and the addition of 80 Korean Won for distance of every 5 km from the boundary station.

Table 3.7. Total value of yearly transactions made with KSCC-issued smart card tickets

(unit: million Korean Won, %)

Classification	Year 2006		2007		2008		2009		2010	
	Total value of transactions	Ratios	Total value of transactions	Ratios	Total value of transactions	Ratios	Total value of transactions	Ratios	Total value of transactions	Ratios
Transport sector	568,818	99.2	693,871	98.9	885,167	98.1	1,156,849	97.0	1,364,583	96.4
Retail sector	4,461	0.8	7,661	1.1	17,147	1.9	36,269	3.0	51,377	3.6
Total	568,818	100.0	693,871	100.0	885,167	100.0	1,156,849	100.0	1,364,583	100.0

• Source: Korea Smart Card Company homepage (http://www.koreasmartcard.com)

Table 3.8. Smart card ticket fares of Seoul Metropolitan Government (as of 2003)

(unit: Korean Won)

Classification	Regular		Jwaseok (Metropolitan)				Mini bus	
			General		Luxury			
	Adults	Middle and high school students	Adults	Middle and high school students	Adults	Middle and high school students	Adults	Middle and high school students
Cash	700	700	1,300	1,300	1,400	1,400	350	350
smart card ticket	650	490	1,200	1000	1,300	1100	320	320

• Source: Seoul Metropolitan Government·Seoul Development Institute, "Action Plans for Restructuring the Seoul Transport System", 2003. re-quoted.
• Note: There were no card-related discounts for elementary school students.

than the regular fares paid in cash.

Fares for Seoul Metros were determined differently, depending on whether trips were made within or outside the city area. The overall fare scheme included unfair and irrational elements. For example, some far-away Seoul districts were categorized as regions subject to the application of the movable section-based fare system, thus causing an addition a fare burden to the residents of those areas. In addition, it was difficult for ordinary citizens to understand the complicated fare system. There were also conflicts over the designation of zones, because citizens residing near the zone boundaries were penalized in terms of fares.

Unlike the Metro, the buses did not offer free transfers. Bus riders had to pay separate fares every time they board a bus during their journey. The system, oriented toward ensuring the convenience of transport operators, made the process of using public transport cumbersome. Thus, it hindered the facilitation of the use of public transport. In terms of operational aspects, there was controversy over fares hiked nearly every year because the fares were determined based on the concept of post-reimbursement of costs. Under the system, operators' deficits accumulated, thus making it difficult to improve services.

3. Improvement Objectives and Alternatives

Seoul Metropolitan Government was looking to restructure the public transport fare system to ensure user equity, operator revenue increase, expansion in user convenience and reduction of transfer-related fare burdens. As alternatives, it examined the following systems: flat fares, distance-based fares, time-based differential fares, demand-based fares (season ticket, daily free pass, discounts for disabled persons and students, transfer discounts), and service-based fares (regular/high-speed).

Public transport fare policies should aim at increasing user demand and convenience as well as at ensuring differential fares depending on user characteristics. Under this guideline, the Seoul Metropolitan Government set the evaluation criteria, each of which was alloted maximum scores, and appraised the above-mentioned options. Through this process, the distance-based fare system was chosen as the basic option. Then, the city government conducted further analysis of the system, particularly in regards to proposed changes in the transport environment, such as bus route restructuring and the implementation of a new smart card ticket system.

Table 3.9. Comparison of fare system options

Options	Fare structure	Advantages	Disadvantages
Flat fare system	• Applying the same fare along the whole route	• Easy to understand fares • Easy to manage/administer • Easy to operate automation facilities • Easy to sell and buy tickets	• A relatively big fare burden on short-distance passengers • Difficult to secure operating revenues • Difficult settle fare revenues among operators
Zonal fare system	• Setting fares between zones • Charging fares by the number of stations passed	• High level of passenger understanding due to fixed zones • Fare discrimination between short- and long-haul trips increases the level of fare-related fairness • Relatively easy to sell and buy tickets	• Difficult to set the zones because of resistance from residents • Need for agreement among operators • Short trips across a zonal boundary may be penalized, thus causing concern about possible resistance
Distance -based system	• Paying fares proportional to distance travelled	• Ensuring fairness through fare payment based on distance travelled • Increase in transport revenues of operators	• Difficult to understand fares • Need to cover costs for system expansion
Time-based differential fare system	• Fare discrimination between peak and off-peak hours • After-midnight surcharge	• Shifts in demand from peak to non-peak hours helps to reduce congestion • Facilities are expanded to demand for peak-time traffic. So, it is fair to impose additional fares on peak-time riders.	• Potential to cause unlawful use of public transport • Generation of costs due to additional system expansion
Service -based fare system	• Fare discrimination based on the quality of services	• Relatively easy to understand the system • Fair to impose high fares on high-quality services • A diversity of passenger choices	• Increase in fare burden caused by the use of high-quality services
Demand -based fare system	• Fares reflecting the diversity of demand	• Satisfy user requests through market division • High level of political acceptability	• Generally, the lowest level of revenues is secured • Excessive market division is required to ensure increase in ridership

• Source: Seoul Metropolitan Government·Seoul Development Institute, "Action Plans for Restructuring the Seoul Transport System", 2003.

4. Selection of the Integrated Distance-Based Fare System

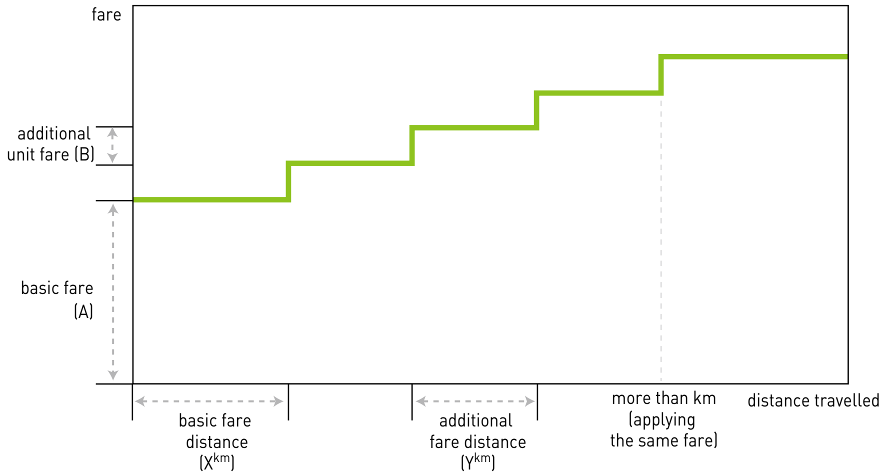
Integrated Distance-Based Fare System

The integrated distance-based fare system was adopted to ensure a rational

Figure 3.7. A conceptual drawing of an integrated distance-based fare scheme

$$\text{Fare} = A + B \times \frac{\textit{distance travelled} - X}{Y}$$

(A : basic fare, B : additional unit fare, X : basic fare distance, Y : additional unit fare distance)



approach for imposing travel fares and to minimize additional fare burdens related to transfers. Under this system, the total fares are basically determined by the basic fare plus additional fares calculated by additional unit distance travelled. In such a scheme, setting the basic fare distance has a very significant impact on revenues.

Matters That Need to Be Considered When Implementing an Integrated Distance-Based System

The following matters should be considered when implementing an integrated distance-based fare system. First, the system requires smart card ticket usage at 100%. This is because travel distance and fares can be calculated only for passengers using smart card tickets. Such calculations cannot be made for passengers paying fares in cash. Second, as for the buses employing a flat rate system, it is necessary to install distance-calculating devices on the buses or at bus stops. There is also a need to replace the existing ticket vending machines, and to continuously monitor the card ticket issuing machines to find out any malfunctions and implement repairs. Third, it is necessary to provide support to people with mobility handicaps (disabled, elderly, children, etc.) in regards to the use of public transport services. Fourth, rate tables should be posted properly to provide exact information on the determination of fares, because under an integrated distance-based system, it is difficult for passengers to figure out correctly their travel distance and the expenses they have to bear. Fifth, it is necessary to increase demand for bus travel. Bus passengers do not show great variations in their trip lengths, which are mostly concentrated in the 3-9 km range. This puts bus operators at a disadvantage because increase in income is largely dependent on the number of long-distance users under a distance-based fare system. In contrast, Metros are expected to see increases in fare revenue because there are significant variations in travel distance of passengers. These circumstances make it necessary to determine fare levels differently for various public transport modes so that fare revenues can cover the costs.

Basic Fare and Additional Unit Distances

If the basic fare distance differs depending on public transport modes, it becomes difficult to implement an integrated distance-based fare system in a way that can meet its intended purpose. So, it is quite important to properly determine the basic

Table 3.10. Options on basic fare/additional unit distances

Classification	Basic fare distance	Additional unit distance	Remarks
Option 1	3 km	3 km	• The sample group's average travel distance on Mini buses is 3 km. So, for the convenience of analysis, this option adopts a 3 km basic fare distance and 3 km additional unit distance scheme.
Option 2	5 km	3 km	• The sample group's average travel distance on regular city buses is 6.5 km. However, for the convenience of analysis, this option adopts a 5 km basic fare distance and 3 km additional unit distance scheme.
Option 3	5 km	5 km	• The sample group's average travel distance on regular city buses is 6.5 km. However, for the convenience of analysis, this option adopts a 5 km basic fare distance and 5 km additional unit distance scheme.
Option 4	1 km	1 km	• This option represents the most minutely segmented scheme based on 1 km basic fare distance and 1 km additional unit distance.
Option 5	10 km	5 km	• The Korean National Railroad Administration receives the basic fare of 650 Korean Won for 10 km, and additional 80 Korean Won for every 5 km. So, this option employs a 10 km basic fare distance and 5 km additional unit distance scheme.

rate distance. Should 90% of the users pay the same fare, the system would lose its effectiveness. On the other hand, if only a small number of users pay the same fare, long-haul travellers would be penalized in terms of fare burden. To prevent these problems, the basic fare distance should be set in such a way that those paying the same fare can make up a proper percentage of the entire users. Table 3.10 shows the options considered based on changes in revenues depending on various basic fare and additional unit distances.

Based on the analysis of these options, Seoul Metropolitan Government determined to impose the basic fare for distance less than 10 km and additional fares every 5 km outside the basic fare range. As for the buses, the city government decided to maintain the flat rate system for unlinked trips and to apply the same standards as the Metro fare scheme for liked trips, that is trips involving transfers.

Principles of Revenue Allocation Among public transport Modes

Under integrated public transport fare system, it is essential to set a principle regarding the allocation of fare income among various modes that differ in their respective investment amounts and operating costs. So, Seoul Metropolitan Government launched a system under which the fare revenues of the public transport modes are pooled, settled and allocated by a single designated organization in accordance with pre-determined rules.

The fare revenues of buses and Metros are combined to be settled in accordance with the ratios between their basic fares, except for additional fares collected in the Metro sector. It was determined that revenues from such additional fares should be given entirely to Metro, by considering the enormous amounts of infrastructure investments made in the Metro sector.

$$\mathrm{m}_i \textit{Settled farerevenue} = \textit{Total farerevenue} \times \frac{\mathrm{m}_i \textit{Unlinkedtrip fares}}{\sum_{i=1}^{6} \textit{Fares imposed on unlinked trips}}$$

(i= luxury trunk route bus, trunk route bus, feeder route bus, circular feeder route bus, Mini bus, Metro)

The fare revenues involving additional Metro fares are settled in accordance with the following formula.

$$m_{urbanrail}\,Settled\,farerevenue = Total\,farerevenue \times \frac{m_{urbanrail}\,Basic\,fare}{\sum_{i=1}^{6} m_i\,Basic\,fare\,for\,unlinked\,trips} + urbd$$

(i= luxury trunk route bus, trunk route bus, feeder route bus, circular feeder route bus, Mini bus, Mtero)

In case additional fares are generated through linked trips involving Metros and other modes, the fare revenues are settled based on the ratios between basic fares of the modes involved, regardless of differences in distances travelled by each mode.

5. New Fare Scheme's Impact on Public Transport Demand

Demand for public transport increased following the public transport reform in 2004. It rose 4.5% during the one-year span from 2003 to 2004. The modal share of public transport reached 62.3% in 2006, up 1.7% from 60.6% recorded in 2000.

Table 3.11. Changes in demand for public transport

(unit: 1,000 rides/day)

Classification	2002	2003	2004	2005	2006
Public transport (total)	17,990	17,992	18,806	19,299	19,455
Change compared to 2002	100	100	105	107	108

The number of registered private passenger cars in Seoul rose 10% from 2,053,613 in 2002 to 2,266,106 in 2006. During the same period, demand for passenger car use went up merely by 2.6%. Analysis shows that this result is related with the fact that the passenger car traffic volume had not increased since 2006. It may be further interpreted as indicating that a considerable number of passenger car users shifted to public transport, thus contributing to reducing traffic congestion in the city.

Figure 3.8. Changes in demand for public transport and its modal share

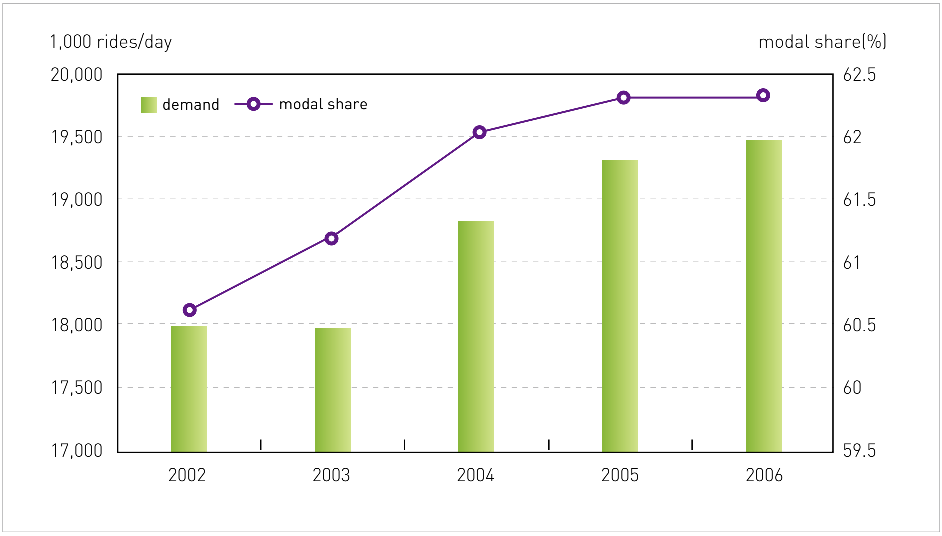
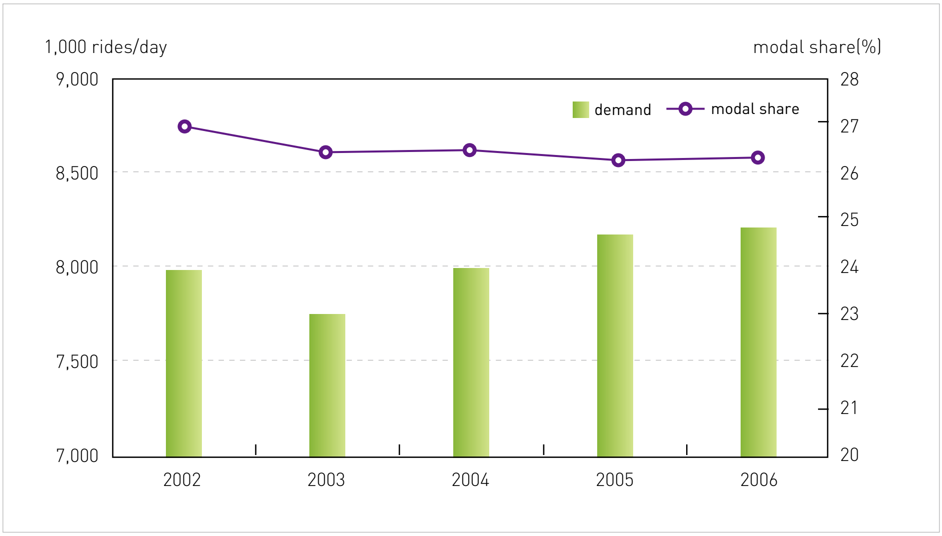


Figure 3.9. Changes in demand for passenger car use and the modal share



SECTION 03.

Expansion of the Integrated Fare System

1. Necessity for Expanding the Integrated Fare System to Cover Seoul's Adjacent Areas

In Seoul, a growing number of residents moved to places away from the city center due to the rising housing prices. In addition, the implementation of the five-day workweek system caused changes in lifestyles of citizens. These developments led to an increase in the need for metropolitan transport system connecting Seoul with the neighboring areas.

In particular, continued construction of new cities around Seoul led to an upward trend in commuter travel from these areas to Seoul. Relevant statistics showed a 7.5% increase in commuter traffic to Seoul from its five major satellite cities, and a rise of as high as 65.5% in traffic from other areas where new housing development projects were underway (see Table 3.12).

Overcoming difficulties in conducting negotiations with other local governments, Seoul Metropolitan Government succeeded in expanding the integrated distance-based fare system to cover the areas of Gyeonggi Province and Incheon.

Table 3.12. Demand for commuter travel to Seoul from various areas

Areas	Year 2002	Year 2006	Growth rate
5 major satellite cities (Bundang, Ilsan, Jungdong, Pyeongchon, Sanbon)	210,764	226,515	7.5%
Areas that recorded sharp increases in housing development projects (Yongin City, Gimpo City, Gwangju City, Yangju County, Namyangju City)	116,826	193,367	65.5%
Incheon and other areas in Gyeonggi Province	668,377	754,314	12.9%
Total	1,031,662	1,174,196	13.8%

• Source: Seoul Development Institute, "A Desirable Seoul Metropolitan Transport System", 2008.

2. The Process of Expanding the Integrated Distance-Based Fare System

The expansion of the integrated distance-based fare system was carried out in three stages. The first stage was focused on introducing the system for its implementation within the Seoul area. It then was expanded to cover the Gyeonggi Province area in the second stage. In the third stage, it was further extended to include the Incheon area, thereby covering the nation's capital region.

In Seoul, the integrated system was introduced in 2004 as part of a public transport reform. In July 2007, the Gyeonggi Province introduced the system, agreeing with Seoul Metropolitan Government to offer transfer discounts for cross-boundary trips involving transit buses, Mini buses and/or Metros. The system was expanded to incorporate Incheon City as well in October 2009. The integrated distance-based fare system applies to Gyeonggi buses (regular, jwaseok, jwaseok express, Mini), Seoul buses (trunk route, branch route, circular, metropolitan, Mini), Incheon buses (trunk route, branch route, jwaseok, metropolitan) and Seoul Metros. The detailed process of implementing the integrated distance-based fare system is shown in Table 3.13.

Table 3.13. Procedures for implementing the integrated fare system for the Seoul metropolitan area

Year/Month	Details
1996. 07.	• Initiated smart card ticket system for Seoul city buses
1998. 06.	• Initiated smart card ticket system for Seoul phase-1 Metros
2000. 04.	• Initiated compatible use of prepaid/post payment smart card tickets between Seoul and Incheon Metros
2000. 06.	• Initiated the use of post payment smart card tickets for bus rides (compatible use)
2000. 09.	• Initiated smart card ticket discount system (8% for adults, 20% for middle and high school students)
2001. 05.	• Initiated smart card ticket system for Mini (community) buses
2001.10.	• Initiated transfer discount system for smart card ticket users (Metro⇔bus)
2002. 02.	• Number of deferred payment smart card ticket companies increased (from 1 to 8)
2002. 04.	• Initiated Mini bus transfer discount system
2004. 07.	• Initiated new smart card ticket system for Seoul city buses and Seoul metropolitan Metros
2005. 12.	• Replaced smart card ticket readers on Gyeonggi Province buses
2007. 07.	• Initiated transfer discount system for Gyeonggi-Seoul city/Mini buses, Metros
2008. 09.	• Initiated transfer discount system for Gyeonggi-Seoul jwaseok (metropolitan) buses
2008. 11.	• Initiated the issuance of free-ride smart card tickets in Seoul
2009. 05.	• Initiated the use of single-use smart card tickets for Seoul metropolitan Metros
2009. 10.	• Initiated the transfer discount system for Incheon-Gyeonggi/Seoul buses, Metros

• Source: Metropolitan Transport Association, "A Case Study of the Smart Card Ticket System", 2009.

3. Fare Collection and Clearing Under the Expanded Integrated Distance-Based Fare System

Fare Collection System

Public transport users in the nation's capital region, which incorporates Seoul, Incheon and Gyeonggi Province, can transfer from one mode to another without the burden of paying transfer fees. The fare is imposed on the user only for the distance travelled, regardless of the mode (City bus, Mini bus and Metro) and the number of rides during a journey. The fare schemes of these areas are all based on the integrated distance-based fare system initiated by Seoul Metropolitan Government. This system is applied to city buses running in the Seoul, Incheon and Gyeonggi Province areas as well as to the Metro in the capital region. Passengers can use make free transfers up to four times during a trip. They should pay the basic fare of 900 Korean Won for distance less than 10 km, and additional fares of 100 Korean Won for every 5 km between the 10-40 km range. Outside this range, 100 Korean Won is imposed every 10 km. (See Table 3.14).

Table 3.14. Fare structure under the integrated distance-based fare system (as of 2011)

Classification	Fare structure
Fares	• Basic fare: 900 Korean Won for distance within 10 km • Additional fares - 10-40 km: 100 Korean Won for every 5 km - Distance exceeding 40 km: 100 Korean Won for every 10 km • Adolescents are given a 10% discount from the adult rate • Children aged 6 or above are given a 50% discount from the adult rate • Free ride services are offered to elderly people aged 65 or above, persons who have made significant contributions to the nation, and the disabled. These services are restricted to Seoul metropolitan railways.

Figure 3.10. Concept of fare collection system

Revenue Management/Clearing System

A joint revenue committee was launched for the management and settlement of fare revenues. The committee was composed of Seoul Metropolitan Government, the Gyeonggi Province government, the Incheon City Government, KORAIL, Metro

the basic fare distance (10 km), are given to pertinent Metro operators, if the trips are unlinked to other modes. Other fares are settled in accordance with the ratios between the basic fares of the modes involved.

Table 3.16. Intermodal and link fare clearing procedures

Classification	Details
Intermodal clearing	• Revenue allocation between bus and rail operators • Revenue alloted to a particular mode = Total fares collected * (Basic fares of the particular mode / Combined total revenues of the modes)
Link fare	• Applied to rail operators concerning rail link sections • Allocation of revenues according to passenger/km ratios between operators (stipulated in the Framework Act on Railroad Industry Development) • KORAIL, Seoul Metro, Seoul Metropolitan Rapid Transit Corp., Incheon Rapid Transit Corp. + (Seoul Metro Line 9, Sinbundang Line, ...)

CHAPTER 04

Implications of Korea's Integrated Smart Card Ticket Operation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money

SECTION 01.

Policy Implications

1. Policy-Makers' Commitment and Stakeholders' Adjustment of Differences

Implementing a new smart card ticket system represents a policy effort to provide convenience to public transport users. However, no matter how good a policy is, problems can occur in the course of its development and implementation. In particular, projects related to the daily lives of citizens are more likely to face difficulties because of resistance from stakeholders. Seoul Metropolitan Government was no exception; it encountered serious obstacles in the process of promoting its public transport smart card ticket system.

To be effective, a new smart card ticket system should be applied to all transport modes at the same time. In this regard, it was natural that from the beginning, the Seoul Metropolitan Government pushed for a system that would allow transit users to ride city buses and Metros with a single smart card ticket. However, it was not easy to establish the desired system, mainly due to conflicts of interest among various stakeholders. The Seoul Metropolitan Government needed to hammer out an agreement among various organizations with vested interests in the smart card ticket system. At that time, there were a considerable number of public transport operators like bus companies and Metro corporations. Besides, the conventional smart card ticket operators were also important stakeholders.

Despite the difficulties, the smart card ticket project could be implemented thanks to the policy-makers' commitment and the stakeholders' adjustment of their differences. Initiating a new smart card ticket system in July 2004, the city government produced an agrement involving all the stakeholders. The mayor of Seoul Metropolitan Government at that time could make that achievement by consistently pursuing a policy to improve the level of public transport services through drastic reform measures. In the process of executing the policy, he exerted strenuous efforts to help the stakeholders understand the importance of the smart card ticket project.

The stakeholders also made significant contributions by reaching an agreement on the new smart card ticket system. Through frequent meetings, they coordinated some of the important measures regarding the use of smart card tickets. For example, they agreed on a grace period during which the card tickets issued by the existing smart card ticket operators could be used along with the new card tickets. They also decided to induce replacement of old cards with new cards through normal procedures.

To ensure the new smart card ticket's future inter-regional compatibility, Seoul Metropolitan Government had sufficient consultations with the municipal and provincial governments as well as smart card ticket operators in the neighboring areas. The Seoul Metropolitan Government also made sure that the smart card tickets can be used in newly opened Metros, thus making it possible for citizens to use various modes of transport with a single smart card ticket.

2. Policy to Ensure Intermodal & Interregional Use of Smart Card Tickets

There are various kinds of transport modes in Seoul, such as buses, Metros and taxis. Metros are run by five different corporations, who are providing services for more than 10 routes. public transport users can use such various modes of transport with a single smart card ticket, thanks to the smart card ticket system introduced by the Seoul Metropolitan Government. They can use public transport without being bothered by differences in payment methods and fare levels among the public transport modes. The citizens can use public transport in such a convenient manner thanks to the intermodal compatibility of smart card tickets. Seoul Metropolitan Government further increased the level of user convenience by expanding the smart card ticket system to cover taxis as well.

The need to ensure the interoperable use of smart card tickets has been consistently raised since the smart card ticket system was first introduced to the nation. Seoul Metropolitan Government initiated the use of prepaid smart card tickets for buses in 1996. In the same year, post payment cards began to be used for Metro rides. Operated by different companies, the bus and Metro smart card tickets were not interoperable. The revenues were also settled separately. The lack of compatibility caused inefficiency in transit operation and complaints from citizens. To address the problem, the relevant authorities initiated an interoperable system for bus and Metro smart card tickets in 2000. The city experienced numerous difficulties in the process of implementing the interoperable scheme. Having experienced such difficulties, the city government gave top priority to interoperable services while preparing for the 2004 public transport reform.

After the smart card ticket system was initiated in the city, Seoul Metropolitan Government pursued a policy to allow transit users to ride various public transport modes with a single card ticket, not only in Seoul but in the adjacent Incheon and Gyeonggi Province areas. At that time, two smart card ticket operators were conducting business in Seoul as well as Gyeonggi Procince and Incheon. Seoul Metropolitan Government took steps for the companies to sign a mutual cooperation agreement to allow the interoperable use of their cards.[23] The policy to ensure intermodal and interregional compatibility of smart card tickets helped increase user convenience, thus positively affecting the efforts to facilitate the use of public transport. Partly due to the interoperable services, demand for public transport has kept increasing in Seoul since the smart card ticket system was initiated in 2004.

Furthermore, the central government has enacted a law containing provisions for realizing nationwide interoperability of smart card tickets by 2013. Relevant plans have been devised pursuant to the law. These efforts are expected to lead to the appearance of an integrated smart card ticket that can be used for any travel mode, whether it be a city bus, a Metro train, a high-speed train or an express bus.

3. Promotion of Smart Card Ticket Projects in Association with the Integrated Fare System

The 2004 public transport reform initiated by Seoul Metropolitan Government involved various transit policies, including one for the implementation of a new smart card ticket system. The city aimed to increase the level of public transport through a comprehensive overhaul of the public transport system. Various public transport policies could be interlinked and effectively executed through the use of the public transport smart card tickets. For example, the integrated smart card ticket was an essential element in rationally restructuring the public transport fare system.

A complicated public transport fare system causes confusion among the users as well as an increase in payment-related expenses the transit operators have to bear. The integrated distance-based system has many advantages but it has a very complicated structure. Seoul Metropolitan Government and public transport operators had not been able to introduce it because of the manpower and costs they would have needed to handle the system. However, the use of smart card tickets, which can store a diversity of information related to public transport usage, made it

23) Analysis showed that the ratio of public transport users in Seoul making trips to the Incheon and Gyeonggi Province areas reached about 15% (based on 2006 and 2010 surveys).

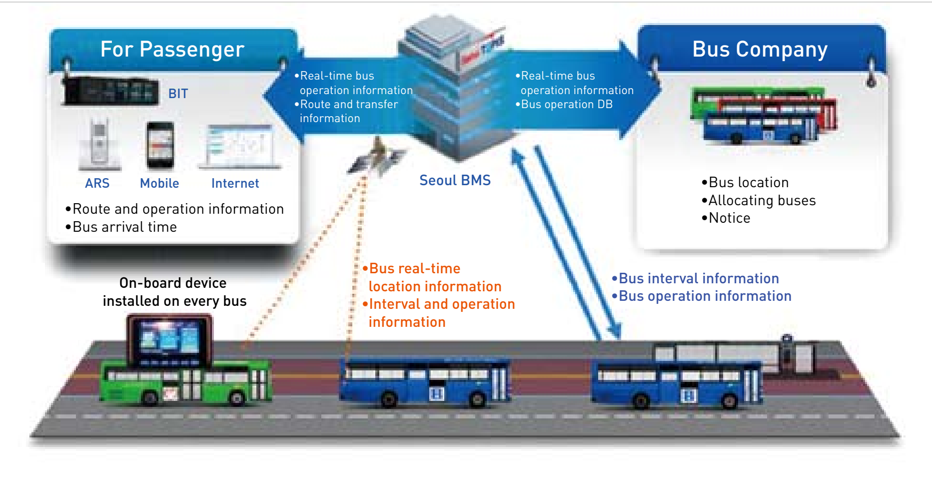
possible for the city government to implement the distance-based fare system.

Table 4.1. Seoul's public transport reform policies linked to the use of smart card tickets

Classification	Contents
Public transport smart card ticket	• Introduction of a new smart card ticket and construction of relevant facilities
Bus route restructuring	• Function-oriented restructuring of routes (metropolitan, trunk, branch, circular routes) • Reform of the bus numbering system (numbers granted based on the division of the Seoul area into eight zones)
Median exclusive bus lanes	• Operation of median exclusive bus lanes
BMS (Bus Management System)	• GPS-based bus readers, bus stop information service and management system
Semi-public bus operation	• A system designed to ensure the operational stability of buses through provision of subsidies to make up for losses of bus companies
Distance-based fare system	• Payment of fares proportional to distance travelled (inter-modal use possible)

The distance-based fare system was introduced along with smart card ticket system when Seoul Metropolitan Government initiated a public transport reform in July 2004. Under the distance-based system, buses and Metros are considered the same public transport mode. The fare is calculated based on the distance travelled, regardless of transfers, which are allowed free of charge up to five times a trip. Compared to the previous system, the new scheme helped reducing the

Figure 4.1. Information flow of bus management system in Seoul



travel expenses of public transport users considerably. As such, the integrated distance-based fare system is considered a positive factor in promoting the use of public transport.

Figure 4.2. Median exclusive bus lane in Seoul

Even after introducing the integrated smart card ticket system, Seoul Metropolitan Government carried out various policies designed to facilitate the use of smart card tickets. For example, it introduced a policy to give year-end income tax deduction benefits for payments by smart card ticket. It also expanded the scope of fare discount services to include smart card ticket-using airport limousine buses.

Various public transport policies that began to be implemented along with the introduction of the smart card ticket system are interconnected, positively affecting each other. This demonstrates the necessity for studying the prospects of a smart card ticket project in association with other relevant policies.

SECTION 02.

Financial Implications

1. Utilization of Private-Sector Capital and Ensuring Public Service Functions

The integrated smart card ticket system in Seoul has been built with private-sector investments, and it is still being operated by a private company. So, it can be referred to as a PPP project. Public transport ridership in Seoul averages more than 10 million rides a day. Such a high level of demand made the Seoul Metropolitan Government confident enough to decide that the smart card ticket project would have sufficient profit potential, eventually determining to purse its private promotion. The city government promoted a plan to launch a new corporation for the operation of the integrated smart card ticket project. It also determined that the capital-to-assets ratio of the new corporation should be at least 35%. Through this process, KSCC was inaugurated as the operator of Seoul Metropolitan Government's smart card ticket system. It is running the smart card ticket project as a profitable business through smart card ticket sales and the collection of fees for card loading and revenue clearing services.

When a social infrastructure project is implemented with private-sector investments, relevant public services can be provided to citizens without the use of government budget. Another advantage of this scheme is that the private sector's managerial expertise and know-how can help ensure the operational efficiency of a project. However, such a scheme may cause problems related to the monopoly of project-related business activities by a private company. The private company in charge of the smart card ticket operation may not seek to ensure interregional compatibility of the card. Besides, the smart card ticket system may be operated without sufficient connections to other relevant traffic policies. The card operator may also face difficulties because of uncooperative attitudes of relevant government agencies. To prevent such problems, it is essential to ensure that the smart card ticket system can maintain its public service functions as a kind of public property. KSCC was founded on the principle that Seoul Metropolitan Government would have a 31% or more stake in the company. This requirement was aimed at maintaining the city government's supervisory function to prevent KSCC from abusing its monopolistic status. Seoul Metropolitan Government is currently the largest shareholder of the company with a 35% stake.

Despite such precautionary measures, problems have been reported in regards to the way the smart card ticket project has been implemented. KSCC has not fully disclosed traffic information it has, although such information should belong to the public. Besides, the company often causes delays in conducting negotiations with other related organizations due to its policy to expand profits. For example, the use of post payment smart card such as credit cards was once suspended because of conflicts between KSCC and credit card companies over the question of commission fees. There is also a possibility that KSCC might abuse its monopolistic status in conducting negotiations in the future over new Metro services.

Seoul Metropolitan Government has developed a scheme to secure the public service functions of its new smart card ticket system while implementing the project with private-sector investments. In this regard, the city can be considered to have made a meaningful achievement. The smart card ticket project in Seoul should serve as an example for other countries and cities now seeking to pursue their own smart card ticket projects. First of all, they should prepare an apparatus for ensuring public service functions of a smart card ticket project, while exerting efforts to select an appropriate implementation scheme based on analysis of their traffic conditions and various other relevant matters. It is also necessary to prepare measures to cope with problems taking place in the course of implementing a project.

It should be made clear that there can be more than one answer when it comes to the question of selecting a scheme for implementing a smart card ticket project. Seoul has adopted a PPP project scheme because it suits its various circumstances. In contrast, Singapore has built its smart card ticket system with government budget. Its operation is also under the responsibility of the government. To conclude, the implementation method for smart card ticket projects should be selected based on analysis of the following factors: urban traffic conditions, the chief transit operator (government or private sector), transit operational characteristics and demand for public transport, the government's transport policies, and the level of government supervision.

2. Efforts to Increase Profitability

A smart card ticket project requires a vast amount of initial investments for building relevant facilities. So, endeavors should be made to secure profitability in order to provide stable smart card ticket services. Smart card ticket-related revenues are mostly made up of commission fees for card sales and loading, clearing service, and system management, plus advertisement income. KSCC, which is in charge of the smart card ticket operation in Seoul, is exerting efforts to increase its profitability through expansion of its business scope and development of new products.

During its early stages of operation, KSCC expanded the scope of its smart card ticket business, which had been restricted to buses and Metros, to cover taxis as well. It also made inroads into other local markets such as Jeju Island. It has also been implementing smart card ticket projects overseas in such countries as New

Zealand, Malaysia and Colombia. In addition, the company has advanced into the retail business sector, ensuring that transit smart cards can also be used as a means of payment at convenience stores, PC rooms, bookstores, cosmetics shops, bakeries, theme parks, baseball stadiums, schools and ancient palaces. It has also developed mobile smart card ticket functions using smart phones as well as related automated loading functions. Besides, the company has issued free-ride cards through alliance with financial institutions, and developed smart card tickets that can concurrently serve as student ID cards as well as cards with automatic loading functions. It has further expanded its business scope, introducing smart card ticket vending machines and providing membership, mileage and discount services through alliance with convenience stores and other retail stores.

Figure 4.3. Vending machines can be used by smart card tickets

Thanks to the efforts, KSCC achieved a turnaround from a deficit in 2006 to a surplus of 14 billion Korean Won (14 million US Dollar) in net income in 2010. In particular, its efforts to penetrate into the retail business market has made appreciable progress. In 2010, the retail sector accounted for 3.6% of the company's total sales revenue, up from 1% recorded four years earlier. But the number of smart card ticket operators went down from the initial 11 to seven in 2012. The first- and second-ranked companies account for 90% of the market share, while the remaining five occupy a mere 10%.

Smart card ticket business is closely related with the everyday lives of the citizens. It is essential that the smart card ticket operators diversify their business, thereby creating profits and securing financial resources needed for stable provision of their services. When expanding the scope of their business, the operators should conduct thorough feasibility analysis of target enterprises. In addition, they should be cautioned against recklessly pursuing the same business project.

Additional effects from the introduction of smart card tickets also need to be

Figure 4.4. Single journey ticket in Seoul

considered. One of the additional effects is the reduction in costs for issuing and processing single-use tickets. The use of smart card tickets, which can be used semi-permanently, can preclude the spending of expenses for issuing and processing single-use disposable tickets. The use of smart card tickets has made it possible to save 6.5 billion Korean Won (6.50 million US Dollar) in Seoul alone in annual costs for producing single-use magnetic-striped cards.

Implementation of the smart card project has also led to a decrease in the number of ticket attendants at stations, consequentially to a reduction in labor costs. About half of the attendants have been reassigned the tasks of cracking down on free riders or enforcing safety measures at stations.

SECTION 03.

Technological Implications

1. Securing Stability and Technological Compatibility Through Enactment of Standards

By establishing relevant technology standards, Korea has secured its stability and the interoperability of smart card ticket system. The smart card ticket system is closely related to the daily lives of citizens to the extent that the number of daily smart card ticket transactions exceeds 20 million in Seoul alone. In this regard, the utmost emphasis in operating the system should be given to the maintenance of its stability. Interoperability is also an indispensable element needed to increase user convenience, particularly given the expanding geographical range of livelihood activities and the operation of a diversity of travel modes.

To ensure the stability and compatibility of smart card tickets, the government has enacted standards for smart card ticket-related devices. This move has enabled smart card ticket operators to manufacture and establish reliable devices and facilities, and to provide services in a stable manner. The government has also introduced a certification system for smart card tickets interoperability. Those seeking to establish and use smart card ticket-related devices are required to obtain certification regarding their nationwide compatibility. The standards and the certification system are basic apparatuses needed to ensure that the citizens can use the smart card ticket services conveniently.

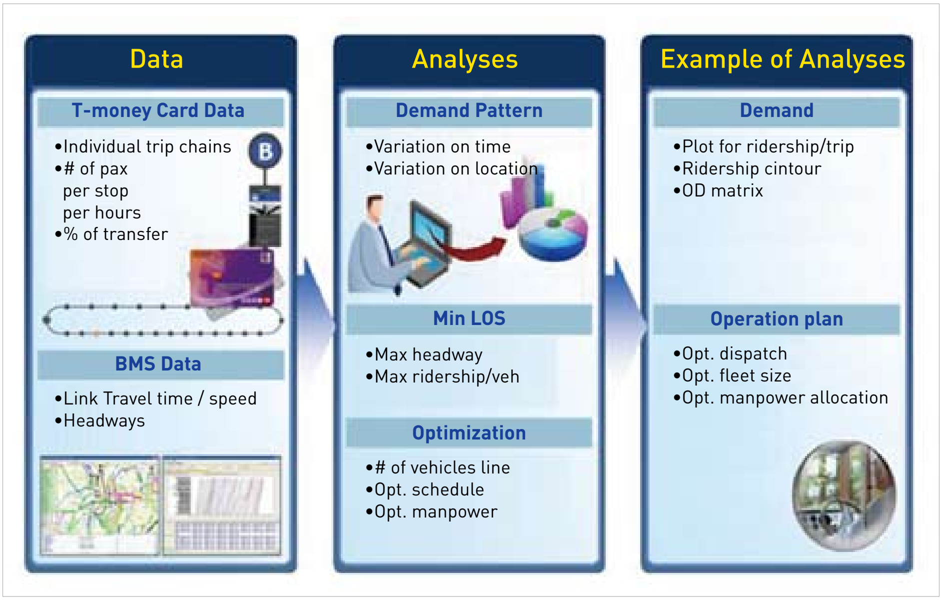
From the beginning, Seoul Metropolitan Government placed emphasis on ensuring the stability and interoperability of the smart card ticket system. The T-money card, the smart card ticket used in Seoul, has various technological features. First of all, the T-money card is a contactlress (RF) smart card that has a built-in CPU chip. The chip allows it to perform self-operating functions, unlike previous smart card tickets with an embedded memory card. Based on international standards (ISO14443 Type A/B), the card has a communication speed of 0.25sec, and is embedded with an 8K memory mode. These features allow for flexible application of transport policies. Besides, the card is capable of performing computation functions. With a built-in security algorithm that meets domestic and international standards, it cannot be copied or altered. The card has been developed in a way that it can secure interoperability through accommodation of various SAMs.[24]

2. Building and Utilizing a Database of Information on Public Transport Usage

Developing, implementing and monitoring effective transport policies requires the collection of relevant traffic data more than anything else. Data on transit use such as demand, usage by regions and hours of the day, and travel lengths are basically needed to devise effective public transport policies. It takes a lot of time and expenses to obtain information on such matters. Before the integrated smart card ticket system was implemented, questionnaire surveys were conducted to build a database of public transport statistics. However, the reliability of the data was constantly questioned.

Compared to conventional questionnaire surveys, the method of collecting data by using smart card tickets has many advantages. First of all, the method makes it

Figure 4.5. Use of smart card data for policy development



possible to obtain correct information on public transport usage in an economical way. Besides, it reduces the time needed to collect data, thus increasing their applicability. (See Table 4.2).

By using the data obtained through smart card tickets, Seoul Metropolitan Government is conducting research and developing policies on public transport. Studies carried out by using such data include "Building a Public Transport Evaluation System Based on Smart Card Ticket Data"[25] and "OD Estimation and Utilization Based on Smart Card Ticket Data."[26] Based on the results of such studies, the city government is steadily developing measures to evaluate and improve its public transport policies. As shown in the example of Seoul Metropolitan Government, it is important to foster an environment for effectively

24) SAM (secure application module, secure access module) : A secure application module installed inside a card reader. It certifies the validity of the card and the reader, codify the communication data to prevent the leaks of personal information, and authenticates and inspects communication messages. It can also store transferred electronic values.

25) Seoul Development Institute, 2007.

26) Seoul Development Institute, 2007.

utilizing the data obtained through smart card tickets.

Table 4.2. Advantages of building a database using smart card tickets

Advantages	Contents
Accuracy of data	• Increase in accuracy and reliability of the collected data
Economic feasibility of surveys	• Dramatic reduction in survey costs
Wide area coverage	• Possible to obtain data across all time zones and a wide range of areas
Shortening the survey period	• Reduction in time needed to build or obtain real-time data
Applicability of data	• Increased applicability of data in identifying travel purposes
Scalability of data	• Possible to collect a vast amount of data and expand information in the future
Safety of surveys	• Prevention of safety accidents and unforeseen circumstances

• Source: Korea Transport Institute, "A Study on Using Smart Card Ticket Data in Developing Public Transport Policies", 2006.

CHAPTER 05

Conclusion


Windows Internet Explorer

The use of public transport should be facilitated in order to increase the efficiency of urban transport and build a sustainable urban transport system. Today, relevant efforts are being exerted throughout the world. Particularly noteworthy is the application of Intelligent Transport Systems (ITS) based on the combination of the advanced information-communication technologies and public transport promotion policies.

The smart card tickets, one of the elements of the ITS, is considered a very effective tool for increasing the convenience of public transport. The smart card ticket system is in successful use in Korea and various other countries and cities, including Hong Kong and Singapore. A number of other international cities are looking to follow suit and implement their own smart card ticket projects. The smart card ticket system can be used effectively in various aspects, particularly in cities of developing countries which transport infrastructure projects are underway or anticipated.

Korea is cited internationally as a nation that is successfully operating an integrated smart card ticket system. However, it also faced various problems in the early days of its smart card ticket system, which was introduced to the nation in 1996. The problems included user inconvenience due to the lack of compatibility, capacity shortages, and partial suspension of services. The nation has exerted continuous efforts to address such problems and improve related systems based on steady monitoring of card ticket usage. In particular, the top policy-maker's commitment played a decisive role in ensuring the stable operation of the smart card ticket system. Other contributing factors include amicable adjustment of differences among stakeholders, enactment of laws and regulations to realize nationwide interoperability of smart card tickets, improvements in financial and technological aspects, and efforts to increase user convenience. All of these efforts led to the promotion of easy-to-use public transport, increased user convenience, and expansion in demand for public transport usage. In this regard, the smart card ticket project implemented in Korea offers many implications for other countries and cities seeking to build their own smart card ticket system.

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Korea's Integrated Fare and Smart Card Ticket System

The goal of this book is to offer technical information and project development history of integrated fare and smart card ticket system in Korea. Particularly Public-Private Partnership (PPP) based innovative approach was implemented to create efficient smart card ticket system. But policy implementation does not always guarantee successful outcomes and intended consequences. However, we believe that understanding what kinds of efforts were missing or why certain policy measures were not as successful as others is equally important to understand the right ingredients of a success.

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