Strategies for Developing an Intelligent Transportation Systems Industrial Base in South Korea

by

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Director, Technology and Policy Program
Abstract

Thirty years of high economic growth has transformed South Korea into a middle-income country with strengths in many promising industries. However, the government of South Korea realizes that the country must constantly push into new areas to maintain its economic growth rates and achieve its goal of joining the ranks of advanced, First World nations. With the economic emergence of China and Southeast Asia, this pressure to advance up the value chain has intensified. Thus the government has been actively seeking new growth areas that will aid in the next level of South Korea’s development.

This thesis aims to examine the prospects of the Intelligent Transportation Systems (ITS) industry as a source of growth for the South Korean economy over the coming 20 years. It investigates the industry’s potential for domestic growth as well as South Korea’s prospects for becoming a major participant in the global market for ITS equipment and integration services.

This paper discusses the arguments for various policies to encourage the development of the ITS industry. In particular, it draws on information about the latest ITS enabling technologies and South Korea’s existing data infrastructure, as well as the country’s financial constraints to analyze the feasibility of building a common ITS data transport infrastructure in the Seoul Metropolitan area. It also reviews the arguments for policies designed to develop ITS as an export industry.

The examination suggests that South Korea’s existing strengths in related technical fields, and the unique circumstances which make it an ideal test bed for new technologies, presents the country with opportunities for taking an early lead in this still developing market. In addition, the costs of funding key policies to encourage the development of ITS are well within reach for the national government, considering its financial situation.

The paper concludes that the prospects for the ITS equipment and integration market over the next two decades are bright, and that the Korean government should consider nurturing it as a potential high-growth industry. ITS should not only be viewed as a promising technology for improving the efficiency of Korea’s domestic transportation system, but as an industry that should be actively supported for its export potential.
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1 Introduction

In the past 30 years, South Korea has experienced an impressive transition from an impoverished agricultural society to a solidly middle-income country with a high-growth economy that is increasingly driven by advanced technologies.

However, the government of South Korea realizes that the country must constantly push into new areas to maintain its economic growth rates and achieve its goal of joining the ranks of advanced, First World nations.

With the economic emergence of China and Southeast Asia, this pressure to advance up the value chain has intensified. Thus the Korean government has been actively seeking ways to develop the economy to advanced country levels and transform the country into a major economic hub of East Asia.

As an initial step towards these goals, the South Korean government has commissioned research by various ministries to look for what it has dubbed "Vision Industries," that is, technologies that have good prospects for high growth in the coming 15-20 years. In addition, it has put forth an assertive Intelligent Transportation System (ITS) Master Plan as part of a broad initiative to raise the country’s competitiveness.

This paper will argue that the prospects for the ITS equipment and integration market over the next 15 to 20 years is bright, and that the Korean government should consider nurturing it as a potential high-growth industry. ITS should not only be viewed as a promising technology for improving the efficiency of Korea’s domestic transportation system, but as one of the "Vision Industries" that should be actively supported for its export potential.

In addition, we will argue that ITS also represents an industry with strong prospects for spurring exports and further development in other, related high-tech fields—particularly when South Korea’s existing strengths in related fields and the unique circumstances which make it an ideal test bed for new technologies are considered.

Section 1 begins with an overview of South Korea’s road and transportation network conditions. It then outlines the drivers for implementing ITS Technologies in South Korea.

Section 2 outlines the case for the implementation of a national ITS infrastructure, including an examination of the economic feasibility of such an implementation. Automatic Red Light Enforcement system deployment (which would address safety—a major driver for ITS implementation in Korea) is examined as an example of an ITS service that a national infrastructure would enable. Its economic feasibility as well as direct benefits received are detailed.

Section 3 discusses the importance of exports to the Korean economy, and details the attributes that make the global ITS equipment and integration market an attractive one for Korea. It also discusses the challenges Korea faces in becoming a major player in this market.

Section 4 reviews examples from the recent past which provide evidence that the government, through various incentive policies, can help Korean industry overcome the hurdles they face.

Finally, the paper concludes with suggested strategies for how to facilitate the implementation of a national ITS infrastructure and develop the ITS export industry in light of the current conditions in Korea.
1.1 Summary of Current Conditions

1.1.1 Geography / Road Network
With one-third of its 100,000 square kilometer area covered by mountain ranges and a population of 48 million, The Republic of Korea has one of the world's highest population densities. The country has 80,000 kilometers of highways, including 1900 kilometers of expressways. As of December 2002, there were 13 million registered vehicles, a number that is expected to surpass 20 million by 2010. The Seoul Metropolitan Region comprises 12,000 square km (roughly 1/8th of the country's total area) and is home to 23 million or roughly 50 percent of the total population.

1.1.2 Travel Demand and Mode Shares
Automobile ownership and personal incomes briefly declined during the Asian financial crisis in 1998, but a strong recovery since then has continued to push private auto travel demand upwards.

Trends in Private Automobile Ownership

![Trends in Private Automobile Ownership](image)

- Total number of vehicles, current and predicted
- • private cars
- ▲ vehicles per 1000 households, current and predicted
- ○ vehicles per 1000 population.

Source: Modified from Nelson, 1998
Private automobiles have taken mobile share primarily from buses and taxis. An efficient and expanding subway system has continued to gain share and is becoming the dominant mode of travel within the capital city. It however has failed to halt the increasing use of private automobiles, gaining most of its increased ridership from the bus system.

The bus system, while extensive, is poorly organized. There is little oversight of the operators, and many switch over to other routes without permission, leaving approximately one-quarter of the routes underserved. The city government sets fares and allocates routes to private operators.

1.2 Drivers for the Implementation of ITS Technologies in South Korea

1.2.1 Congestion

Despite massive investments in (insert figures) transportation infrastructure, the costs of congestion are high, particularly in and around the capital region, and are increasing sharply. As of 2000, estimated costs due to congestion across South Korea were 19 trillion won (roughly $17 billion USD), or nearly 4% of GDP. Despite a sharp drop in 1998 due to the economic crisis that swept the Asia Pacific region that year, congestion costs have risen an average of 18% per year during the 1990’s. (Kim & Ahn, 2001)

<table>
<thead>
<tr>
<th>Congestion Costs</th>
<th>'91</th>
<th>'92</th>
<th>'93</th>
<th>'94</th>
<th>'95</th>
<th>'96</th>
<th>'97</th>
<th>'98</th>
<th>'99</th>
<th>2000</th>
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</thead>
<tbody>
<tr>
<td>Total</td>
<td>4,564</td>
<td>6,242</td>
<td>8,579</td>
<td>10,027</td>
<td>11,565</td>
<td>15,920</td>
<td>18,539</td>
<td>12,193</td>
<td>17,113</td>
<td>19,448</td>
</tr>
<tr>
<td>Rural</td>
<td>1,658</td>
<td>2,480</td>
<td>3,563</td>
<td>4,274</td>
<td>5,165</td>
<td>7,174</td>
<td>8,028</td>
<td>5,102</td>
<td>7,635</td>
<td>8,299</td>
</tr>
<tr>
<td>Metro</td>
<td>2,906</td>
<td>3,762</td>
<td>5,015</td>
<td>5,753</td>
<td>6,400</td>
<td>8,346</td>
<td>10,511</td>
<td>7,091</td>
<td>9,487</td>
<td>11,149</td>
</tr>
<tr>
<td>GDP (Trillion Won)</td>
<td>216.5</td>
<td>245.7</td>
<td>277.5</td>
<td>323.4</td>
<td>377.3</td>
<td>418.5</td>
<td>453.3</td>
<td>449.5</td>
<td>483.8</td>
<td>517.1</td>
</tr>
<tr>
<td>% of GDP</td>
<td>2.11</td>
<td>2.54</td>
<td>3.09</td>
<td>3.10</td>
<td>3.07</td>
<td>3.80</td>
<td>4.09</td>
<td>2.71</td>
<td>3.54</td>
<td>3.76</td>
</tr>
</tbody>
</table>

1.2.2 Safety

The increased crashworthiness of newer model automobiles combined with stricter traffic enforcement and increased driver education has resulted in decreased fatality rates in recent years. However, they remain at very high levels. There are nearly 300,000 accidents per year which kill more than 12,000 motorists and injure 350,000 more, giving South Korea one of the highest traffic related accident rates in the world.

Traffic accidents and casualties in Korea.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidents</td>
<td>37,243</td>
<td>120,182</td>
<td>253,303</td>
<td>248,865</td>
<td>265,052</td>
</tr>
<tr>
<td>Fatalities</td>
<td>3069</td>
<td>5608</td>
<td>12,325</td>
<td>10,323</td>
<td>12,653</td>
</tr>
<tr>
<td>Injuries</td>
<td>42,830</td>
<td>111,641</td>
<td>324,229</td>
<td>331,747</td>
<td>355,962</td>
</tr>
</tbody>
</table>

In 1998, direct costs related to these accidents (i.e. excluding adjustments for pain, grief, and suffering, PGS) were 6.7 Trillion Won ($5.8 Billion USD) or 1.5% of GDP. (Lee & Park, 1999)

In addition to the humanitarian aspects of reducing accident rates, controlling the significant economic costs associated with road accidents have become a priority for transportation policy planners in South Korea.

Thus the drivers for implementing ITS in Korea are similar to other regions and countries. In particular, the rapidly rising costs related to congestion and traffic accidents (both in absolute amount and as a percentage of GDP) are growing concerns for South Korean policymakers.
2 The Case for a National ITS Data Infrastructure

In this section, we examine the case for the government-led implementation of a national ITS infrastructure. We first define the components which make up an ITS data infrastructure and what functionality they would enable. We then discuss the benefits of a common ITS data architecture. The feasibility, both technical and economic, of implementing such a system in the Seoul area is discussed. The section concludes with a discussion of the benefits and costs of Automatic Red Light Enforcement deployment in Seoul—an example of what a national ITS infrastructure can enable.

2.1 The Key to Korea’s ITS Industry Development

2.1.1 ‘ITS Infrastructure’ Defined

We define ‘ITS Infrastructure’ as a common data transport network based on open, well-known technical standards and protocols, that allows disparate devices to connect and transfer information (needed to enable ITS services) to/from other nodes on the network.

Such a system could be based on wired infrastructure, wireless equipment, or a combination. It would run well-defined protocols such as TCP and IP to interconnect various ITS components such as digital cameras, dynamic navigation devices, and roadside sensors.

In our definition, “ITS infrastructure” also implies the existence of a sensor network (connected to the data network) which supplies data which users of the infrastructure can access to enable their services. We will assume that the existing CDMA wireless data network (CDMA 2000 1x standard) will act as the primary backbone for carrying ITS-enabling traffic data.

We will further assume that a network of automated video image detection systems (VIDS) will be used to perform the sensing and data collection for the national ITS infrastructure. Although nearly 3 times as expensive and traditional analog technologies, these systems provide the most flexible platform for government agencies and private operators to develop their services.

As the ITS technology overview at the California PATH program brings out, video image detection systems (VIDS) work with digital Closed Circuit Television (CCTV) cameras to automatically analyze traffic data. They can be used to monitor freeway, arterials and intersections, and provide data that can enable a variety of functions:

- Rapid incident detection.
- Identification of the incident type, the level of gravity and what type of intervention is needed if any. (Mostly done by human operators currently, but software advances are increasingly enabling automation of interpretation as well. Digital systems allow easy upgrades as new software upgrades are released.)
- Vehicle classification, intersection monitoring, signal actuation and license plate reading. These features can be used for enforcement (including automatic red light enforcement) as well as travel time predictions by private ATIS operators.
• Surveillance data could be used not only for safety but also for transportation planning, 
  operations and research.

• Integration with other technologies such as variable message signs and adaptive ramp 
  metering control as they are rolled out.

2.1.2 General Benefits

Assessing the benefits and costs associated with ITS implementations is challenging because in many 
cases, the information simply is not available. Often this is because the systems have not been widely 
implemented yet, but issues such as difficulties in collecting the “willingness-to-pay” information 
necessary for complete benefit-cost analysis play a role. (Gillen, Lee, Dahlgren. 1999)

However, we know that benefits of ITS exist. Broadly defined, they include improvements in the 
following areas:

• Safety
• Efficiency
• Accessibility and mobility
• Productivity
• Environmental protection and energy consumption

In addition, there are additional, intangible benefits (e.g. increased comfort level from knowing the level 
of delay that can be expected) which are more difficult to measure.

Acknowledging that ITS implementation would play a key role in addressing these concerns, the central 
government coordinated development of the Korean National ITS Master Plan (approved in 1997 after 
three years of development), which outlines a target schedule for the nationwide deployment of ITS in 
Korea.

However, the lack of common infrastructure standard has led to incompatible systems and 
fragmented markets.

A National ITS Infrastructure would provide a common, standardized platform for private industry to 
enable the systems needed to address Korea’s traffic safety and congestion concerns.

Several high profile private-sector ventures have been put on hold due to the prohibitive costs involved in 
building an ITS data infrastructure. (Examples include extensive ATIS services planned by a 
LG/Hyundai joint venture and a Samsung/Korea Telecom partnership.) A government initiative to build 
a National ITS Infrastructure would remove this key barrier to local firms developing ITS components 
and services.

Implementation of an ITS infrastructure also will help to strengthen key industries by providing another 
market for their products and helping them to keep abreast of the latest applications of its technologies.
The existence of a common infrastructure will encourage private industry to invest in ITS and continue to 
refine its products, helping to build a competitive domestic industry.
A competitive domestic ITS industry will in turn benefit other key industries. An example of a key industry that stands to benefit from ITS implementation in Korea is the nation's up-and-coming auto industry. The global automobile industry, and Korea's manufacturers in particular, have identified Telematics, a form of traveler information systems, as a source of future growth. Viewing it is a potential steady revenue stream and a way to maintain contact with the subscriber after the initial sale transaction, Korea's automakers have been making active investments in this field (particularly Hyundai-Kia, which dominates 70% of the local market, through its new subsidiary Hyundai Autonet). A national ITS infrastructure would allow domestic manufacturers to develop and refine Telematics devices and services so that they will be competitive when the global market for such products develops.

In this manner, the Korean government, by investing in ITS research and pilot projects, will be supporting further skill accumulation and development in related key industries.

2.1.3 Directly Measurable Benefits

In this section, we will focus on the 'direct' benefit of congestion reduction to gain a sense of the extent to which directly measurable benefits (of the services an ITS infrastructure would enable) may offset the costs involved in implementing ITS technologies.

Congestion reduction is a good measure to focus on for a couple of reasons—1. The Korean ITS plan at its core focuses on ATIS, and 2. congestion reduction (along with increased travel time reliability) is seen as a major benefit of ATIS.

Kim & Ahn (2001), in the Korea Transport Institute’s annual study of congestion costs in South Korea, details the breakdown of the estimated 19.5 Trillion Won ($17 Billion USD) cost in 2000:

Of the total, 57% or 11.1 Trillion Won (57%, US $9.7 Billion) was due to congestion on intra-city roads. Congestion in the capital city of Seoul accounted for approximately $4.1 Billion USD.

Two types of direct costs were combined to arrive at this total cost of $4.1 Billion:
- The fixed and variable costs related to operation of the vehicle.
- Cost arising from lost time. This cost accounted for US $2.3 Billion, which represents 56% of the total congestion costs in Seoul. (Kim & Ahn, 2001, p 27, Table 8)

ATIS can help reduce this $2.3 Billion figure in two ways:
1. Time savings due to reduced congestion
2. Time savings by enabling business commuters to work in vehicle using e-mail and other productivity tools.

Thus, every 1% reduction in time lost due to congestion represents a US$23 Million savings per year. Thus a 12% reduction (from a combination of number 1 and 2) in congestion alone, if it can be achieved, would in essence offset the entire cost of maintaining the infrastructure.

Thus modest improvements in congestion and safety can help noticeably offset the direct financial costs of implementing. When consider with other benefits outlined in this paper, it is clearly worth pursuing.
2.2 Feasibility of Implementation

2.2.1 Technical Strengths

Because of its strength in related enabling technologies, South Korea possesses unique advantages in implementing ITS.

The technologies and skills involved in ITS deployments are a mixture of those involved in promising fields such as wireless communications, liquid crystal and plasma displays, and software designed to integrate disparate systems (so called “middleware”) among others.

South Korea's relative strength in these areas provides an additional reason for the government to invest in ITS because they give Korea a potential advantage over many other countries in the implementation of ITS. For example, an extensive CDMA wireless network (with near 100% coverage in the capital area) is already in place. This gives Korea a significant cost advantage as well as the ability to implement a data ‘infrastructure’ much more quickly than other countries which must either install landlines (which are costly and take longer to install) or extend existing wireless networks to provide full coverage.

In addition, Korean firms have leveraged this wireless network to build an extensive mobile content distribution network. It is currently used to distribute train and bus schedules, news clips, and games to various mobile devices. It also supports interactive activities such as multiplayer gaming, simple commerce (movie ticket purchases, bank fund transfers, and messaging.) This same network, which is based largely on common software standards can be leveraged to deliver ATIS (navigation, traffic conditions, news flash info) information.

2.2.2 Economic Feasibility

In this section, we will examine the economic feasibility of implementing a National ITS Infrastructure in the Seoul Metropolitan area. Approximately one-half of the population and nearly two-thirds of the economic activity in South Korea are concentrated in the capital region, making it a natural focal point for ITS projects.

We will estimate the cost involved in implementing an ITS infrastructure in the Seoul Metro Area to assess its economic feasibility considering the budget constraints the local and national governments face. We will not attempt to rank implementation in relation to other ITS or general investments.

Cost Summary

- Length of roads in metro area: 7933km
- To enable services outlined in Korean ITS Master Plan, one sensor required every 0.8 km
- # of required sensors: Approximately 10,000
- Cost (capital) of digital video camera/sensors: $10,000 - $30000; Maintenance: $100 - $300 / month
- Mounts: $20,000-30,000; Maintenance: $200-$400/month

(Sources: U.S. Department of Transportation, ITS Benefits and Unit Costs Database, Ministry of Construction and Transportation Statistics Yearbook 2002)
### Capital Costs

<table>
<thead>
<tr>
<th>Type of Equipment</th>
<th># of units needed</th>
<th>Cost Per Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Video Camera / Sensors (20 year life; Includes communications equipment to interface with national CDMA wireless network)</td>
<td>10000</td>
<td>$10,000 - $30,000</td>
<td>$100 - $300 million</td>
</tr>
<tr>
<td>Mounts (20 year life)</td>
<td>10000</td>
<td>$20,000 - $30,000</td>
<td>$200 - $300 million</td>
</tr>
<tr>
<td><strong>Total Capital Cost</strong></td>
<td></td>
<td><strong>$300 - $600 million</strong></td>
<td></td>
</tr>
</tbody>
</table>

### O&M Costs

#### Transmission costs

<table>
<thead>
<tr>
<th>Frequency of updates required to enable services outlined in Master Plan</th>
<th>Volume of data transferred per update</th>
<th># of updates required per year per camera</th>
<th>Total # of cameras</th>
<th>Total volume of data transmitted per year</th>
<th>Cost per Byte transmitted</th>
<th>Total Yearly Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 updates / minute</td>
<td>2 Kbytes</td>
<td>3.1 million</td>
<td>10,000</td>
<td>62 Terabytes</td>
<td>0.22 cents per 512 bytes</td>
<td><strong>$263 million</strong></td>
</tr>
</tbody>
</table>

#### Maintenance Costs

<table>
<thead>
<tr>
<th>Type of Equipment</th>
<th># of units needed</th>
<th>Maint. Cost Per Unit per year</th>
<th>Total Cost (per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameras (20 year life)</td>
<td>10000</td>
<td>$1200 - $3600</td>
<td>$12 - $36 million</td>
</tr>
<tr>
<td>Mounts (20 year life)</td>
<td>10000</td>
<td>$2400 - $4800</td>
<td>$24 - $48 million</td>
</tr>
</tbody>
</table>

**Total Maintenance Costs**  
**$36 - $84 million**

**Total Operations and Maintenance Costs**  
**$299 - $347 million / year**

### Notes:

- An exchange rate of 1150 Won per US dollar was used to convert all Korean currency values.
- Carriers’ retail pricing (as of mid-year 2003) was used to calculate transmission costs.
- Equipment costs source: U.S. Department of Transportation, ITS Benefits and Unit Costs Database

This is a conservative estimate. Actual costs likely to be lower for several reasons:

- Used retail pricing in calculations. Wholesale tariffs will be lower:
  - Carriers’ wireless data business are currently profitable
  - Their marginal costs will continue to drop as additional data is carried
  - Carriers currently have large amounts of excess data capacity
• Equipment costs will likely drop as volumes increase and digital video technologies continue to develop.
• The figure for the # of cameras needed is likely an overestimate. Considering that the 'total km of road in Seoul' figure includes many minor side roads, effective ITS systems are likely possible with fewer cameras.

Obtaining new funding for any project is challenging, but the calculations show that rollout of a common ITS data infrastructure in the Seoul Metro area is economically feasible. The estimated capital costs of $300 - $600 million represent roughly 4-8% of the Ministry of Construction and Transportation’s 2002 infrastructure build / improvement budget. Assuming a 3 year timetable for full implementation, capital costs represent 1-2.5% of the MOCT’s annual infrastructure budget over the 3 year period.

The cost per kilometer of building new road is roughly US $8 million. The cost to build an ITS Data Infrastructure in Seoul with a 20 year life expectancy is equivalent to the cost of building approximately 35 – 75km of new road. Thus the capital required to expand the existing system by 0.5 – 1% is sufficient to build out an infrastructure which can improve the efficiency and safety of Seoul’s entire 7700km network.
2.3 Automated Red Light Enforcement - Example service enabled by National ITS Infrastructure

In this section we examine Automated Red Light Enforcement (ARLE)—a safety-enhancing service that could be implemented over the envisioned ITS data infrastructure.

As Sussman (1997) brings out, ARLE is a good candidate as a first service to be rolled out city-wide for several reasons:
- It is a safety-oriented system, which has a high level of support among the general population.
- It generates revenues through ticketing of offenders, which helps cover operating costs (In several implementations, private operators have assumed all capital and O&M costs, in exchange for a large share of revenues.)
- It is relative ‘standalone’ in that a partial rollout in one part of a region can still be effective (i.e. it does not require a system-wide deployment before major benefits can be achieved)

The following sections outline the cost of implementing and operating ARLE across the city of Seoul. This information is then used to examine the economic feasibility of a city-wide implementation given the Ministry of Construction and Transportation’s budget and overall financial situation. The final section concludes with a review of the magnitude of potential benefits (in the form of reduced accident costs) of an ARLE system.

2.3.1 Economic Feasibility

<table>
<thead>
<tr>
<th>Cost Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Red-Light Enforcement Camera</td>
<td>$60,000</td>
</tr>
<tr>
<td>Installation plus related detectors, equipment cabinet, pole, etc.</td>
<td>$25,000</td>
</tr>
<tr>
<td>CDMA 2000 1x transmitter</td>
<td>$500</td>
</tr>
<tr>
<td>Monthly operation and maintenance</td>
<td>$5000 / mo</td>
</tr>
</tbody>
</table>

Source: U.S. Department of Transportation, ITS Unit Benefits and Unit Costs Database

<table>
<thead>
<tr>
<th>Telecommunication Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission costs per picture: 150Kbytes * 2.6 Won per Kbyte = 390 Won ($0.34 USD / picture)</td>
</tr>
<tr>
<td>150Kbytes – approximate file size for picture with resolution of 1024x768 with 16bit color depth in JPEG file format.</td>
</tr>
<tr>
<td>Peak hour transmission charges (2.6 Won per Kbyte) over South Korea’s existing CDMA (2000 1x) network were used.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capital Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td># of major intersections in Seoul:</td>
</tr>
<tr>
<td>Required camera setups: 520 intersections x 4</td>
</tr>
</tbody>
</table>
camera setups per intersection

| Total startup cost = 2080 x Cost of (Camera, Installation, Related equipment, CDMA transmitter) = 2080 x ($85,500) | $178 Million USD |

Source: Seoul Metropolitan Police Association website www.spatic.go.kr

**Operation and Maintenance Costs**

| 2080 installations x $60,000 per year | $125 Million USD / year |

In typical implementations however, ‘dummy’ cameras are used along with functioning units to reduce costs while maintaining the same level of effectiveness. Thus one-third to one-half the number of cameras (calculated in the previous section) will likely be sufficient to cover the Seoul Metropolitan area. This would imply capital costs of approximately $60 million - $90 million USD and O&M costs of $40 - $65 million USD per year.

### 2.3.2 Direct Benefits

**Accident Reduction**

Two methods—the ‘Human Capital’ method and the ‘Comprehensive’ approach-- are generally used to measure the cost of crashes. (Victoria Transport Policy Institute, 2000). The Human Capital approach measures only the direct market costs (property damage, medical costs, lost productivity). The Comprehensive method adds costs such as pain, grief and suffering (PGS) and reduced quality of life.

The Comprehensive method better measures the true cost to society of crashes. However, properly measuring these non-economic costs depends on accurate Willingness-to-Pay (WTP) information (e.g. willingness-to-pay for an incremental increase in safety). This information is difficult to obtain, particularly for developing countries such as South Korea. Thus Lee and Park (1999) use the Human Capital method to estimate the cost of traffic accidents and fatalities. Since this method excludes PGS, for us, these figures represent a conservative figure for the cost of accidents in Korea.

- 250 Million Won (US $217,000) per fatality, excluding PGS
- 26 million Won (US $22,600) per serious accident
- 8.4 million (US $7300) won per light accident

<table>
<thead>
<tr>
<th>Accident Type</th>
<th>Frequency per Year</th>
<th>Nationwide Yearly Cost (US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>9000</td>
<td>$1.9 Billion</td>
</tr>
<tr>
<td>Serious injury</td>
<td>157,000</td>
<td>$3.5 Billion</td>
</tr>
<tr>
<td>Light injury</td>
<td>177,000</td>
<td>$1.3 Billion</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$6.7 Billion</strong></td>
</tr>
</tbody>
</table>

(Adapted from Lee, Park 1999 - Table #2)

**Revenues**

Ticketing violators produces a revenue stream that helps defray the costs of this service. Governments
around the world have entered into various revenue-sharing agreements with private operators. (where in some cases private operators assume 100% of the capital and O&M costs in exchange for a share of revenues) This has helped Automatic Red Light Enforcement become one of the most widely implemented and successful ITS services. A similar arrangement could easily be implemented in Seoul as well, further reducing the outlays needed to implement ARLE.
3 The Case for Developing ITS as an Export Industry

This section provides a review of Korea’s Post-World War II development, which highlights the importance of historical and present importance of exports to the country’s economy. It then discusses the specific drivers for developing ITS as an export industry.

3.1 The Importance of Exports – Korea’s Post-World War II Development

3.1.1 1945 – 1962 Liberation from Japanese Colonial Rule; The Korean War
During Japan’s 35 year occupation of Korea (1910-1945), technological and economic development was suppressed. Approximately 95% of manufacturing capital was held by the Japanese, and only 11% of technicians in the manufacturing field were locals. Thus technical skill formation during this period was minimal.

After liberation from Japanese colonial rule at the end of World War II, the U.S. began occupation of what is now the Republic of Korea, and the country slowly began to gain exposure to Western ideas and values. However, when the country was divided into North and South Korea, South Korea was left with a minimal industrial base. Most manufacturing infrastructure was located in the North, which had 90% of the country’s electric power generating capability and 75% of its coal and iron. The three year Korean War (1950 - 1953) left the country blighted, and destroyed the little industry that remained. Starvation, even among the middle classes was common. In the 10 years following the war (’53 - ’62), the country was heavily dependant on U.S. aid. Agriculture and the light industries such as textiles, which made up the bulk of the country’s remaining industry were insufficient to sustain the country. Its citizens, under-educated and under-fed, struggled simply to survive.

In 1961, Jung-Hee Park took power via a coup d’etat. The Park administration focused the country on a series of 5-year plans designed to build an economy around, first, exports of labor-intensive sectors such as textiles, then capital-intensive industries such as automobiles, steel, petrochemicals, shipbuilding.

3.1.2 1963 – 1972 The Beginning of Korea’s Export Drive
Realizing that The Republic of Korea’s miniscule domestic market held little potential but that the country had a relatively well-trained and entrepreneurial workforce, the Park administration initiated an export-led industrialization strategy in 1961. As (Seong, 1998) outlines, a series of policy reforms were implemented:

- **Currency depreciation** - In 1964, the South Korean Won was devalued, from 130 won per dollar to 255 won per dollar to spur exports. Later, in 1965, a limited floating exchange rate was implemented.
- **Encouraged savings through interest rate increases** - In 1965, interest rates on bank deposits were raised sharply (from 15% to 30% on 1 year CD’s) to encourage savings. At the same time, rates on loans to consumers were raised to the 26-30% range. These moves had the effect of encouraging savings, but discouraging domestic consumption. This allowed the government to mobilize the country’s limited capital toward export-oriented activities through preferential loans.
- **Strengthened government control over finance** - As part of the 1965 reforms, the government nationalized all commercial banks and established other State-owned banks. This allowed the
government to closely monitor the progress of industrial investments and export performance.

- **Export credit subsidy** - The government extended subsidized credit to exporting firms. It also provided this subsidized credit for international purchases of raw and intermediate goods to be used in the manufacture of export products, as well as the purchase of export-oriented products from local sources.

Restricting this type of support to companies that exceeded certain export targets forced export companies to compete vigorously with each other and international companies to obtain a share of the subsidies. This turned out to be an effective method of allocating to deserving firms, while minimizing the risks of corruption and favoritism associated with government-led subsidy policies.

South Korea's economic progress during the 1963-1972 period was quite impressive. GNP growth averaged more than 9% per year, with manufacturing growth averaging 18% during the period. The proportion of manufacturing output to GNP rose to 26%, more than double the 11% recorded in 1963. At $310, per-capita GNP more than doubled (in real terms) during the 10 year period. This period represented the first steps in a move towards a more industrialized society that would accelerate over the next 30 years.


<table>
<thead>
<tr>
<th>Year</th>
<th>Export growth</th>
<th>GDP growth</th>
<th>Wholesale price index</th>
<th>Per capita GNP (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963</td>
<td>9.0</td>
<td>9.1</td>
<td>19.0</td>
<td>100</td>
</tr>
<tr>
<td>1964</td>
<td>23.5</td>
<td>9.6</td>
<td>34.9</td>
<td>103</td>
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<tr>
<td>1965</td>
<td>35.9</td>
<td>5.8</td>
<td>10.3</td>
<td>105</td>
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<td>1966</td>
<td>42.4</td>
<td>12.7</td>
<td>8.6</td>
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<td>8.1</td>
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<td>1969</td>
<td>36.1</td>
<td>13.8</td>
<td>6.9</td>
<td>219</td>
</tr>
<tr>
<td>1970</td>
<td>19.6</td>
<td>7.6</td>
<td>9.4</td>
<td>252</td>
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<td>1971</td>
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<td>10.8</td>
<td>318</td>
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<td>9.9</td>
<td>395</td>
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<td>42.1</td>
<td>540</td>
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<td>590</td>
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<tr>
<td>1976</td>
<td>31.6</td>
<td>14.1</td>
<td>12.2</td>
<td>797</td>
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<tr>
<td>1977</td>
<td>27.6</td>
<td>12.7</td>
<td>9.0</td>
<td>1008</td>
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<td>-3.8</td>
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<td>18.6</td>
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<td>5.2</td>
<td>38.9</td>
<td>589</td>
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<td>6.2</td>
<td>20.4</td>
<td>1719</td>
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<td>1982</td>
<td>6.2</td>
<td>5.6</td>
<td>4.7</td>
<td>1723</td>
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<td>1983</td>
<td>13.8</td>
<td>9.5</td>
<td>0.2</td>
<td>1914</td>
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<td>8.1</td>
<td>7.5</td>
<td>0.7</td>
<td>2044</td>
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<tr>
<td>1985</td>
<td>2.1</td>
<td>5.4</td>
<td>0.9</td>
<td>2242</td>
</tr>
<tr>
<td>1986</td>
<td>36.6</td>
<td>12.5</td>
<td>-1.3</td>
<td>7568</td>
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<td>1987</td>
<td>36.2</td>
<td>12.3</td>
<td>0.5</td>
<td>3218</td>
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<tr>
<td>1988</td>
<td>12.8</td>
<td>12.0</td>
<td>2.7</td>
<td>4295</td>
</tr>
<tr>
<td>1989</td>
<td>16.3</td>
<td>6.9</td>
<td>1.5</td>
<td>5210</td>
</tr>
<tr>
<td>1990</td>
<td>14.4</td>
<td>9.6</td>
<td>4.2</td>
<td>5833</td>
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<tr>
<td>1991</td>
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<td>5.4</td>
<td>6759</td>
</tr>
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<td>1992</td>
<td>2.9</td>
<td>5.0</td>
<td>2.3</td>
<td>7007</td>
</tr>
<tr>
<td>1993</td>
<td>3.4</td>
<td>5.8</td>
<td>1.5</td>
<td>7446</td>
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<tr>
<td>1994</td>
<td>13.8</td>
<td>8.4</td>
<td>2.7</td>
<td>8483</td>
</tr>
<tr>
<td>1995</td>
<td>30.3</td>
<td>8.7</td>
<td>4.7</td>
<td>10076</td>
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<td>1996</td>
<td>3.7</td>
<td>6.9</td>
<td>3.3</td>
<td>11380</td>
</tr>
<tr>
<td>1997</td>
<td>5.0</td>
<td>5.0</td>
<td>3.8</td>
<td>16307</td>
</tr>
<tr>
<td>1998</td>
<td>-2.0</td>
<td>6.7</td>
<td>12.2</td>
<td>6742</td>
</tr>
<tr>
<td>1999</td>
<td>8.6</td>
<td>10.7</td>
<td>2.1</td>
<td>8581</td>
</tr>
</tbody>
</table>

Source: Korea Development Institute, Major Indicators of the Korean Economy
3.1.3 1973 – 1979 Heavy and Chemical Industry Drive

In 1973, President Park announced a shift away from general export promotion to a focus on the heavy and chemical industries (HCI). The administration targeted the shipbuilding, automobile, steel, and petrochemical industries during this period.

The government began by reducing the scope and magnitude of benefits that had been given to exporters during the '62-'73 period. The Tax Exemption and Reduction Control Law of 1975 gave 5-year tax holidays and investment tax credits, among other benefits, to these favored industries.

Because the targeted industries were highly capital intensive and domestic savings were still very limited, the government turned to foreign capital. To compensate for domestic companies' poor international creditworthiness, the government guaranteed loans (approved by the government) taken out by companies, whether public or private, in the target industries.

Skilled scientists and engineers from abroad were actively recruited. In particular, outstanding Korean engineers and scientists in each designated field were recruited and supported with modern research facilities. Networks with local professors and industries researchers were set up to encourage collaboration.

Technical high schools and colleges were expanded, and investments made to improve their quality to address the severe shortage of skilled personnel.

As a result of these efforts, the HCI share of export production rose from 7% in 1970 to nearly 20% in 1980. Particularly successful were the electronics, steel, and shipbuilding industries.

Side effects of this strong interventionist policy eventually became evident however. The sudden influx of capital into the small economy spurred inflation, which was aggravated by the two oil shocks in 1973 and 1979. However, the HCI push successfully moved the economy away from producing labor-intensive industries such as textiles and wigs and toward higher value-added goods.


The government's policies in the early 1980s were focused on containing the inflation that had cropped up as a result of the oil shock in 1979 and the rapid increase in the money supply brought on by its expansionist policies in the 1970s. The HCI drive was deemphasized and government spending was reigned in. In addition, the government made its first efforts at improving capital allocation by reducing its interventionist policies. It sold to the private sector many of the commercial banks established in the 1960s and abolished most of its preferential lending programs.

These anti-inflationary policies were largely successful. They reigned in inflation, which threatened to spiral out of control, in exchange for relatively lower growth.

<table>
<thead>
<tr>
<th>Year</th>
<th>Wholesale Price Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>'80</td>
<td>39%</td>
</tr>
<tr>
<td>'81</td>
<td>20%</td>
</tr>
<tr>
<td>'82</td>
<td>4.7%</td>
</tr>
<tr>
<td>'83</td>
<td>0.2%</td>
</tr>
<tr>
<td>'84</td>
<td>0.7%</td>
</tr>
</tbody>
</table>
GDP Growth | -5.2% | 6.2% | 5.6% | 9.5% | 7.5%
Source: (Seong, 1998)

Thanks to favorable external conditions (low Won vs. the Japanese Yen, low international interest rates, and low international oil prices— the so-called "three lows") the Republic of Korea enjoyed an economic boom from 1986 to 1988. GDP growth was in the double digits with inflation in the low single digit range. In addition, the country experienced a large export boom.

<table>
<thead>
<tr>
<th></th>
<th>86</th>
<th>87</th>
<th>88</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP Growth</td>
<td>12.5</td>
<td>12.3</td>
<td>12.0</td>
</tr>
<tr>
<td>Inflation</td>
<td>-1.5</td>
<td>0.5</td>
<td>2.7</td>
</tr>
<tr>
<td>Export Growth</td>
<td>27</td>
<td>36</td>
<td>13</td>
</tr>
</tbody>
</table>
Source: (Seong, 1998)

In the mid-1980s, the government began its import liberalization program, with only restrictions on primary products and foods/beverages remaining by the end of 1988. Average nominal tariffs (not adjusted for the volume of each good imported) was reduced from 24 percent in 1983 to 13 percent in 1989.

By the mid-1990s, the Republic of Korea had developed a mid-size, trade dependent economy that was open to external shocks. While the government had moved away from an explicit industrial policy, it continued to possess several key control mechanisms. For example, it still controlled several large banks, and dictated who could enter and exit certain industries through various licensing schemes. In addition, by repeatedly providing bailout funds, it seemed to be implicitly guaranteeing all the loans of large conglomerates (called "Chaebol") which dominated the country's export economy. With little worries of the government letting them become insolvent, the Chaebol became very aggressive in luring foreign capital (a large percentage of which was short-term) to invest in overly ambitious projects.

By 1996, the average debt-to-equity ratio of the Top 30 chaebol reached nearly 390 percent, with several lower tier companies having debt-to-equity ratios above 2000 percent and continuing to accumulate losses. However, financial institutions, under pressure from the government, continued to provide credit to these companies.

3.1.5 1997 – 2002 Debt crisis; Forced restructuring sows seeds for further growth.

A year later in 1997, the Top 30 chaebol had an average debt-to-equity ratio of 519 percent, as their profitability continued to decline. These high debt levels coupled with the downturn in the economy which followed the financial crisis that swept across Asia later that year, pushed the Republic of Korea into a debt crisis.

On news that the country had accepted a $48 billion bailout loan to replenish its foreign exchange reserves which had dwindled to nearly zero, speculators and panicked local and foreign investors drove the Korean Won down to a low of 1995 Won per dollar, less than half the 750-800 Won per dollar range it had been trading in previous to the bailout.

As a condition of providing the loan, the government was forced to raise interest rates to the 18 percent
level (1 year time deposits). The combination of high interest rates, depressed demand, and a paralyzed banking system sent the economy into turmoil.

Asset prices dropped sharply, with asking prices on residential real estate dropping by 30-50% but finding no buyers. Financial institutions’ capital adequacy ratios were decimated as large quantities of loans turned sour. Sales of many durable goods such as automobiles fell by 50% or more. Unemployment peaked at 8.7%, a level unseen since the country began its industrialization drive in the 1960s.

The government responded to this crisis with drastic measures. The agreements for reform signed with the International Monetary Fund provided a measure of political cover for the new president Dae-Jung Kim to push through many reforms. These reforms helped set the stage for the country’s rapid ascent in several key fields.

The government’s low debt levels allowed it to inject roughly $130 billion into the banking sector, an amount equal to 30% of its GDP at the time. It wrote down major banks’ capital and injected fresh public capital, effectively nationalizing them. In addition, it aggressively purchased non-performing loans from the banks to take them off their books. It moved to trim the bloated workforce at the banks, eventually reducing the total headcount by 1/3 by 2000.

The severe downturn forced other groups to reform or face exit from the market. Chaebol shed layers of middle management, with the Samsung group notably reducing its workforce by 25%. Foreign investors took control of dozens of struggling affiliate divisions, helping them avoid bankruptcy and furthering the push to reform chaebol’s management structures.

To help spur business creation, the government established the “Kosdaq,” Korea’s version of the Nasdaq stock exchange in the United States. Korea’s investor class, wary of investing in the weakened Chaebol, directed funds towards this new market, hoping for returns similar to those being generated on its American counterpart. This shift in capital towards toward small companies it allowed an entire class of highly skilled and entrepreneurial high tech workers who were laid off from conglomerates such as Samsung and LG access to equity capital. The shift from 15+% small business and personal loans to an equity culture created an explosion in new companies. In 2002, the roughly 11,000 ‘venture’ companies (those less than three years old) employed 9% of workers, the highest percentage in the world. (Noland, 2002)

Despite the economic crisis, the relatively young and technically savvy population took immediately to the new products and services that the startups offered. These included areas such as digital video recorders, MP3 players, PDA’s and other electronics products, niche areas that were growing very rapidly. While these companies in general were not path-breaking companies, they successfully carved our global market niches. These in turn helped Korea develop skills that were transferable to other key areas. For example, digital signal processing technology in MP3 players, server tuning with online games, wireless protocols and mobile handsets. These nimble startups led the country into new business areas and played a large role in creating employment and pulling the country out of its slump. Small company exports now account for 30% of total exports, and increasingly focused on high value-added goods.

Thus exports, which played a key role in the Republic of Korea’s initial industrialization drive, continue to be crucial to the country’s economic development. The country’s exports as a share of GDP has risen from 5 percent in the early 1960s when Chung-Hee Park’s industrialization drive began, to nearly 50 percent in 1999. The country’s imports as a percentage of GDP has seen a similar rise from
the 10 percent level to nearly 40 percent.

The Republic of Korea’s Total Trade as a Share of GDP

Source: Bank of Korea, National Accounts

Despite problems with cronyism and the poor allocation of capital during these years, the results these policies have been quite impressive:

- Per-Capita GDP, which hit $10,000 in 1995 before dropping under $7000 due to the debt crisis in 1997, had recovered strongly to $10,087 by year-end 2002—a 100-fold increased from the levels seen in the mid-60’s.

- When measured at purchasing power parity (PPP), South Korea’s per-capita GDP has risen to equal those of middle-income nations:
- The Republic of Korea’s trade volume has expanded to become the 11th largest in the world.

- Foreign reserves, which dwindled to nearly zero in late 1997, have recovered to $130 Billion as of mid-2003, the fourth largest in the world.

- The government’s focus on education has been rewarded, with literacy rates, which hovered near 30% in the early 1950’s, rising to one of the world’s highest at over 99% (2000).

In summary, South Korea has, in the roughly 50 years since the end of World War II, has developed a diversified economy, with strengths in traditional heavy industries as well as newer, information intensive fields. However, a constant is that it remains dependent on exports to fuel its growth.

3.2 ITS Market Characteristics.

Despite dramatic economic successes in recent years, the South Korean government realizes that greater economic progress must be made to realize its goal of elevating South Korea into advanced country status over the next 10 – 15 years.

The new administration, under Roh Mu-Hyun, has set a goal of making the country a technological and business hub of Northeast Asia. Acknowledging that exports still power Korea’s economy, the administration highlighted the identification and development of new, high value-added sectors which are likely to experience high growth in the next 10-15 year period (Dubbed “Vision Industries”) as key to reaching its goal.

The ITS equipment and integration industry is an ideal candidate to receive support as one of these “Vision Industry” for several reasons:

3.2.1 The global ITS equipment market is expected to be large

Although build-out and adoption of ITS technologies is still in its earlier stages, indications are that the market will be very large. In addition to the large cities in the developed world where road congestion is a well-known problem, the rapid growth of cars in the mega-cities of Latin America and Asia represent potentially large ITS markets.

Korea’s GDP of $500 billion makes it the 12th largest economy in the world. However, the size of its domestic market is still insufficient to justify massive investments into new industries. Thus for firms to justify serious investments in ITS, it will require access to export markets.

Although market predictions for developing technologies often vary greatly, direct evidence of the ITS technology market’s emergence are starting to appear. This is most apparent in the Telematics (location-sensing devices which enable two-way communication between in-vehicle and out-of-vehicle devices using various wireless protocols) market. 3.5% of all cars sold in 2002 (including 11% sold in the U.S.) were equipped with a telematics device. These numbers are expected to rise to 20% (global) and 40% (U.S.) by 2007, with nearly 80% of cars sold in the U.S. expected to include a Telematics device by the end of the decade. (Chow, 2003) Since Telematics devices provide a platform for many ITS services, their steady adoption is a positive indicator for uptake of future ITS services.
The global market for ITS (including services) was approximately $18 billion USD in 2001, which is expected to jump to $42 billion in 2006. (ITS Canada) Global market size estimates for the end of the decade range from $60 billion USD to $120 billion USD, with services making up about one-third to one-half those totals.

Given the size of South Korea's economy, even a niche within this global market represents a significant export opportunity, and thus should be pursued. In particular, the Asia-Pacific market, which Korea will likely have the most success penetrating, is expected to see strong growth.

3.2.2 Korea’s Talent Pool

The government and society's emphasis on education in the post-WWII period (particularly its focus on science and mathematics education) has helped to produce a highly skilled workforce.

In fact, the country has been producing more skilled talent than the economy can absorb. As the economy transitions to a more transparent, shareholder-centric equity culture, companies have focused on improving efficiency, trimming headcounts even as the economy steadily expands. This has resulted in a near 9% unemployment among young college graduates, many with high quality training in engineering and mathematics.

Korea's PhD-per-capita ratio (the highest in the world), has created an oversupply of high skilled graduates, resulting in a 40% unemployment rate among recent PhD holders. Thus investments in ITS research and implementation will help to make full use of this large pool of highly skilled, but underutilized pool of workers in South Korea.

3.2.3 Compatibility with Existing Strengths

In particular, an examination of Telematics, which is closely related to ATIS systems which are predicted to make up a significant portion (various estimates place ATIS' share at 30 - 50%) of total ITS sales over the next decade, shows that South Korea's strengths coincide with its major enabling technologies and skills.

![Telematics Value Chain Diagram](Modified from Incode)

**Hardware manufacturers** – Large conglomerates such as Samsung and LG have gained highly competitive positions in related markets such as PDA's, digital signal processing, wireless...
communications, miniaturized display technology (plasma, LCD, organic, etc.) and wireless devices. As a result, Korea’s engineers have accumulated a high level of proficiency in the technologies that make up ITS hardware and software. With the availability of startup funding, many of these skilled workers have left their positions to start their own firms. Several dozen of these firms, (which lack global recognition but often possess globally competitive skills) are developing ITS products, looking for export and domestic markets into which they can sell their products.

**Wireless carriers** South Korea’s three wireless carriers, SK Telecom, KT Telecom (formerly Korea Telecom), and LG Telecom are, along with Japan’s NTT Docomo, are among the world’s leaders in the implementation of third generation wireless technologies. The highly competitive domestic market has allowed them to accumulate knowledge and skills related to the packaging and delivery of various content to end-users. For example, all three have developed extensive wireless “portals,” working with various content providers to provide location-based services, transit schedule information, and e-commerce applications such as money transfers and the ability to purchase movie and theatre tickets quickly and conveniently online.

**Content Providers** - The widespread willingness of the country’s population to incorporate the Internet into its daily life has resulted in a flourishing content industry. Dozens of nimble companies cater to the fast-changing tastes of the population, delivering its content through mobile handsets, PDA’s, as well as standard Internet sites.

**Telematics Service Providers** – This segment of the market is dominated by SK Telecom (a part of the SK Group, the fourth largest company in South Korea) with its “Entrace” service. Launched in mid-2002, it utilizes the advanced wireless infrastructure present in Korea and includes many of the ATIS functions envisioned when various Master ITS plans in Europe and the U.S. were created in the late 80’s and early 90’s.

It provides dynamic route guidance (taking into account real-time traffic conditions), location-based services, emergency response as well as traffic and other news. Data is delivered through cell phones (both voice-activated and on-screen), as well as PDA’s and fixed in-vehicle devices.

The system was built using common and flexible database and content delivery standards, allowing the service access to be enabled from a wide range of devices (including those yet to be released which support the same standards). Data is delivered over the standard CDMA (2000 1x) network in place in Korea.

LG Telecom, along with Hyundai Motors has funded another service dubbed “Atom” but has delayed deployment due to the time needed to build its own traffic network information collection infrastructure.

Other services, including one planned by Samsung and Korea Telecom, have been delayed due to still uncertain demand and generally sluggish economic conditions in mid-2003.

**Automotive OEM** – Despite a late start, improving quality has made the Korean automobile and automobile parts industry an up-and-coming player. In line with the Information Technology boom in the late 90’s, Korean automakers have shown a willingness to offer leading edge electronics devices in their devices. While Telematics does not represent a revolution for the industry, it does offer a constant revenue stream and contact with its customers, which the industry craves in light of its low margins and cyclical nature of its business.
**Integration Expertise**
In addition to these strengths, through the implementation of extensive wired and wireless infrastructure and integration with corresponding consumer e-commerce platforms, Korean companies have also accumulated expertise in the integration of large systems. Along with hardware sales, 'export' of integration expertise represents another promising new market. We can see evidence of this in other industries where Korea took an early lead in implementation. Most notably, Korean telecommunications firms (as well as systems integrators such as Samsung SDS and LG CNS) have had success in winning CDMA mobile phone and broadband implementation contracts in South East Asian countries.

Korea’s successes up to this point have been driven by its ability to quickly absorb new technologies, make incremental improvements, and quickly integrate technologies into commercially successful packages. Improvements since the crisis in the late 90’s have made the country more competitive in this respect. These are the very traits needed for successful ITS deployments and success in the ITS hardware market, indicating that Korea is well positioned to be a major player in this developing market.

### 3.2.4 Modest Investment Requirements

Developing ITS as an export industry will not require massive new investments. South Korea is already a major player in many of the enabling components of ITS. Thus, unlike the Heavy and Chemical Industry export drive in the 70’s or the movement towards value-added goods in the 80’s and 90’s, Korea is not starting from ‘scratch’. Past successes have allowed Korean firms to accumulate the skills and resources necessary to develop world-class ITS products. Therefore, incremental steps, such as funding the establishment a national ITS data infrastructure, and investing in pilot projects (such as Automatic Red Light Enforcement), will be sufficient to act as a catalyst for further private development in the field. Thus the country as a whole stands to gain much for a relatively small incremental investment.
3.3 Hurdles to becoming a major player in the ITS equipment and integration industries.

However, the Korean ITS industry faces key challenges in becoming competitive in the global export market.

3.3.1 Limited Domestic Market

The domestic market is limited. Korea's GDP, at less than US $500B, is barely 1/20th that of the U.S., and 1/10th the size of Japan's. Annual auto unit sales, despite seeing two decades of high growth, is still 1/10th of U.S. levels, and is even smaller in dollar volume terms. Thus, companies will likely have a difficult time justifying extensive product development costs if they are restricted to the domestic market.

3.3.2 Strength of Advanced Nation's Industries.

South Korea faces global competitors with more experience, technical resources, and access to their larger domestic markets.

The United States, Japan, and Europe have a significant lead in the development and deployment of ITS technologies. Japan has had a formal ITS program since the late 70's, while Europe and the United States have initiated formal organization efforts since the later 80's and early 90's.

In the crucial U.S. market, Western European, Canadian, and Japanese firms have better recognition and existing alliances. In addition, because ITS projects around the world are primarily driven by public agencies, many developed markets are likely to favor their own domestic manufacturers when implementing systems. In particular, business practices in many markets within the European Union and the Japanese market will make it difficult for Korean firms to win large equipment contracts.

3.3.3 Dependent on advanced countries for core technologies

South Korea is still dependent on advanced countries for core technologies in their products. Though localization of key components has accelerated in recent years, Korea's dependence is evident in the chronic high-tech equipment deficit ($1.5 billion in the first half of 2003. Kim, 2003) with Japan.
4 Feasibility – Evidence a Competitive Domestic and Export ITS Industry Can Be Cultivated

This section outlines attributes Korea has display and similar policies from the recent past that suggest cultivating a competitive domestic ITS industry is a realistic goal for the country.

4.1 Early Adopters

Korea has proven itself to be a nation of early adopters of technology. While many companies in developed nations have made large investments in new technologies in recent years, they have in many cases struggled with consumer apathy and hesitancy in adopting the new offerings. The Korean consumer on the other hand has embraced a series of new technologies and has integrated them into its daily life at an amazing rate. Broadband Internet and mobile phone technologies are two recent examples:

![Diagram: Consumer Broadband Penetration (Percentage of Total Households)]

Proactive government policies to encourage (1) investment and competition on the supply side and (2) raise awareness of the benefits of the technology on the demand side helped to make South Korea a major player in a very short period of time.

<table>
<thead>
<tr>
<th>Country</th>
<th>Mobile Phones per 100 inhabitants (as of 1Q 2002)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td>83</td>
</tr>
<tr>
<td>Finland</td>
<td>78</td>
</tr>
<tr>
<td>WM</td>
<td>WM</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Germany</td>
<td>68</td>
</tr>
<tr>
<td>South Korea</td>
<td>61</td>
</tr>
<tr>
<td>Japan</td>
<td>59</td>
</tr>
<tr>
<td>U.S.</td>
<td>44</td>
</tr>
</tbody>
</table>

Similar policies in the mobile phone market helped the domestic industry (both in the carrier and customer equipment industries) to become globally competitive against much more established participants, despite being a late entrant.

Korea’s affinity for new technologies extends beyond these usage statistics. For example, the average mobile phone subscriber tends to own a very late model capable of full Internet access and other advanced features, and upgrades his/her phone frequently. This has allowed operators to offer additional value-added services, which consumers have rapidly taken to. Examples include:

<table>
<thead>
<tr>
<th>Wireless (cell phone) and Internet banking</th>
<th>Has grown to 60% of all banking transactions in the 3 years since introduction.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online brokerage services</td>
<td>Handles 75% of all retail stock/option trades. Reached 70% milestone 2 and ½ years after its 1998 introduction.</td>
</tr>
<tr>
<td>Mobile Payment Systems</td>
<td>Popular form of payment at all major e-commerce sites, many convenience store chains and vending machines.</td>
</tr>
</tbody>
</table>

Thus the majority of the population, in addition to simply owning these devices, has incorporated these new features into its daily lifestyle.

These trends suggest Korea’s domestic market can make an ideal test-bed to pilot and refine ITS technologies and services so that its industry is ready with competitive solutions when the global market takes off in earnest.

4.2 Successful precedents – past policies to encourage adoption

An examination of government policies from the recent past shows that they have been an effective catalyst in encouraging end-user adoption of new technologies and services, allowing manufacturers to fine tune products before demand accelerated elsewhere.

4.2.1 Diffusion of Broadband in South Korea

In this section, we will examine the regulations and other factors which affected the rapid diffusion of broadband technologies in South Korea.

When Korea Thrunet, Ltd, a cable-based broadband Internet service provider, first offered service in South Korea in mid-1998, the “innovator” user group (as defined in Moore, 2002) signed on immediately. Because the service had been available in the United States for some time, the service providers did not have to expend much energy to “win over” this group, since they were already aware of the technology and what the innovators in the U.S. were saying about potential applications.
However, as Moore (2002) brings out, having the innovators on board does not guarantee success with the early adopters since they are quite a distinct group with different goals for adopting a technology, and this was certainly true for Korea Thrunet. After the initial spurt of subscribers, growth flattened as the carrier had difficulty convincing the early adopters of the need or practicality of this new service.

What made it even more difficult to grow the subscriber base was that they were not dealing with the relatively small discontinuity of consumers having to switch from a modem connection to a broadband one. When Thrunet began offering service, dial-up penetration was very low, significantly below the levels in the US. Thus the broadband providers were in the position of convincing people who had never been online to go straight to broadband.

4.2.1.1 Driving Application

However, by the spring of 1999, when the second broadband startup (Hanaro Telecom, Ltd.) began offering ADSL service, the driving application that highlighted the benefits of the technology had appeared--StarCraft. This multiplayer online game exploded in popularity in 1999, and its players quickly realized that they could tap into a much larger pool of potential competitors by subscribing to broadband connection. Other multiplayer games soon emerged, swelling the online gamer ranks to over 4 million regular players. They were not interested in the underlying technology itself, but quickly became interested when they saw a clear application of the technology that addressed their needs. Hanaro Telecom in particular realized this and marketed heavily to this early adopter group, emphasizing how it could vastly improve the gaming experience. Subscriptions took off, reaching 4 million subscribers by year-end 2000 (or roughly 30% of the total number of households) and far surpassing the penetration rate in other parts of the developed world.

A positive feedback loop developed, where the popularity of online gaming led to increased demand for broadband, which in turn increased the attractiveness of online gaming to new players (since there was a larger pool of players to compete against).

The explosive popularity of online gaming in turn led to the creation of “PC Bangs” (literally meaning “PC Rooms” in Korean) where multiple players could gather to play their favorite online games.

The number of PC Bangs increased rapidly.

<table>
<thead>
<tr>
<th># of “PC Bangs” in S. Korea</th>
</tr>
</thead>
<tbody>
<tr>
<td>'97</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

These PC Bangs served as a showcase for broadband, allowing users to experience high-speed applications at an extremely affordable price (initially 1000 Korean Won per hour, or roughly 80 U.S. cents per hour).
4.2.1.2 Role of govt policies

4.2.1.2.1 Subsidized access to jumpstart supply

In the mid-90's the Korean central government spent 1.5 billion dollars to build out a national backbone, then sold subsidized access to providers. This lowered the uncertainty for operators contemplating entry into the market and allowed them to price service near narrowband rates.

In addition, the government provided approximately $1 billion in soft loans to assist in the rollout of services across the country.

This relatively modest investment by the government had a tremendous effect. The initial subsidized access fees allowed carriers to offer service at attractive prices from service inception. This helped to spark initial demand, allowing the private carriers to financially justify further infrastructure build-outs. Between 1995 and 2002, the government and private companies had spent a total of $10 Billion USD on a national high-speed network infrastructure.

By year-end 2002, the country boasted the highest broadband penetration in the world at 80 percent, with new subscriptions continuing at a steady (though lower) pace, likely indicating that even the laggards are being drawn into the market. In addition, statistics about the extent to which broadband applications (Internet Banking, securities trading, online shopping, communities) are utilized show the extent to which the technology has penetrated daily life.

| # of Broadband Households / Penetration Rate – Korea |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| '98             | '99             | '00             | '01             | '02             |
| 14,000 / 0.1%   | 380,000 / 2.7%  | 4,000,000 / 29% | 7,500,000 / 54% | 11,500,000 / 82% |

Total # of households: 14 million

The backbone project was a financial success for the government as well. Increasing demand allowed it to charge higher and higher rates, to the point of turning an operating profit. The company was sold to a consortium of private investors in 2002 (although the deal has yet to be completed as of mid-2003), valuing the company at approximately $1.7 billion USD and allowing the government to recoup most of its investment into the project.

4.2.1.2.2 Education

When penetration reached approximately 30%, the government took the lead in educating the public on the benefits of broadband. A notable initiative was a program to educate 1 million (later expanded to 2 million) housewives on the basics of using the Internet over broadband connections. This group was under-represented in the Internet user base, but was known to heavily influence all types of purchase decisions.

This helped to broaden the user base beyond the predominantly young male gamer group and further increased home penetration of broadband.

The success of the two startups induced the major established fixed-line telecom carrier-- Korea Telecom (KT) -- to enter the market in earnest. As the technology became mainstream, increased coverage in
established magazine and newspaper publications, the experiences of the early majority conveyed by word-of-mouth, and the entrance of an established name into the field in turn helped draw in the skeptical late majority.

The resulting large subscriber base in turn drove the growth of many other Internet applications that require a large critical mass of users to be truly become useful. (instant messaging, discussion groups, online auctions, consumer electronic commerce, etc.)

4.2.1.3 Factors driving adoption
In retrospect, the main determinants of diffusion in this industry were:

- Government-led build-out of the common infrastructure, the “backbone” required to transport users’ data. This removed a key barrier to private firms’ entrance into the market—namely, that immense investments in infrastructure might go wasted if demand did not materialize as quickly as expected. It also helped carriers to avoid duplicative investment.

- Allowing carriers subsidized access to the backbone allowed them to offer attractive prices to the end-user. This helped jumpstart initial demand, which was crucial considering the network externalities which increased the value of the service as more and more people joined.

- The ”killer app,” which turned out to be online gaming, that allowed providers to cross the chasm between visionaries and early adopters.

- The mainstream market (gamers), when developed, encouraged the development of other, related submarkets (chat, electronic communities, etc.) that further grew the subscription base. In each of these submarkets, there was a similar jump from innovators to early adopters. However, each jump became progressively less difficult since the amount that people had to change their behaviors (i.e. the discontinuity) to adopt each new service was less, as consumers in general became more familiar with the online environment.

- Network externalities associated with the new web applications. The value of applications such as online communities and auction sites increase as more users join the network. Thus the positive feedback led to explosive growth in online interactions.

- Geographical advantages that allowed companies to meet demand quickly. Living patterns (high density condo / apartment clusters that feed into large, aggregation points that allow easy hookup for large numbers of people at one time) allowed operators to immediately increase supply to meet demand when it suddenly soared.

- Government sponsored education that brought in groups traditionally unfamiliar with technology.

Conclusions
Many factors contributed to the rapid diffusion of broadband in Korea. Government initiatives however acted as catalysts in several key areas:

- Significantly reduced the high barrier to entry (i.e. cost of infrastructure buildout) in the
broadband market
  • Enabled 'suppliers' to be ready when demand materialized.
  • Helped provide initial market demand through education
  • Helped stimulate demand through initial price subsidies

There are many parallels with the ITS industry now and the broadband industry in the mid-1990's:

  • Signs that the industry will be very large
  • Evidence its applications will be important to future national competitiveness
  • Need for a common, extensive infrastructure before meaningful service can begin
  • Related to other, high value-added industries
  • Export potential

These similarities increase the probability that similar policies can be successful in developing the ITS industry.

4.2.2 CDMA wireless strategy: Government-led Standardization

Government initiatives have had a similarly large impact on the development of the South Korean mobile wireless industry.

The central government in the early 90's through ETRI (Electronics and Technology Research Institute) investigated various standards for the mobile phone system it wanted to set up in the country. ETRI recommended the newly developed CDMA standard from the U.S.-based Qualcomm Inc.. The government then granted five licenses with the mandate that the operators adopt the CDMA standard. This would lead to the first commercialized CDMA system in the world.

With all the operators required to run on the same CDMA standard, equipment manufacturers were able to develop products to a single transmission standard, allowing them to focus on value-added features. While the government mandated a single standard, it allowed fierce competition to take place among the 5 players. Thus the telecommunications industry gained an early lead in CDMA expertise which it would later use to capture value through exports to later adopters of CDMA.

For operators, having access to the larger, more competitive equipment market created by the common underlying transport mechanism lowered their costs relative to what it would have been in a fragmented market. This allowed them to lower prices charged to end-users, speeding adoption. It also allowed them to focus on creating value through different channels. Eventually, the operators developed expertise in content delivery, and gained valuable knowledge about how consumers were using their phones. This knowledge later allowed them to develop successful mobile commerce applications quickly as 2.5G and 3G technology implementation began in the early 2000's.

Thus the government, by setting a common open standard for the underlying data infrastructure, but refraining from over-articulating in its policies, provided a common platform in a way that allowed firms to compete and innovate as consumer preferences and related technologies developed.
4.3 There are recent examples of Korea leveraging this “early-adopter culture” and government initiatives into export success

4.3.1 CDMA Wireless Technologies

Being first to successfully commercialize the CDMA cellular standard has led to systems integration and equipment contracts throughout South East Asia.

The domestic CDMA handset market (the first substantial CDMA handset market in the world) gave Samsung Electronics and LG Electronics an ideal testbed to refine its products. The standard-setting by the central government along with fierce competition between rival companies resulted in world-class products. Korean handset makers have leveraged this advantage into $12 Billion USD in annual exports. A non-player in the global industry as late as 1999, the two makers have established themselves as top 5 companies.

<table>
<thead>
<tr>
<th>Global Share of Mobile Handset Market (based on units shipped)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Nokia (Finland)</td>
</tr>
<tr>
<td>#2 Motorola (U.S.)</td>
</tr>
<tr>
<td>#3 Samsung (Korea)</td>
</tr>
<tr>
<td>#4 Siemens (Germany)</td>
</tr>
<tr>
<td>#5 LG (Korea)</td>
</tr>
</tbody>
</table>


When total mobile handset revenues are counted, Samsung and LG’s global ranks move up to #2 and #4 respectively. Average revenue per handset is nearly $200 for Samsung, while it averages under $150 for the two traditional leaders Motorola and Nokia. This shows that the Korean makers are concentrating on higher-end products and are able to charge a premium for them, illustrating the importance of the government-fostered early market lead.

The importance of the early market the government fostered is also evident when Korea’s smaller handset makers (such as Pantech, Appeal Telecom, and Telson Electronics) are examined. Despite their small size and limited resources, their early lead has allowed them to build world-class expertise in the design and manufacturing of CDMA handsets, often rivaling those of global leaders such as Nokia and Motorola. These three minor players now supply CDMA handsets to Nokia and Motorola, representing over US$1 billion dollars of additional exports for Korea.

In addition, these makers are experiencing high export growth in key emerging markets such as China and India, with Korea’s reputation as a CDMA leader often cited as being essential to their gaining footholds in new markets.

4.3.2 Broadband

Korea status as the country with the highest broadband usage rates is beginning to earn the country valuable recognition.
Korea’s status as the world’s most wired nation has helped to upgrade the image of a whole host of related IT industries, including e-commerce payment systems and related telecommunications fields, helping the industry gain a foothold in the Southeast Asian, Japanese, and to a lesser extent the U.S. and Western European networking markets.

It has helped its companies to win equipment and consulting contracts to the growing telecommunications markets in South East Asia such as Thailand, Malaysia, Vietnam.

In addition, its prowess in the broadband / Internet field has helped Korea’s high tech firms in fields outside of telecommunications (in particular the consumer electronics divisions of Samsung and LG) to develop a premium brand image in China that allows them to charge a premium for their products. A small (but growing number) of their products now command higher premiums than their Japanese counterparts, demonstrating the “halo” effect strength in one industry can have on others.

4.3.3 Online gaming
Early broadband adoption has led to an explosion in massive multiplayer gaming. The skills learned in server optimization and distributed application development have helped to raise Korea’s fledgling software industry’s competitiveness. In addition, the gaming industry has gone from being a non-player 4 years ago, to being the third largest exporter behind the U.S. and Japan.
5  Suggested Strategies

5.1 Showcase ITS infrastructure and services in the Digital Media City project

Particularly in Asian markets, the image a nation projects is often crucial to establishing the alliances necessary to penetrate new markets. Since East and South East Asia (which have rapidly growing car ownership but no indigenous ITS industry) represent the most promising ITS markets for Korea, it is strongly recommended that Korea invest in projects that showcase the country’s capabilities.

A specific project Korea should investigate is the Digital Media City project—a US $1.5 Billion mini-city being built in western Seoul. Being designed in partnership with the Massachusetts Institute of Technology and Accenture (an IT and management consultancy based in the U.S.), it’s goal is to become a ‘live’ showcase for what a city that fully implements the latest in information and communications technology will look like. The plans, which call for the mini-city to be blanketed with wireless infrastructure, make it an ideal showcase for ITS technologies. The government should investigate using this project as a proof-of-concept for wider deployment of an ITS data transport infrastructure and services. The planned nature of the city along with its small footprint will allow planners to implement meaningful services for a modest capital investment.

Korea’s reputation as the world’s most wired nation and a leader in the wireless communications industry has paid great dividends in the form of equipment contracts, consulting arrangements, and enhanced image that has extended to other (sometimes unrelated) industries such as automobiles. Similar investments in showcases such as Digital Media City will also yield dividends.

5.2 Implement ITS within Korea

5.2.1 Build a national infrastructure, beginning with the capital area, for the collection of road network data.

The lack of a common data transport infrastructure for ITS is a major stumbling block to the private sector making further significant investments.

Thus the Ministry of Construction and Transportation (MOCT) should investigate funding a national, government-led rollout and levying fees (subsidized) to ITS operators to help recoup some of the costs and help justify the initial funding proposals.

- This model was extremely successful during the nation’s broadband deployment, and the recent investments by the nation’s large conglomerates in recent years in ATIS services (despite their having to build their own infrastructure) suggest Korean firms will be aggressive in ATIS implementation once a data collection infrastructure is in place.

- As with the broadband rollout, the government’s lead will help avoid overlapping investments during the crucial ‘incubation’ phase, when private firms (as well as public agencies) often struggle to find sustainable revenue and service models.

- Thanks to the extensive wireless network that is already in place, the incremental funds needed to build such a system are well within the region of feasibility for the MOCT.
• The buildout should first focus on the Seoul Metropolitan Area as it has the highest congestion and accident rates, and thus promises the most “bang for the buck” for ITS investments. The high concentration of inhabitants and wealth makes it attractive for private sector investments in ITS as well.

5.2.2 Implement Automatic Red Light Enforcement
As outlined in section 2, Automatic Red Light Enforcement is a proven technology that has been shown to be effective. The costs of implementation in the Seoul Metro area are within reach for the Seoul Metropolitan Government (SMG).

In addition, the technology is focused on safety, making it easier to justify during the budgeting process. It’s also a standalone technology that does not require massive investments in call centers or in-vehicle devices, making it an attractive service to deploy first.

5.3 Implement policies to encourage domestic adoption & R&D

5.3.1 Other considerations when implementing: Korea is subject to “new” international rules (WTO, OECD)
As a member of the OECD and World Trade Organization, Korea needs to consider the new rules it is subject to.

In particular, Korea must be mindful that direct subsidies will be difficult, and outright protectionist barriers while the industry develops are unlikely to be tolerated.

Upon joining the Organization for Economic Cooperation and Development (OECD) in 1996, Korea underwent an evaluation of its policies related to (among others) trade barriers as well as its willingness to pursue further liberalization in the future.

As outlined in by Yoo, 2000, the OECD pointed to the higher level of tariffs (in comparison to countries with similar economic development), and in particular criticized the following non-trade barriers:
• Suppressing import competition by relying on private industry groups’ recommendations on which foreign goods should be permitted to be imported.
• The arbitrary interpretation of trade-related laws and regulations by customs services.
• Government-level import restrictions. In particular, the National Tax Service’s questioning of the source of funds for import car purchases, and their frequent targeting of import car buyers for general tax audits.
• Other more trivial actions such as a habit of delayed submission of revised trade regulations to the WTO and not making relevant notifications available in English, making it difficult for foreign corporations to obtain needed information.

The Trade Policy Review on South Korea, conducted by the WTO, reached similar conclusions, highlighting the relatively high level of trade barriers still present in the Republic of Korea.

In addition, the Memorandum of Understanding reached with the International Monetary Fund presented a timetable for the elimination of export subsidies and the import license system (which mandated government approval before foreign goods could be imported). It also specified actions the government
would take to diversify its import sources.

Clearly, the Republic of Korea can no longer rely on these techniques to protect their home markets.

5.3.2 Deemphasize direct subsidies, provide catalytic funding

The government should not foot majority of ongoing R&D expenses. It should simply provide catalytic funding directed towards the formation of an initial market, just as it did with broadband infrastructure. During the procurement process, it should emphasize flexibility (keeping in mind the direction of international standards-setting processes). In addition, once an infrastructure and standards guidelines are in place, it should allow market competition to occur. As was the case in the broadband and CDMA wireless markets, this competition will be key to fostering innovation and the market driven domestic ‘boom’ that will give Korea an advantage in the global market.

Some recommended options still available to the Korean government under these restrictions include:

- Supply-side financial incentives, including tax credits for ITS R&D expenditures
- Investment in pilot and implementation projects
- Demand-side financial incentives. In particular, equipment cost reductions in the form of tax incentives that lower the yearly excise tax paid by all automobile owners should be investigated.
- Ministry-sponsored research into chosen ITS areas to encourage ITS industry development.

The Korean central government’s finances are in relatively good shape to support these incentives. It has run budget surpluses averaging 1.5% since 2000, with continued surpluses expected through the next several years. Total public debt, at 37% of GDP (year-end 2002), is moderate by both advanced and emerging-economy standards.

5.3.3 Closely follow standards-setting process

International standards-setting has a profound influence on how global markets develop, and Korea should make efforts to participate as much as possible in such processes. However, it also must acknowledge the reality that it lacks the political clout to substantially affect them. Thus it should keep close tabs on proceedings. To avoid having Korean firms shut out of the market, the government in its procurement specifications should follow global trends, but emphasize flexible, open standards which will enable low-cost changes as global standards change. That is, it should not over articulate by specifying precise standards and protocols, but specify the features that the technology must enable and the group of open standards that may be utilized, leaving the equipment details to the private sector to build. This is the concept behind the United States’ National ITS architecture, and Korea, as a small player looking to access developed markets, should closely follow it.

5.3.4 Support as export industry

5.3.4.1 Target East and South East Asian markets

East Asia and South East Asia (listed as ASEAN in the table below) is growing in importance as a trade partner for South Korea.
Exports

<table>
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<tr>
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<tbody>
<tr>
<td>Total exports</td>
<td>65 016</td>
<td>129 715</td>
<td>136 164</td>
<td>132 313</td>
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</tr>
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<td>Asia</td>
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Source: Korea International Trade Association, custom clearance figures (Billions of won)

While, the share of exports to the U.S. and Japan is decreasing:

Figure 2: U.S. and Japanese Shares of South Korean Exports, 1960-97

Korea should first focus first on building on existing strengths to localize key technologies, as it has in other industries. Then it should target East and South East Asia as its primary markets. These countries do not have significant indigenous ITS industries, and recent experiences have shown that they are receptive to awarding contracts to Korean firms with significant experience in their domestic (Korean) markets.
5.3.4.2 Target niches in U.S. market

South Korean firms have leveraged strengths in display and wireless communications technologies to attain respectable market share in the mobile handset industry in developed countries in the U.S. and Western Europe. They accomplished this despite the existence of strong global firms native to each market (e.g. Motorola, Nokia, Ericsson). Given its size, these relatively small market shares represent huge industries for South Korea, and have funded research and development into other areas that have further advanced the country’s technological level. In the same way, Korea is well positioned to repeat the same strategy in the ITS industry.

However, governments in countries with indigenous ITS industries, such as the U.S., will understandably favor local players when procuring new equipment. Korea can overcome this hurdle by focusing on niches where domestic players are relatively weak, with the goal of attaining a modest share of the market. Given the size of Korea’s economy, even a modest share represents a large opportunity that can contribute to the further development of its economy.

5.3.4.3 Focus on niche component supply in the Western European and Japanese markets

Regulations and business practices create impediments to market entry for non-local firms in these two regions. Expectations of large shares in these markets will likely be disappointed. Thus Korea should focus on niche component supply, particularly where its technology is complementary to local player’s strengths. It should consider these markets as tertiary.

5.3.4.4 Induce foreign investment to facilitate market access

The Korean government should investigate sponsoring trade shows and investment road shows to support smaller ITS companies, which often possess high quality technology but have limited distribution and marketing channels available to them. Past experience has shown that foreign investment in local companies can facilitate access to relatively closed markets such as Japan’s while still enabling the local skill accumulation which is crucial to Korea’s long-term competitiveness in the market.

Korea is thus uniquely positioned in this market. In a short time, it has accumulated a high level of skill in industries which coincide with those involved in the ITS industry. Yet, its economy is small enough that only a small share of the global market represents a large opportunity. Thus a relatively small, well thought-out investment in integrating its existing strengths can yield high returns for the country.
6 Conclusions

South Korea entered the post-WWII era as an impoverished country with extremely limited natural and human resources. Thus to build an industrial base, it relied on a model where its limited capital was pooled, then channeled to preferred industries by a central authority. Despite some serious side effects, this method was, by most measures, extremely successful. It enabled South Korea to pull itself out of abject poverty and become the middle-income country that it is today. Along the way it has developed competitive positions in many high-growth, high value industries.

Today however, it is at a crossroads. It needs to seek out new growth areas to propel it into the ranks of advanced nations. These new areas must have high growth potential, as well as an ability to help raise the skills of the country’s workers.

ITS is an ideal candidate for the following reasons:

- Its implementation in Korea will have benefits in terms of traffic congestion and safety—two areas which costs the country a combined 6% of its GDP in wasted resources.
- It holds much promise as an export industry.
- Its development will create high quality employment for Korean workers.
- It development will increase the country’s level of knowledge in related enabling technologies (many which are expected to experience high growth in the coming 15-20 years).

Despite decades of rapid growth, Korea’s domestic market is still small. Thus, as it always has in the post war era, exports will drive growth and wealth accumulation in the country. A competitive domestic industry is a prerequisite to strong export competitiveness. To spur development of a competitive domestic industry, the government should:

1. Direct ‘catalytic’ implementation funds towards projects which provide a common foundation from which domestic firms (which now have the technology skills to compete globally) can develop and refine their products and services. In particular, an initiative to build a national ITS data transport infrastructure will have far-reaching benefits.
2. Participate in the international standards-setting process.
3. Develop ITS showcases. An ITS showcase within the Digital Media City (DMC) project is ideal in terms of timing, location, and compatibility with the general goal of the DMC—showcasing the information technology capabilities of the country.

An examination of successful policies related to the domestic mobile phone and broadband industries suggests these types of initiatives help lower the level of uncertainty for the private sector, encouraging further investment and innovation, which will yield the benefits outlined in this document.

In addition to increasing the efficiency of Korea’s transportation system, ITS also holds great promise as an industry to help drive the continued growth of Korea’s greater economy. Thus we should consider all the potential benefits, including the development of related skill sets, potential access to export markets, and the “halo effect” that a competitive ITS industries can have on related sectors, when assessing policy options. When this is done, it is evident that policies to spur the development of the domestic industry, starting with an implementation plan in the Seoul Metro area, can have significant benefits for the economy and thus the development of the country as a whole.
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