

# A Multimodal Automated Fare Collection Solution for Facilitating Strategic Information Technology Planning of Public Transportation in Malaysia

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## ABSTRACT

*This paper explores the essential to integrate effective information technology management into the public transportation strategic information technology planning and recommend a framework for constructing a strategic information technology planning for multi-modal automated fare collection solution, which it will be adaptable to allow the public transportation agencies to fine-tune their strategy to the internal and external environmental changes and to align with their business vision and objectives. The organizational analysis shall study the current position of public transport companies within internal and external environments structures and the development of public transport strategic goals. The development of strategic information technology planning for public transport multi-modal automated fare collection solution includes the assessment of strategic organizational and information technology objectives, requirements analysis and strategic information systems modeling. The planning includes the technological, environmental, social, business and legislative framework assessment that include fare collection service, personnel management, resources administration, financial and fiscal, environment and market dynamics, institutional and legislative, multi-modal system integration and enabling technological dimensions.*

## Keywords

strategic information technology planning, automated fare collection, information system management, public transportation

## 1.0 Introduction

The study focus on an approach of information technology strategic planning for public transportation industry by adopting the strategic information technology planning of public and private sector best practice models to generate a set of framework. The framework may flexible enough to allow the industry to align its business and technological strategies with the integration of automated fare collection system implementation and the environmental changes, in order to continue staying on course with its' vision.

With the multi-modal automated fare collection solutions implementation for the public transportation services, it may perhaps allow multi-modal passengers to travel seamlessly between modes of train, bus, light rail transit and express rail into different cities, all using the same payment mechanism, a single contactless smart card (Calder, 1999). When used with contactless smart card, an electronic purse (e-purse) shall be implicated for the monetary value stored in the card. The multi-modal automated fare collection solution shall create a whole new process of collecting fare payment and generating revenue thus making the public transportation services more appealing and convenient for the travelers (Dunning, 1998).

The multi-modal automated fare collection could be use to address many of the key issues especially in regards to fare collection that faced by the public transportation agencies today. Today, some of the public transportation services such as the Light Rail Transits (LRT), bus, and commuter train in Malaysia have already included their fare payment option using the contactless smart card. It is hoped that the payment mode using the contactless smart card will be fully extended to other mode and operators of public transportation throughout all the states in Malaysia.

By any measure, for Malaysian metropolitan cities, like the Klang Valley's and Penang public transport marketplace, it is at large and growing. For Klang Valley's itself, with the basis that the operators is supplying transportation services for more than 500,000 thousand passengers per day and it is resulting in fare revenues that exceed RM 2 billion per year (RapidKL, 2004). Despite the growing load factors, the public transport market place is in the midst of major transformation and modernization from the industry that focused solely on cost recovery, to revenue and profit generation environment. Given with the pressure to increase revenues, decrease cost of operations, increase passengers' satisfactions, as well as improve ridership and capacity planning and management, the public transportation operators should invest in information technology such as multi-modal automated fare collection solution in order to take control of the pressure and drive the industry forward (Huey and Everett, 1996). Consequently, multi-modal automated fare collection systems will be a key area of focus for the Public Transportations services improvement Huey, and Everett, 1996).

## **2.0 The Needs for Strategic Information Technology Planning**

There are many reasons why strategic information technology planning and investment should be studied as they are collectively can be articulated for the mean of achieving competitive advantage (Laudon and Laudon, 2004). The management of information systems is the core instrument of communication within organizations and externally to stakeholders and consumers; in addition, the advancement in information technology can be effectively and efficiently create a competitive advantage of customers services improvements thus allow organizations to quickly seize business opportunities over the competitors. Information Technology investment is the significant ingredient that provides powerful improvement in communication and data movement, hence bring a competitive edge to organizations (Schneiderjans, Hamaker, at e.l. 2004).

In order to be efficient public service organizations in the 21st century and Internet era, the public transportation industry should become highly proficient with technology-driven transportation services organizations where business operations are efficient well equipped with supreme technology to master the change and provide the new technology-based services for the best service possible. With the ever-changing information technology environment, the organizations

should constantly adapt best practices in delivering public transport services with the assistance of information technology. However, in Malaysia, there are still a lot of public transportation organizations using the manual and paper based technology for their fare collection system.

For the public organizations to assert their roles as critical players in transportation services environment, they should adapt, reinvent and recast their operational method in fare collection as to carry forward and continue their mission and obtain competitive advantage in the industry and the digital era (Anderson, 1999). Thus, to offer new and enhanced services, they must acquire financial commitments to continually enhance system infrastructure and ready to provide the required capabilities. Several researchers have found that there is a positive relationship between information technology investment and organizations performances (Bhatt, 2000; Swierczek and Shrestha, 2003).

Strategic information technology planning also involves the prediction of risk in capital investment that the risk may due to in part to the fact that technology components comparatively fragile, easily sabotaged and decentralized of transaction data (Schneiderjans, Hamaker, at e.l. 2004). According to Schneiderjans and Hamaker, there are two classes of information technology risk:

1. Physical risk: The vulnerability of computer hardware and software, which include the security and piracy risk of data.
2. Managerial risk: the failure to attain the anticipated benefits or cost reductions; the deployment within the budgeted time frame and cost; end user resistance; as well as incomparability and interoperability issues.

Therefore, selecting the best strategic planning methodologies for generating the strategic framework of multi-modal automated fare collection solution can minimize risk of failures.

## **3.0 Business Case of Automated Fare Collection Solution**

In Klang Valley, several public transportation operators have implemented the multi-modal automated fare collection using contactless smart card and electronic payment system, with this indication, the

industry is recognizing the multitude of challenges these technologies could address and enrich. Though, the full benefits of the technological innovations have yet to be realized, as the multi-modal and multi-operator automated fare collection solution are still not comprehensively manipulated the solution functionality and fully deployed by all of the public transportations operators in Malaysia especially for the big cities.

The automated fare collection using smart card technology and electronic payment system are perhaps the most important fare related innovations of the past 10 years for the public transportation industry (Anderson, 1999). However, to date there is relatively little integration of these two innovations for example, only a few of the public transport operators in the Klang Valley that implements the technology. While for other parts of Malaysia, especially urban city like Penang, they are yet to utilize these innovations to provide the public with fully automated payment systems. There is practically no strategic planning of information technology for the design of multi-modal automated fare collection solution for the public transportation industry in Malaysia. Essentially, there is a need to develop a strategy framework for the implementation of the technology. The strategic planning of information technology may develop the technical framework flexible enough for the public transportation companies to implement multi-modal automated fare collection systems with the strategy of obtaining the competitive edge within the industry (Bryson, 2004).

The multi-modal automated fare collection benefits have very significant payoff in developing ridership by delivering effective and efficient services with revenue rising in tandem. The strategy framework of multi-modal automated fare collection systems would perhaps be extremely timely, given that the rapid development of public transportation infrastructure in metropolitan cities like Kuala Lumpur and Penang; in addition, the announcement of financial budget plan on September 2007 by the government of the budget allocation for the sum of RM12 billion in the next four years for Public Transportation to improve the services (The 2008 Budget speech, 2007).

#### **4.0 Strategic Planning of Public Transportation Information System in Malaysia**

The evolvement of information technology such as integrated systems, networked and wireless connectivity, expert system and enterprise information system have developed new avenue and provision for the establishment of the strategic planning of information system in public transportations Industry. With opportunities and motivation by environmental, technical, and social changes has caused the public transportation operators to recognize the need to enhance and integrate the current ticketing system with the automated fare collection solution. The strategic planning of information systems shall address the functional aspects, institutional and technical requirements, opportunities and challenges of the systems implementation while furnishing a holistic overview that may synergistically integrate the multi-modal and multi-operator systems in a systematic manner (Rackoff, et. al, 1985).

The strategy clearly relates to the Malaysian Ministry of Transport strategic objectives of increasing ridership especially the need of exploring and evaluating the cost-effectiveness way of improving public transportation attractiveness and capital and operating efficiencies. The strategy shall also provide the guidance to public transportation agencies in considering the development of multi-modal automated fare collection system with regards to the institutional and technical requirements based on the internal and external environments of the industry in order to maximize the likelihood of a successful integration of multi-mode fare and transfer environments.

With all the motivation and opportunities that drive the multi-modal automated fare collection solution, the business case appeared to be solid and sturdy for the usage of contactless smart card with electronic payment technology for the solution, which it is dynamic, robust and based on several rationales which they include the following (Eric Tai, 2006; PRC Rail Consulting Ltd. 2007):

1. Reduce maintenance and operational costs
2. Increase transaction throughput for the travelers
3. Reduce fraudulence activities
4. Innovations of ticketing and fare options
  - Flexible fare pricing
  - Special and Ad-hoc Events
  - Multi-operator scheme revenue

- Multi-modal fare ticketing options
  - Stored value ticket
  - Seasonal Pass
  - Loyalty and membership program
  - Multi Application and functional ticket
  - User and system management information
  - Financial and marketing purpose
5. Political and social acceptance
  6. Integrated services management

### **5.0 Public Transportation Multimodal Automated Fare Collection System**

The multimodal automated fare collection systems strategic plan should define the public transportation strategic directions for its fare collection system and specify the technologies and project plan that shall be implemented for the short and long-term plan with the financial assistance allocated for the duration (Bryson, 2004). The strategic plan should be consistent with the public organizations' mission, vision and values as well as the institutional requirements related to the industry. The plan must corroborate the needs for the multimodal automated fare collection solution. The plan should described the technologies considered, the resources required for the systems investment and the cost funding and sharing among the public transportation organizations involved in the systems integration. The definition of the plan shall include a set of automated fare collection systems goals and objectives that consistent with public transport overall information technology strategic plan. The plan should also contain the performance measures to determine the outcome status and issues arise.

### **6.0 Designing Strategic Multimodal Automated Fare Collection Solution Planning Process**

The study shall propose two phases of the strategic information technology formulation process, which they are the environmental analysis and strategic Multimodal Automated Fare Collection development.

#### **6.1 Internal and External Environmental Analysis**

The analysis shall focus on the public transportation agencies current position within the public transport industry environment and the deployment of the agency's vision and goals. The institutional analysis includes the internal and external analysis that shall capture an understanding of the agencies position in the environment. The analysis should determine the agencies strength strengths and weaknesses that analyze and evaluate their financial and transport services performance, multi-modal transits integration and servicing area (Boar, 2001). The analysis process established the services that the agencies could offer to their environments; bring in and adapt from the environment or opportunities those services and best practice needed to enhance their competitive advantage (Ward and Peppard, 2003).

After the critical examination of the internal and external organization position in the environment, the future vision and goals of strategic multi-modal automated fare collection solution should be established as well as the organizational vision and goals. The organization vision shall set the direction that offer stability and steadiness in decision-making and strategic planning of information technology functional area. The incorporation of information technology and strong strategic organizational plan has proved to be the important successful factor of many organizations (Schniederjans, Hamaker, at. el, 2004). Therefore, when establishing organizational vision, the agency should solicit input from the information technology expert on new technology that relates to the development of the agency's business and operation, and may possibly give impact on the agency's information technology planning (Clarke, 1999). The strategic vision and goals shall be used as a guide to develop benchmark and a set of criteria for the selection of strategic information and analysis techniques that should be employed for public transportation strategic multi-modal automatic fare collection system planning.

#### **6.2 Strategic Multimodal Automated Fare Collection Development**

The analysis activity shall develop architecture for identifying strategic multi-modal automated fare collection solution requirements within the public transport industry. The need for strategic planning of information technology is because of the public transport agencies external and internal environment changes and opportunities (Lawrie, 2005). Therefore a greater need to plan, implement and monitor the

information technology deployment of public transportation agencies, in order to develop greater competitive advantage which the strategic planning of information technology and decision-making should be involved with multiple aspects of the dimensions of strategic information technology planning that includes the technological, environmental, social, business and legislative dimensions (Ward and Peppard, 2003).

1. Fare Collection Service Dimension
2. Personnel Management Dimension
3. Resources Administration Dimension
4. Financial and Fiscal Dimension
5. Environment and Market Dynamics Dimension
6. Institutional and Legislative Dimension
7. Multi-modal System Integration Dimension
8. Enabling Technological Dimension

### **6.3 Fare Collection Service Dimension**

The fare collection service dimension is concerned with fare media, policy, payment and structure analysis and development activities (Pickett, 2000). The service analysis include the evaluation and definition of fare media type such as contact and contactless smart card; the evaluation and definition of fare policy and categories such as, service classification, passengers classification, daily, weekly or monthly trip; the payment mode definition may include cash, postpaid and credit card; the fare structure analysis and definition include the evaluation of journey type, journey distance, flat fare, zoning, mileage based, service based such as local, express, transits or circulator.

### **6.4 Personnel Management Dimension**

The activities for the dimension include the human resource and personnel management analysis and allocation that include recruitment, training, evaluation and promotion of administration, technical and operation staff. By reviewing the personnel profile, the agencies can determine their operational and technical strength. These reviews provide the identification of gaps in fare collection operational services offerings and the technical staff skills, thus determine whether the agency is better off servicing passengers using

internal full service or outsourcing managed services. There are a number of techniques for the analysis activities, which may include the technical and operation staff analysis; servicing area definition, evaluation of customer support management index, personnel performance index, systems support requirements definition, and operation management analysis.

### **6.5 Resources Administration Dimension**

The dimension is concerned with administration systems planning, management and monitoring as well as allocation and utilization of resources that include equipment supplies, capital and operations expenditures, and facilities management. The strategic information technology shall help managers and administrators respond to changes and needs quickly, assist in communication and the functional areas necessary to manage organizational internal operations. The administration analysis and evaluation techniques include facilities planning and management model, operation performance index, facilities management model and administrative and utilization analysis.

### **6.6 Financial and Fiscal Dimension**

The financial position and fiscal resource analysis is related to the efficiency and effectiveness of financial resources management with respect to fiscal factors. The public transport agencies financial position analysis techniques include the financial credit policy analysis, fare collection and payment policy analysis, public service definition and performance analysis. The analysis shall include the data such as public market norms and trends, as well as other public transport organizations position analysis that allow the development, deployment and correction actions to take place for the implementation of multi-modal automated fare collection solution. The dimension also concerned with open or public-private partnership of public transport organizations, governments and other services providers.

The fiscal dimension activities is concerned with agencies monetary and financial resources and assistance aspects such as governments grants, collaboration funding that determine the potential revenue, the strengths and weaknesses of financial

framework. The financial performance evaluation techniques are the cost-benefits analysis, reviewing the projecting revenue and trends, budgeting and cash flow analysis. The dimension also includes costs and revenue administration and distribution among the agencies that involve in the multi-modal automated fare collection implementation.

### **6.7 Environment and Market Dynamics Dimension**

The environment dimension shall include evaluation of the internal and external environmental factors and the proposed method for strategically change the public transport agencies position within the industry and provide the competitive edge. The evaluation activities start with the identification of agencies major opportunities and threats, and then continue to monitor and review further environmental changes and effects to the public transport industry. The analysis techniques include the market analysis, stakeholders' evaluation analysis, competitor analysis, vendor and supplier analysis, service area analysis, demographic and passengers projections, industrial relation analysis as well as short and long term environmental trends and forecasting.

Before the establishment of public transport organization strategies, the management should identify and analyze the market trends and dynamics in regards to the ever-changing passengers market in terms of geographical area, income level and population segments. The analysis techniques that relate to these factors are consumer need analysis, public image analysis, promotion and marketing service analysis, consumer satisfactions index, fair pricing analysis, public responsibility contribution, authority and legislation impact on public transport and passengers benefits, public safety and security procedures and standard.

### **6.8 Institutional and Legislative Dimension**

The institutional requirements framework is critical in the multi-modal and multi-operators integration environments because the multi-modal automated fare collection strategy requires coordination and consensus among the operators Foote and Stuart, 2000). The dimension is concerned with the organizational culture of the public transport agencies, common visions of integrated public transport services, politics of

redistributing authority and power over resource between the participating public transport operators and other governmental authorities (PRC Rail Consulting Ltd., 2007). The dimension also includes the role of federal and state governments in the public transport companies. The institutional analysis techniques include stakeholder consultation method, conflict management methods, political theory and policy Analysis.

The legislative dimension is concerned with the regulations and policy of public transportation operations, governmental legislation of public services, commercial regulation on public transport services, state and municipal legislation of public utilities (Cluett, Chris et.al, 2006). In order to abide to all the regulation and legislation set, the strategic planning of public transport fare collection should include the dimension activities before the systems is in operational. This shall allow the agencies and the authorities to derive with a consensus legislation framework for public transportation multi-modal fare collection system.

### **6.9 Multi-modal System Integration Dimension**

The multi-modal system integration shall involve multi-operator and integration of new and existing fare collection systems of each transport mode. Each modal may utilize different technology and systems, hence, before the development and implementation of multi-modal integration, the system integration planning should be comprehensively conducted through the following activities. The system integration activities should include the planning and study of system compatibility and interoperability, identification of available systems standards and specifications developed to address the interoperability, identification of data elements required in multi-modal and multi-operator environment, enterprise system security management, data security and risk assessment, analysis of data flow between agencies, intellectual property rights, integration of new capabilities into existing systems, information systems for administration, support and maintenance. The techniques that can be used for the integration study may include common fare media and system compatibility verification laboratory, industry systems interoperability study, definition of required data elements, gap analysis on systems and data, system security and risk management (Pickett, 2000).

### 6.10 Enabling Technological Dimension

The enabling technology dimension should include the study of new technology available as well as the future technological trends for fare collection systems and enterprise systems integration. The technology may include the fare card technology, electronic payment technology, enterprise system networking and communication, data consolidation and warehousing, enterprise systems infrastructures, advanced transportation management systems integration, automatic passenger counters, fare integration technology, online customer service application and common central clearing system (Stanford, 1999). The technology can be studied by reviewing the case studies of public transport organizations, research publication by transportation research organizations, academic institutions publications, research centers results and publications, journal and academic report publication on public transportations.

### 7.0 Conclusion

Public transportations must remain sensitive and responsive to the rapidly changing environments and technologies, thus taking an active approach in managing the fare collection and transportation services in the interest of society and authority as well as the aspect of business. The environmental and technological factors that effecting business and operational performance has intensified and the interaction between internal public transport management and these factors has increased. The management uncertainties and qualms have increased with the lack of predetermined and established strategic guidelines required for responding to these interactions. A comprehensive and well-established strategic information technology planning shall provide the public transport organizations with flexible, efficient and effective systems necessary to offer excellent and convenient services, thus obtain competitive advantage in the industry.

### 8.0 Conclusion

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