

GHG Reduction Effect through Smart Tolling: Lotte Data Communication Company

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스마트톨링을 통한 온실가스 저감효과: 롯데정보통신 사례를 중심으로

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Abstract Intelligent transportation systems are one of the most important new forms of infrastructure on domestic roads, and is a system that makes possible the most efficient movement of vehicles on a road. The High Pass system, which is a domestic intelligent transportation system, started a little later than in other countries but developed at a rapid pace. With the recent introduction of smart tolling technology, it provided an opportunity to stop and review the tolling system. This study aims to investigate the driving method and results of LDCC for domestic smart towing through case study. Unlike other companies, Lotte Data Communication Company has long invested in payment systems. It has little experience investing in infrastructure, but participated in the Smart Toll System at the Gwangan Bridge in cooperation with the Busan City government, to lead the development of intelligent transportation systems. LDCC, which has made new investments, not only exceeded its existing core competencies, but also upgraded Korea's tolling system's ability to reduce greenhouse gas emissions and improved its financial performance.

Key Words : Lotte Data Communication and Company, Intelligent Transportation System, Smart Tolling, High-Pass, Pavement

요 약 지능형 교통시스템은 국내 인프라 중, 도로에서 가장 중요한 역할을 하는 기술로 차량이 도로에서 가장 효율적으로 움직일 수 있도록 만들어주는 시스템을 말한다. 국내 지능형 교통시스템인 하이패스는 다른 나라와 달리 조금 늦게 시작하였지만 빠른 속도로 발전하며 최근 스마트톨링 기술이 도입되면서 톨링 시스템에서 ‘멈추고 다시 출발’하는 stop and go를 해결할 수 있는 기회를 마련하였다. 본 연구는 사례연구를 통해 국내 스마트톨링을 견인한 롯데정보통신의 추진방법과 결과를 다루고자 한다. 롯데정보통신은 다른 기업과 다르게 정보통신 기술 중, 결제 시스템을 오래전부터 투자한 기업으로 인프라에 투자한 경험은 적지만 부산시와 협력하여 광안대교에 스마트톨링 시스템에 참여함으로써 지능형 교통시스템의 발전에 앞장서게 되었다. 새로운 투자를 감행한 롯데정보통신은 단순히 기존 핵심역량을 뛰어넘게 되었을 뿐 아니라 한국 톨링 시스템의 온실가스 저감 역할을 한 단계 격상시키는 역할을 하게 되었고, 기업의 재무성과도 향상된 것을 확인할 수 있었다.

주제어 : 롯데정보통신, 지능형 교통시스템, 스마트톨링, 하이패스, 도로

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1. Introduction

Established in 1996, the Lotte Data Communication Company (hereafter, LDCC) has been developed using various SM (System Management) businesses within the Lotte Group. In particular, while developing ERP (enterprise resource planning) with Lotte Confectionery within the group, we expanded our information technology and ISP (Internet Service Provider) / BPR (Business Process Reengineering) business to establish core competencies. In 2000, an opportunity arose to develop as an IT company. Although Lotte Group has been in charge of the IT business throughout the Lotte Group from the beginning of the company to the present, Lotte Card has been expanding its business scope over the mid- to long-term, because it has made payment and settlement transactions such as cash card transactions since the acquisition of eB-CARD. In the course of the development of Lotte Information and Communication, the ability to deal with various information systems in the group has now been integrated into one, and the smart tolling system has been developed. This has provided an opportunity to accommodate the disadvantages of High Pass that were most commonly seen on Korean highways in the past. This technology is similar to the non-stop tolling system that has been verified all over the world. It is a method that is able to assign toll charges to a vehicle passing the billing place at a maximum speed of 80 km/h.

Smart tolling refers to a multi-car based irregular system, and it is important that consumers can use toll without additional burden[1]. Smart tolling works with existing high-pass terminals. The high-pass terminal installed in an existing vehicle automatically charges the fare as it does now, and the license plates of vehicles without a terminal are recognized by the smart tolling system and these numbers are automatically assigned the imposed toll. At this time, even if a vehicle passes the tolling gate at >80 km/h, the fare will be automatically settled, which is expected to contribute

greatly to eliminating traffic congestion. When Smart Tolling is operated, the number of vehicles passing through the steps is expected to increase by more than 45%, compared to the current High Pass system. There is also the effect of reducing CO₂ emissions as traffic congestion is resolved (carbon dioxide emissions are projected to decrease by 43%, from 1.52 million tons to 860,000 tons). Korea Highway Corporation plans to incorporate Smart Tolling into the intelligent transportation system by combining it with various traffic technologies. This approach will also include a system that will also quickly notify the driver when the vehicle suddenly decelerates, and informs the driver when the vehicle is in an accident. In addition, customized traffic guidance is available through analysis of big data on expressways, drivers, and cars. LDCC plans to extend its smart tolling business to private roads in the future.

2. Literature Review

The ITS(Intelligent transportation system) industry in Korea is a complex process industry that integrates technologies and systems in various fields, including transportation, information communication, civil engineering, and electricity. However, the definition of the ITS industry is not clear and there is not much pertinent law, regulations, and research for this industry to date[2]. Because the ITS industry exists as a business type that needs to be merged with other industries, it is evaluated as an industry having a large ripple effect in related industries by collaborating in providing various services. Among these related industries, for example, are ETC terminal manufacturers, automobile companies, ETC road surface equipment companies, telecommunication companies, card companies, related software producers, consulting companies, and construction companies (all related to electronic toll collection). This approach could help integrate related industries, and the potential for ripple effects in advanced, overseas countries will be examined[18].

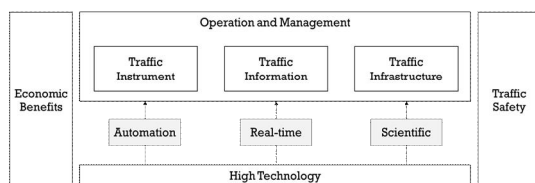


Fig. 1. Diagram and introduction effect of ITS

At the beginning of the introduction of the ITS industry in the past, there was a lack of foundation for the ITS industry. At that time, the focus was concentrated on ITS dissemination and related projects at the national level. In the early 1990s, when ITS was introduced, the Korean government was investing actively and actively promoting infrastructure policy. As a result, the growth rate of the industry in the private and public sector was rapid. This can be regarded as a somewhat stable stage.

However, as the laws, systems, and administrative rules, which are the basis for the current ITS business, are a bit more complicated and because rules are being implemented for each business process, the growth of ITS businesses seems to be limited. In particular, ITS-related businesses such as construction or information aggregation, is showing comparatively low growth in expanding market size and cannot yet be defined as an industry. The reason is that the market participants did not (at the time) recognize the ITS industry as a single industry, and the stakeholders involved in creation of the profit and the nature of the ITS business were merely 'passing traffic information', which limited the scope of the industry.

However, This study aims to figure out how ITS can be developed through ETC (mobile toll collection) while existing studies have focused on manual and/or electronic toll collection [16]. ITS-based smart tolling is the market where companies have been reluctant to invest because of uncertainty for gaining benefits. In this vein, LDCC revealed its rush into smart tolling collaborating with Busan City, 'Gwangan Bridge Project.' This project is the outcome of LDCC's accumulation in tolling and collection business for several years. The com-

pany have waited for the right time to invest in smart tolling system and it started to move forward with integrated tolling and collection system in 2016. Although existing studies have neglected the effect of a firm's challenge in ITS where the level of investment is national infrastructure [17], this study attempts to describe why LDCC took part in smart tolling and how it matters.

3. Changes in the Tolling System

3.1 The appearance of High Pass

Korea's tolling system is divided into high and low pass. On October 27, 1995, High Pass was initiated with introduction of the smart card and a wireless communication method among the contents outlined at the Highway Function Improvement Measures Meeting. In December 1995, Korea Highway Corporation was faced with the problem of introducing a non-stop toll collection system in earnest, establishing international technical standards, and acquiring IC card core technology. From a social aspect, the conditions at financial institutions were insufficient, and the IC cards and terminal prices were too high. At that time, infrared technology ETC (Electronic Toll Collection) technology was improved, and it was applied to the highway at the time when GPS (Global Positioning System) technology was emerging. Internally, the delays or congestion affecting sales offices on highways was getting worse. In particular, traffic delays in the sales offices open in the Seoul metropolitan area were increasing[3].

The High Pass was found to have the effect of improving the stagnation of the highway traffic flow, of reducing the carbon dioxide emissions, and of reducing the amount of consumed fuel. When passing through a toll gate, as compared to the previous ordinary lane, pass time is now shorter than for an ordinary (toll) lane by 39 seconds, and the waiting time of an ordinary lane has been reduced by 17 seconds. According to the ex-

perimental results of the National Institute of Environmental Research, assuming that the High Pass utilization rate is 50% (i.e., with 50% of 3.6 million vehicles passing through the tollgate in one day) 15,000 tons of carbon dioxide emission and 12.3 billion won (KRW) of total fuel cost would be avoided.

3.2 Smart tolling system

A user-oriented, multi-lane, high-speed travel-based fare handling technology (Smart Tolling System) has been developed. It allows a driver to pay for tolls while maintaining high speed. The Smart-Tolling System is the first in the world to adopt active DSRC (Dedicated Short Range Communication) technology using infrared and frequency. The result is a high-speed system that assesses toll charges automatically.

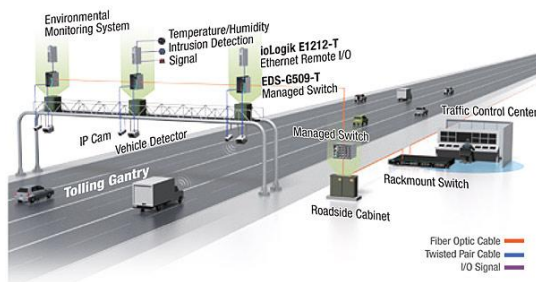


Fig. 2. Concept of Smart Tolling System[4]

The Smart-Tolling System consists of a communication system, a car classification system, a vehicle speed violation shooting system, an integrated lane control system, and an integrated settlement system. It has been developed to accommodate 5.5 million High Pass terminals. The communication system is designed to collect charges by communication with a terminal mounted in a vehicle moving at high speed, to provide real-time 24-hour service.

A vehicle classification system was developed to classify vehicle types for calculation of the toll of a vehicle while maintaining high speed driving, and to classify vehicle types at up to 160 km/h, for four cars at once. The integrated settlement system is a technology

that enables payment processing while maintaining high-speed driving. It is designed to integrate the payment made according to various payment means such as existing High-Pass terminals and smart highway exclusive terminals[5].

A high-pass route can pass about 2200 units in Smart Toll lanes if each lane can communicate between 1200 and 1800 units per hour, which could increase traffic by 17 - 45%. This means that carbon emissions could be significantly reduced through the Smart Toll System. This notion is based on the belief that CO₂ emissions are reduced when there are fewer cars that are lagging or stalled. Currently, 4081 tons of CO₂ per year is emitted per lane, while the Smart-Tolling system can reduce CO₂ emissions by 24% per year (by about 40%)[6].

4. LDCC's Challenges

LDCC is a comprehensive IT service provider established in 1996 that involves IT consulting, IT outsourcing, network integration, E-BIZ, and solution development. In 2004, LDCC merged with Lotte Electronics. Lotte Electronics entered a joint venture with Pioneer Japan in 1973, established as Lotte Pioneer, to produce only audio, cassette, and electronic products. Currently, LDCC produces products such as international telephone prepaid cards, bidets, wireless LAN, digital door locks, and fingerprint readers. As of the end of 2014, Lotteria is the largest shareholder with 34.5% and the second largest shareholder is Daehong Planning, 28.1%. In addition, Lotte Confectionery, Hotel Lotte, and Lotte Chilsung Beverage own shares of LDCC[7].

Until 2013, LDCC turned to profit thanks to the settlement of Cash Bee Transportation Card although the losses were serious because Lotte Group's was so focused on internal businesses. The performance of company is not high but stable. If we acquire all of the cash card transaction business and merge with LDCC, we will be able to grow continuously by checking TMC's

solo system. Once MiBiCard and Hanpei ISIS are subsidiaries of LDCC, they will merge Hanpei Isis, Mavi, and Ibicad (after they acquire Ivica Card from Lotte Card). That is, these can be unified into one, Cash Bee. As of 2015, LDCC has owned various communication technology companies including Hyundai Information Technology Co., Ltd.

LDCC's 2014 consolidated sales and operating profit were KRW 717.4 BN and KRW 28.4 BN, respectively, down 8.1% and 179.6% YoY, respectively. In the midst of uncertain economic conditions, we are pursuing sales activities that will lead to sustainable growth. In addition, we are striving to overcome the economic downturn by continuing to invest in new businesses. LDCC's representative histories are summarized in the table below. In particular, since 2010, we have been investing in Hanpeisis Co., Ltd. to expand investment in various green technology related businesses. In addition to carrying out the smart grease business on Jeju Island, it established a security control specialization business and disaster recovery center, acquired ISO9001 certification, and certified the green data center in 2014, and acquired ISO50001 certification.

Ivica Card, MyBee, and Hanaro Card under the Lotte Group. The brand mascot is a bee. Lotte Group's original plan was to merge the three companies and received the Fair Trade Commission's merger approval through steady efforts. However, due to the nature of the transportation card business, the contracts with the local governments were complex and could not be merged. The Lotte Group has set a strategy that the merger will be effected through the combined brand of Caviar as the next best solution. Still, LDCC is listed on the stock market and is likely to merge with Lotte Card. One card, all pass standard cards are all the same card anyway.

The mobile Cash Bee also has an L Point function. L-points are registered separately after installing the app. In the case of on-line charging, unlike T-money, it was possible to charge only through the Lotte Card, but from the end of 2013, the charging range was extended to all cards. However, online charging method charges are very high like T-money, but Mobile Cash Bee is only charged with Lotte Card with almost no commissions[7].

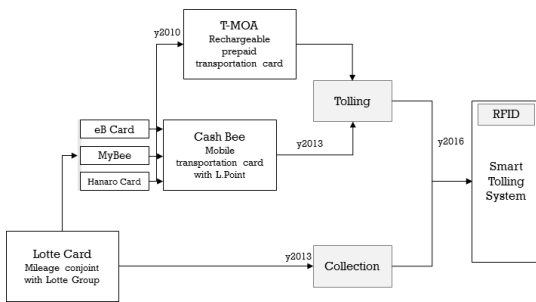


Fig. 3. Technological change of LDCC

4.1 Mobile transportation card system

LDCC's rechargeable prepaid transportation card, based on the T-MOA, the main transportation card of Kyungin Human Rights in December 2010, was installed and renewed with the Lotte Members. With the launch of Cavi, TMO started to become a nationwide brand with the integrated transportation card brands of

4.2 Integrated transportation payment system

In December 2010, we launched Cash Bee, an integrated transportation card brand for Lotte Group affiliates eB Card, MyBee and Hanaro Card. Cash Bee is a rechargeable prepaid transportation card that combines L. point functions based on Ibo Card's previously issued T-MOA. The reason why T-MOA became the foundation is that T-MOA was the standard of three traffic cards and eB Card's sales were the highest among the three companies due to the increase in population in the Gyeongin area. As a result, MyBee and Hanaro cards have been discontinuing their existing MIFARE smart cards, replacing them with T-MOA, and launching their own cash-on-demand Cash Bee. Cash Bee was released in the middle part of card number 16 digits 1210, 1240, 1220 (MyBee) / 1310, 1340, 1320 (Hanaro) with middle part of 1110, 0010, 0040. Cash Bee is all based on T-MOA cards, which contain

only MyBee and Hanaro Card's logo. LDCC is currently responsible for the settlement of traffic cards. LDCC was listed on the stock market in 2015. After LDCC was listed, Lotte Card's smart card business was sold to LDCC. There is a rumor that the company will merge. All smart cards will be unified with Cash Bee card.

4.3 Smart Tolling: Gwanggan Bridge Project

LDCC will enter the smart tolling business based on its know-how on various payment systems accumulated in Cash Bee and eB Card. Cash Bee has built up its capabilities based on prepaid transportation cards and has worked with local governments. In the eB Card, it is possible to raise the sense of business about settlement by participating in the settlement of traffic card. However, the need of the smart tolling business is not simply to integrate RFID functions into the card, but also to recognize vehicles that pass through the toll system at high speed and to have such functions, will require a lot of consideration and effort[8]. In particular, as the Korea Expressway Corporation announced its plan to introduce a high-pass system with a Smart Toll Riding Multi-car system starting from 2020, LDCC was the first company to participate in it.

The above picture is a smart tolling multi-pass high-pass system that LDCC and Busan City carried out together. The Bucheon Tunnel and the Gwanggan Bridge are also known as Busan metropolitan areas. In 2012, Busan was recognized as the city with the highest traffic congestion cost. Busan traffic congestion costs about KRW 1.13 MN per person, which is 34.5% higher than the nationwide average of KRW 840,000. The traffic congestion cost per vehicle was KRW 3,220,000, well above the national average of KRW 2,450,000. In particular, the Wanghyeong Tunnel, which has suffered a total of 128 casualties due to 58 traffic accidents in the past five years, is ranked number one (danger) nationwide among tunnels, along with the Hong Jiemun Tunnel in Seoul. The city plans to improve the traffic system at the intersection of Daehan

and Gwanggan Bridge and to use Jinan Road as a roundabout route to bypass the Hwangyeong Tunnel. However, this is not enough[10].

The reason why the 'High Pass' lane installed to allow more rapid commuting was the cause of traffic congestion was because it neglected the road structure. The Gwanggan Bridge is divided into two bays, passing off Gwangalli, the left is the highway section leading to Yangsan and the Seoul area, and the right is the bend road section connecting Haeundae and Songjeong and Gijang. The problem is that the right-handed road on the right side slips out of the main line and shrinks to three lanes again. As soon as the car passes the toll gate, the road is divided into the Haeundae area on the right and the new city area on the left. At this time, more than 70% of the drivers who use Gwanggan Grand Bridge use this section, so they are driving toward Haeundae, New City, or Ulsan.

As a result, cars are getting tangled every day at the intersection where roads, toll booths, However, because of the High Pass toll gate launched on July 24, three of the four toll booths quickly became unavailable, and the vehicles that did not use the High Pass gate terminal turned into 'turtles'.

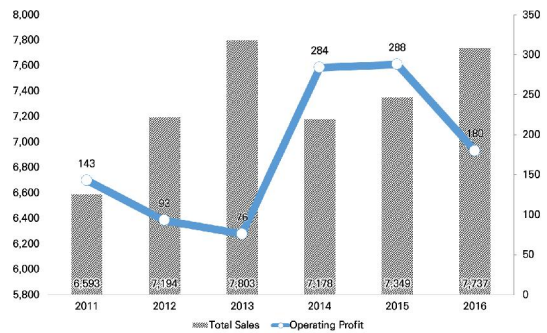


Fig. 4. Financial Performance of LDCC

LDCC solved these problems and solved the inconveniences of the citizens who typically accumulated in the relevant section. Especially, it is expected that the effect will be considerable because workers who need to go to Busan center over the Gwanggan Bridge while

commuting can now maintaining vehicle speed of more than 80 km/h. The new method is similar to High Pass, but it was evaluated and found to be very accurate. There is even a case that it charged even when the vehicle ran through at over 100 km/hr.

5. Conclusion

LDCC did not have a big part among Lotte Group affiliates, and was in charge only of IT services within the group[12]. The LDCC was the only company in charge of service, research, and support in Lotte, which has concentrated its core competencies on food and beverages such as Lotte Confectionery, Lotte Chilsung Beverage, and Lotte Shopping. By investing in the IT service industry, it has become a corporation that provides SI industry and IT consulting service together with the main focus on consulting, system construction, and IT outsourcing[13,14]. In the early days, companies that knew only that they were going to be in charge of billing systems are now seeking innovation in various IT fields, such as Omni-Channel, Big Data, SmartPay, Mobile, and Smart Convergence. Smart Tolling, in contrast to other sectors, has developed into a technology that enables information and communication companies to play an eco-friendly role[15]. Technology investment, which would be an early high-pass handset, is expected to reduce carbon dioxide considerably every time a car passes by, and in the long run, technology could eliminate all delays and congestion on highways, even if all cars end up being electric cars. It is possible to continue development. It is expected that smart tolling technology will reduce potential congestion costs on the road and make a big contribution to environmental improvement. Thus, our findings from the case may give some directions for firms that have hesitated to make an investment in smart tolling industry. Now that LDCC began to build the facility to recognize vehicle on high ways, tolling-related firms can take an opportunity for adding new values. For example, participation of private firms in Beijing ETC and MTC re-

duced a huge amount of HC and CO emission [16], and also the city paid back some amount of firms' expenses. New green technologies, therefore, become the environmentally cost-recoverable area not the unreliable investment one.

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