Strategic Planning of an Integrated Smart Card Fare Collection System: Challenges and Solutions

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ABSTRACT

Public Transportation systems have been developed and formed independently from one another although they are within the same regional province where the corollary of such development is tremendously experienced. This report, which presented the barriers to Integrated Smart Card Fare Collection System (ISFCS) implementation and the possible solutions to these barriers as well as it describe the benefits and risks of the systems. The ISFCS played a major role in improvement process of multi-modal and multi-operator coordination within public transportation industry and bridging the gaps with the aim to provide a customer focused and streamlined and integrated public transport Fare Collection system. The customer information and fare collection data are the two main aspects of ISFCS that have the potential to encourage integration of multi modal operator.

Keywords
Integrated Smart Card Fare Collection System (ISFCS), Public Transport, Multi Modal and Multi Operator.

1. INTRODUCTION

The increasing of automobile ownership in Malaysia produces more single occupancy vehicles (SOV) and with the decreasing in usage for public transports, caused road congestion to be worsened. The unattractiveness of public transport has also contributed to an increase in traffic congestion in Kuala Lumpur. However if automobile drivers could realize and be attracted to the benefits of public transports as compared to the automobile driving, perhaps more drivers would choose to utilize the public transports. An efficient and reliable public transport with the implementation of ISFCS may help to reduce the congestion if Kuala Lumpur population supports the system.

In The Edge Report by Yap Lih Huey (The Edge, 2004), "Transport Minister Datuk Seri Chan Kong Choy has said that the use of public transportation has decreased from 34% in 1985 to the current 16% of the total mode of transportation among commuters; while the use pf private cars has jumped to 17% from 46% for the same period." The demand of traveling into the city of Kuala Lumpur is estimated to be increased as the automobile ownership increased. Though, the demand is far beyond the roads system capacity, even after new roads have been built and existing roads were improved. Besides the SOV, there is also growing concern for noise pollution, traffic congestion, energy use and conservation as well as environment pollution from the excessive use of motor vehicles.

The public transportation industry could become more competitive and viable if it continues to enhance in services and operations. Therefore, the Kuala Lumpur population would be likely to consider public transports more frequently when choosing traveling options. The public transport operators could improve their services by being innovative and proposing something different and new using latest technologies for their current service levels. In regards to this, Integrated Smart Card Fare Collection System (ISFCS) could mean for one of the possible technology solution. When ISFCS implementation is feasible, innovative Fare Collection services could be offered to improve the attractiveness of Public Transport. The operators may possibly attract more passengers with the technology deployed, at the same time passengers may experience improved traveling services and perhaps reduce traffic congestion in the city of Kuala Lumpur.

Here, the discussion for some of the interesting features of public transport fare payment system with the introduction of integrated smart card Fare Collection system. Most of public transport operators in Kuala Lumpur are still using paper and magnetic stripe ticket as fare media for their fare payment system. Tickets must be bought on the spot as they do not have any pre store value in the tickets. It is also not durable for periodical ticket where they have to replace

after each expiry with a new ticket as the old ticket longer is no longer valid. It is difficult to implement multi-ride tickets using the old fare payment system when traveling using multi modal and multi operator transport, unless there is a single card that can hold store-value, then the value shall be deducted once the passenger used the public transport.

2. PUBLIC TRANSPORTATION AND INTEGRATED FARE COLLECTION SYSTEM

James (2001) described that public viewpoint and expectation of Fare Collection integration services are providing an improved experience towards these criteria: safe, reliable, frequent, accessible, easy to use, comfortable and appealing Fare Collection appealing. All of these criteria are so critical for integrated Fare Collection services of multi modal and multi operator public transportations where passenger could experience the seamless traveling and smooth transfer.

2.1 Demand of Public Transport and Private Vehicle

Most people travel into the city will choose private vehicles or automobiles over public transports due to its conveniences and practicality. Public transportation services does not always link up travelers starting point and destination for the essential journey and period, hence most them find that they must travel by private automobiles or driving regardless of the advantages of using public transportations. Moreover, they seems to understand that beside the convenience and practicality aspects, private automobiles or vehicles provides the advantages of comfort, privacy and time saving while public transportations disadvantages are longer journey time, no privacy and discomfort. All these disadvantages are having immediate consequences, whereas the advantages of using public transportations like reduce congestions, pollutions and traveling costs and the disadvantages of using private automobiles, like vehicle maintenance costs, traffic congestions have delayed effects and consequences (Huey and Everett, 1996).

2.2 Integrated Smart Card Fare Collection System

Fare Collection Systems are the first point of contact for consumers and may also be the only equipment utilized by consumers. Hence the conditions, characteristics, features and robustness of the fare collection system and fare media design must be suited well for the consumers. Fairhust (1986) indicated that the needs for attractive Fare Collection solutions for greater revenue provisions and Fare Collection benefits for public transport in order to improve its attractiveness. Here, integrated Fare Collection implies that a single ticket is used to travel using multiple modes of public transports.

Ellenberg (1999), stated that integrated smart card Fare Collection system is usually regarded as too costly to be used by infrequent passengers, however many system integrators would disagree with it (Moreau, 2003). For ISFCS implementation, user requirements identification and finding, and information of the Fare Collection services changes are key characteristics of successful the implementation (Irwin, 2004). ISFCS has to be professed and alleged as beneficial from the standpoint and perception of public transportation industry stakeholders, the operators, users, local authorities, government, as well as system integrators.

2.3 Potential Barriers

There are a variety of potential barriers for ISFCS implementation and they were highlighted here for the comprehensiveness of this study. This review focuses on barriers concerning to the introduction and deployment of integrated Fare Collection with smart card technology for public transports. Lawson and Steinmetz (1997) indicated that certain barriers for widespread of smart card system implementation might have the relevancy with smart Fare Collection even though they may perhaps differ for some extents.

2.3.1 System Funding

The project funding is seen to be the most critical factor that affects ISFCS implementation. Several key concerns are capital and operating costs that include how the costs are apportioned among participated public operators and structured financial arrangement that provide a ‘win-win’ for everyone involved.

2.3.2 Standardization of Operation Procedures and Government Policies

It is difficult to enable large-scale of ISFCS unless a common operation procedures and policy is achieved among the participated public transport operators. Thus the stakeholders involved may reluctant to commit for sponsoring huge funds due to the uncertainty, ambiguity and insecurity of guiding principles in operational. The local government and public transport operators’

coordination is a potential factor that correlates to implementation of ISFCS (Balducci, 2004). The governing structures such as uncertainties of platform setting process, unclear authorization seats over the decision and institutional or legal constraints has restricted operators' authorization and (Giuliano et al, 2000 ; Lovering and Ashmore, 2000). Individual operators may have clear guidelines and procedure for the process of decision making, however when multiple operators are involved, the process would be more challenging and touch when priorities differ and operation guidelines and procedures have not been developed (Multisystem Inc. et. al, 2003).

2.3.3 Cooperation Among Operators

The real challenge in placing the ISFCS is managing stakeholders' expectations and operators' cooperation, but not the technology itself. The cooperation among the participated operators may also hard to establish as a result of differences in operations policy, business process and practices (Turner and Smith, 2001). Nevertheless, there is a need for public transport operators, government, local councils and system technologist to collaborate towards a common goal of placing the ISFCS, to encourage and bring about conversion from driving to traveling using public transport as suggested by Pickett (2000).

Many published studies instituted that interest in ISFCS varied by transport mode. For example, bus operators may have interest in managing smart card fare program using the same system and technology while transits operators interested in coordinating and placing system that reduce fraud (Maxey and Benjamin, 1996; Field and Agnew, 1996; Libbrech and Oy, 1999; Foote and Stuart, 2000). This also entailed that the different type of mode may cause the intolerant decision for adopting ISFCS to improve Fare Collection services among the participated operators.

2.3.4 System Reliability and Constancy

Another concern among public operators is the system stability and reliability as they do not want to invest for a system that is going to be obsolete in near future or not interoperability and incompatibility with other systems. For example, the smart card reader could be transfer or exchange between the operating modes for fare payment systems in used among the participated operators.

This concern has led to reluctance of investment in ISFCS by public operators. However, common standard do exits for smart card elements for its physical feature and data protocols (Stanford, 1999), though the flexibility always comes at a price and normally the figure is at high.

2.3.5 Implementation Costs

The initial cost for the required infrastructure and administration of ISFCS establishment, should take into account the running costs, system upgrades and technology life. However, the cost may likely to decrease as the technology becomes established, ascertained and common as well as accepted by public transport operator.

The high cost of integrated Fare Collection solution may discourage public transport operators to invest into the solutions, especially when the systems are unlikely to be economically viable for longer period and no clear indication that services and operations of public transport could be improved and enhanced.

2.3.6 Competition Among Operators

The competitive and unregulated environment has discouraged public transport operators to cooperate and collaborate in an integrated smart Fare Collection solution even though there is a need for such advancement and progression. However, Clarke (1993) expected that most of public transport operators were compelled and demanded to provide advance services in ticketing, while integration of Fare Collection system may offer opportunity in modernize, enhancing and improving Fare Collection services, although the fare revenue might be shared among their competitors.

2.3.7 Public Behaviors and Operators Conceptions

Public attitude was probably one of the critical barriers for the potential deployment of ISFCS (Dunning, 1998). Lack of necessary knowledge and information about electronic transactions and its applications may cause public to reluctance and accord a lower priority then the conventional tickets or payment methods.

Turner and Smith (2001) reported that critical business risks such as varying and irreconcilable fare revenue policies or procedures, Fare Collection operating strategies that might change data processing implications, revenue apportionment and distribution mechanisms, capital expenditure and operating costs apportionment, transactions data security and privacy as well as new marker share risks

might deter operators from participating in ISFCS establishment. However, if these issues could be overcome and user needs are given priority in ISFCS deployment, patronage levels may possibly improved and the solution would be succeeded.

2.3.8 Organizational Characteristics

Some of the organizational barriers or constraints include resistance to change and risk-taking by the operators, lack of resources for funding, support from management, and institutional infrastructure, the implementation id irrelevant for addressing Fare Collection problems ass well as operational issues and regulatory complexities.

The organization must be committed to introduce and establish the system so as employee also need to be perceptive to implement in order for the deployment to be success. Usually, implementation of new technology would involve altering human behavior, acceptance and tolerance of the new idea. Resistance to change by people normally because of following reasons:

(1) System implementation is ambiguity and no certainty.
(2) The implementation would threaten to change the way people work, relationship between others and status in organization.
(3) Insufficient communication and information about the implementation
(4) No adequate benefits, returns and rewards for the work involved in deploying the system.

2.3.9 Fare Scheme

Public operators' incentives to implement ISFCS that offer smart card stored-value and season pass fare program may also vary by their markets of users and patronage. The acceptance of smart card was differ between income group with lower income groups may resist if they are not likely to have bank account used for reloading the cards and was also unable to afford a large amount pre loaded card instead they may prefer to use the cash tickets for per ride basis (Foote and Stuart, 2000; Multisystem Inc. et el 2003).

2.3.10 Technological Advances

The adoption of ISFCS may be hindered by public transports operators uncertainty over the technological advances in the future. As in the United States (U.S.), the government agencies have been active in developing procedures and standards for reducing operators' risks in implementing a particular technology (Dahlgren and Lee, 1994).

As in normal, technology like the smart card system has the risk of soon to be obsolete or incompatible. As a results, a public-private partnership organization (The International Transport Smart Cards Organization (ITSO), that based in the U.K. has also developed a set of standards for public transport smart card Fare Collection solutions. The American Public Transportation Association (APTA) in United States (U.S.), has also been developing guidelines and standard procedures for its member operators, with the aim to lower the costs for entry of the operators and technology vendors.

3. SYSTEM INTEGRATION GUIDELINES

The public transportation industry in Malaysia for the past fifty years has been mostly oblivious to public variation needs and operated with less optimum of efficiency and effectiveness especially for the Fare Collection or fare payments solutions. The fundamental changes in Fare Collection services with the implementation of ISFCS, it is hoped to serve as backbone of public transports operators' common goal to provide effective and efficient integrated Fare Collection system that based on new paradigm with customer-oriented perspective. The main benefit of the strategy is that the ISFCS would increase demand for public transportation services by inducing travelers to utilize existing public transport at higher rate while reducing the demand for SOV traveling into the city. The Fare Collection system improvement at public transportation is necessary in order to better serve the city population with good levels of services.

The hypothesis of this study is that there were many barriers in implementing the ISFCS for the public transportation but the key barriers that discourages the implementation is lack of funding, while coordination among the participated operators is the main cause to the success of ISFCS implementation. The study has identified that most of the barriers were more of perception then reality and most operators considered these barriers as issues to be solved and not barrier that hold them back.

A key factor for implementing ISFCS is good coordination and collaboration between the participating public transports operators in order to provide customers with multi-operators and multi-modal Fare Collection services.

There must be detail studies and prudent and thorough cooperation because not all existing fare media, equipments and solutions are compatible and complementary to each others. In addition, the new integrated fare structures and policies management would require attention on systems, operations and administration ends as well as organizations structures and setting of all participating operators.

While there are many benefits for the operators, they still have a difficult job at hand when implementing ISFCS. Some of these barriers may be existent and valid while other may be perceived and insignificant. Hence the operators must fully comprehend nature of the barriers and overcome them in order to successfully implement ISFCS. The difficulties deepen when several operators are having different fare media, fair pricing and systems infrastructures.

4. RECOMMENDED SOLUTIONS TO BARRIERS

Financial Funding

Financial funding is the major barrier to implement ISFCS, hence operators must find funding resources in ensuring that the deployment would eventually executed. The funding must cover the cost for research market and creating conducive environments for the implementation. The possible funding availability and mechanisms should be identified and established, in addition, the investigation and estimation of ISFCS initial costs should be also explored before the implementation plan is executed. Implementation funds from the government should be apportioned and extended for deployment and continues in operational. The proposal for initiatives such as establishment of representatives from the operator group to monitor performance, establish measures and provide legislative policy required to achieve long term objectives of ISFCS implementation. Thus it would attract a larger operators group to invest in ISFCS and generate sufficient funding to manage the operation and implementation costs thus greater return on investments.

The flexibility in funds management and allocation and funding mechanism by the authorities, could encourage and enforce collaboration depending on the procedures and policy set. Thus motivate the operators to move towards better coordination and cooperation for the implementation. The government must also provide continues long term and significant source of investment and funding to ensure public transport services improvement security in the future hence building consumer confidence toward public transport.

Project Champion or Coordinator

Generally, it is more feasible and workable to appoint a leader from the organizations involved to oversee the implementation process. Therefore, it is likely that the operators and local authorities will work together on consensus based approach with the guidance of the leader. Project champion or coordinator absent was a critical factor to ISFCS implementation thus with the presence of a champion, public transport operators may possibly be able to establish collaboration and coordination with a centralize implementation management. Project champion would lead and coordinate implementation plans and efforts, to ensure all the participated operators contribute to implementation tasks. The ISFCS project should have a strong, formidable, persuasive and dedicated champion is the key to deploy ISFCS for public transportations.

Collaboration and Cooperation

The barriers of collaboration and coordination are normally political and technical in nature, therefore they could not be solved with structural reform of operators' organizations. They must work together on mutual trust and strong relationship basis to achieve greater flexibility and adaptability among operators as well as the system integration itself. The common vision establishment between participated operators is an important element and directly associated to coordination and cooperation. The vision is needed to establish in order to increase the effectiveness of ISFCS from the standpoint of customers and encourage coordination that creates greater partnership among participating operators. The coordination with consensus driven decision making process is significant and critical in getting a common vision where this effort would resolve the conflicts that may arise during implementation and integration. They should institute standard framework changes for long term strategic vision, improvement of business process and day-to-day operation for Fare Collection services improvement

Resistance to Change

The resistance to change from operators officials could be overcome by emphasizing system training and knowledge transfer to be provided and new scope of work are well established. The resistance to change of operators could be overcome by increasing the cooperation between operators and with leadership role from the participating operators and public transportation planning agencies. For the operators' personnel resistance to change, detail explanation of the implementation objectives should be clearly conveyed to all personnel. Each participated

operators should also have project champion to encourage and overcome resistance to change within public transport officials, furthermore help them to understand, encourage and strengthen to persist with the implementation.

Revenue Distribution and Sharing

The revenue collection process need to be studied and considered carefully as operators need to determine which trips and journeys used its services. The operators should have interoperable agreements, payment and reconciliation system for the revenue and income distribution and proportionate. Furthermore, with centralized managed integrated Fare Collection systems, the revenue and income dispersal would be based on the ridership and it would be easily and quickly to be calculated, reconciled and audited for distribution.

Ticket Pricing

Other main concerns from operators were the smart card Fare Collection system management and operational issues whereby the operators would not want to increase the ticket price any more than necessary. The concerns could be resolved by emphasizing on the system management and operational policy and procedures, as well as educate passengers on the benefits of paying for the initial charge of smart card ticket as it is a one time charge only. Although, the initial charge for smart card ticket was higher and would be absorbed by users, they might favor for paying the charge when they could attained the benefits of having multi-modal integrated ticket for single journey with multi modal public transportation. An integrated and common fare structure would be needed to maintain each operator structure and at the same time, the structure may universally accept by all participating operators, although sometimes practical constraints may impose variability.

Risk of Failure

An appointment of joint technical committee should develop technical requirements and operational procedures of ISFCS that are based on the coordinated and integrated services as well as operators' current status and system infrastructures. The examination of system future capabilities, enhancements and long-term planning must be carried out, in order to avoid integration model that is unable to be incorporated into system future developments and can only be applied to current environments.

Implementation Duration or Schedule

The operators should take a proactive role in the deployment of ISFCS within their operational paradigms for the resonance of deployment. A study to on ISFCS system analysis should be carried out to identify the process of changing, migration path and implementation plan for the integration models to be developed. Integration Fare Collection solution for multi modal and multi operators is a very intricate and complex commencement and it requires tremendous planning, researching and testing before it can be implemented.

Consistency and Persistence

The operating agreements between all participating operators must be developed in which the agreements will define the mutual and joint services within ISFCS, fare structures and policies, roles and responsibilities of each operator, technical and non-technical requirements for ISFCS implementation environments. The operators should gain the local and state government officials for the support required and integration opportunities of public transportation industry, this would ensure that all the participated operators continue to work together till the implementation is successfully completed. There is a need to identify and promote potential project champion or leader to lead, coordinate and strive the ISFCS implementation to the completion. When there is a champion available, the persistence of the project deployment could continuously be forwarded and maintained till completion of the project.

Authorities Policy

Although public transportations policies and legislation are controlled by state or local authorities, public transport operators should have proactive approach to encourage the integration by facilitating coordination and collaboration between participated operators and enable the environment for ISFCS implementation. This would also unite the operators, regional planners, policy makers, and local authorities to position ISFCS which would encourage the operators to step forward and implement ISFCS. The participating operators must be able to discuss and manage the barriers and issues on a common ground with clear definition of roles and responsibilities, and no ambiguity with establishment of standards operational policies to ensure interoperability of ISFCS. The operators should gain the local and state government officials for the support required and integration opportunities of public transportation industry. The involvement of centralized government and local authorities in public transportation industry shall assist the operators in deploying ISFCS. For example, the International research on smart card system in Hong Kong, the ISFCS implementation have been effective and efficient [Widermuth, 1994]. Hence, government could

arrange a standard institutional and legal setting for all public transport operators.

System Fraud

An understanding of the benefits, risks and uncertainties of ISFCS should be developed by participating public transports operators. They may have to make necessary organizational changes in order to trade off for the potential gains and associated risks. With that, cost benefit analysis, and operators and passengers' market surveys are practicable steps to encounter all possible risks.

Cost of System

The operators must agree upon ISFCS technology standards and procedures, and then procure it jointly in order to reduce cost funding. The true costs of ISFCS must be clearly defined during the planning of ISFCS implementation to ensure the participating operators have sufficient funding. Hence, this would mitigate the investment of ISFCS and it could be successfully implemented with the support of all participated operators.

Lack of Knowledge on the System

The operators involved in the new integrated Fare Collection services must agree to incorporate all technical requirements[1] as well as non-technical in order to ensure that ISFCS is well suited for multi-operators and multi-modal setting. A promotional campaign should be conducted to encourage consumers to use new Fare Collection services. Prior to that, it is proposed that the operators should undertake questionnaires survey of passengers and frequency of public transport services used in order to establish demographic characteristics. Smart card ticket production, distribution and marketing must be supported by all the participated operators.

5. SUMMARY

The finding implied that public acceptance of ISFCS may vary depending on ridership of each operator where the successful implementation would depend on operators' abilities to identify market populations, partner with other mode operators, non transportation agencies and local authorities to capture the markets. In summary, the key points that contribute to overcome barriers and successfully implement ISFCS are described as below:

(1) The cooperation and coordination must be established between public transport operators.
(2) The consensus based decision making in addressing customers needs and satisfactions.
(3) The establishment of a single common goal and vision that provides integrated fare payment system with customer-oriented approach.
(4) The standardization of policy and legal framework for the integration and operations.
(5) A clear division of responsibilities and tasks to obtain full commitment from all the participated operators.
(6) The setting up of sufficient communication channels and executing the tasks in joining effort to improve coordination and collaboration.
(7) The government to give initial financial incentives for operators to equip with appropriate Fare Collection technologies. They should also take a more active role in delivery of ISFCS and joint working with the operators.
(8) A centrally managed and coordinated ISFCS and a willingness to relinquish control.
(9) Improvement of users understanding and awareness of ISFCS and national advertising campaign and publicity.

6. REFERENCES AND BIBLIOGRAPHY

Ab Rahman, A. (1993). Bahavioral and Institutional Factors Influencing Car Ownership and Usage in Kuala Lumpur. Texas A&M University, Texas.

Anderson, A. (1999). Not just transport. Travel forward with smart cards: Improving the efficiency of transport systems. (ERA Report 99 – 0826, 7:1-10).

Balducci, P.J. (2003). Central Puget Sound Regional Fare Coordination Project. U.S. Department of Transportation ITS Joint Program Office. Washington DC. U.S.

Briginshaw, D. (2003, January 2003). Dutch to start trials with national E-ticketing. International Railway Journal, pp. 15 -17.

Brown, R.J. (1998,April). The role of ITS in Transport Policy. Road Transport Information and Control, Conference Publication No. 454.

[1] The environments and frameworks within ISFCS to be operated should be first determined.

Chang, F-S., Hou R. C-H., & Shen, K. (1997, October). Proceedings of the 4th World Congress on ITS. A Pilot Study on Integrated Public Transportation Fare Collection Using A Contactless Smartcard in Taipei Metropolitan Area. Berlin.

Clark, J. (1999). Smart Cards and their use in transport Fare Collection – making it work. Travel forward with Smart Cards: Improving the efficiency of transport system. (ERA Report 99- 0826, 4:1 – 9).

Clarke, W.R. (1999). Developments in Multi-Modal Ticketing. Public Transport International, 4:15-19.

Dahlgren, J. & D.B. Lee Jr. (1994). Integrating ITS Alternatives into Investment Decisions in California. California Center for Innovative Transportation. University of California, Berkeley.

Dunning, J. (1998, February 26). Cashless and Seamless: is the integrated journey really on the cards? Local Transport Today, pp. 10-11.

Ellenberg, M. (1999, November). Proceedings of the 6th World Congress on ITS. Urban Tolls and Public Transportation Fare Collection Interoperability. Toronto, Canada.

E-Squared Engineering. (2000). Introduction to Electronic Payment Systems in Transportation. Washington, D.C: ITS America.

Fairhurst, M.H. (1986, July). Proceedings PTRC Conference Seminar K. P280: 47 -58. Travelcards and Zonal Fares in London. Sussex, England,

Field, D.L. & Agnew, P.N. (1996). London Underground's Ticketing, Past, Present and Future. Public Transport Electronic Systems.

Foote, P. & Stuart, D.G. (2000). Impact of Transits fare Policy Initiatives Under and Automated Fare Systems. Transportation Quarterly 54(3):15.

Giuliano, G., Moore, J.E., & Golob, J. (2000). Integrated Smart Card Fare System: Results from Field Operational Test. Transportation Research Record 1735(1735):138-146.

Huey, J.A., & Everett, P.B. (1996). Immediate Benefits: The reasons for the Car's success and Transit's failures. (p.65). Transportation Research Record, #1521, Transportation Research Board, National Research Council, National Academy Press, Washington, D.C.

Irwin, L. H. (2004). Technology Transfer. Millennium Papers. Transportation Research Board, National Academy of Science, Washington, D.C.

James, S. (2001, September). Put the Passenger First in Integrated Transport. Rapid Transit Review, pp. 77 -71.

Lawson, M. & Steinmetz, W. (1997, January). Smartcards: Too much hype? Railway Gazette International, pp. 54-56.

Lovering, M.W., & Ashmore, D.P. (2000). When Do Smartcards Make Commercial Sense? European Transport Conference 2000, Homerton College, Cambridge, Association for European Transport.

Maxey, C.L. & Benjamin, P. (1996). Seamless Fare Collection: Using Smart Cards fro Multiple Mode Transit Trips.

Moreau, B. (2003, January). The Case for Contactless Smart Cards is Overwhelming. International Railway Journal, pp. 20-21.

Oulds, C. (1999). Infrastructure Requirements. Travel Forwards with Smartcards: Improving the Efficiency of Transport Systems. (ERA Report 99-0826, 5:1-11).

Pickett, M. W. (2000). The use of smart cards as part of an integrated transport strategy. TRL Journal of Research, 3 (1) 35 – 37.

Stanford, C.J. (1999). Interoperability and Card Standards. Travel Forward with Smartcards: Improving the Efficiency of Transports Systems. (ERA Report 99-0826, 1:1-8).

Turner, P. & Smith, B. (2001, October, 4). Proceedings of 8th World Congress on Intelligent Transport Systems. Integrated Electronic Fare Collection – Field of Dreams?. Sydney, Australia.

Yap Lih Huey. (2004, November 28). The Edge. Rapid on the move.