

CIV 516: PUBLIC TRANSIT
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TUESDAY, MARCH 31, 2009

FARE INTEGRATION

EXPLORING BARRIERS TO SUCCESSFUL
IMPLEMENTATION

INTEGRATED FARE SYSTEMS

EXPLORING BARRIERS TO SUCCESSFUL IMPLEMENTATION

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INTRODUCTION

The concept of Transit Fare Integration seeks to unite fares for different transit agencies within a region into a single fare structure. For urban areas, such as the Greater Toronto Area, where hundreds of thousands of commuters use transit on a daily basis, the integration of the GTA's nine major transit fare systems will allow for more streamlined and efficient travel.

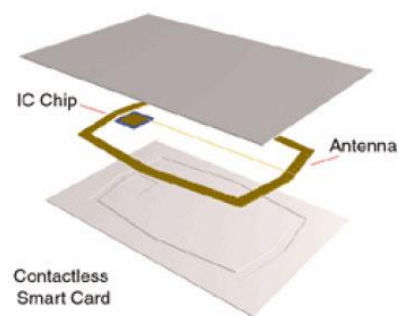
SUCCESSFUL IMPLEMENTATIONS

Transit Fare Integration systems have been implemented in major cities around the world, including London, Paris, Hong Kong, and San Francisco. In such cities, where multiple transit agencies operate different services, it would seem only natural for an integrated fare system to be implemented. For many years, technology has been a limiting factor; with most transit systems using paper, cash, and tokens for fares, it simply wasn't possible to develop a fair and efficient system to allow for integration. However, with the emergence of smart cards in the 1980s, and development of contactless smart cards in the 1990s, transit systems began to adopt this technology to achieve full fare integration across multiple agencies. Hong Kong was the first city to implement this technology in 1997 with their fare integration system entitled "Octopus". The Octopus system now serves as a model for all transit systems implementing this technology due to its incredible success. By mid-2008, over 17 million Octopus cards were in circulation, which accounts for more than twice the population in Hong Kong. Furthermore, an average of 10 million transactions, worth HK\$85 million, were processed daily (1). Other systems, including London's Oyster Smart Card and San Francisco's Bay Area Smart Card have been successful as well.

TECHNOLOGY

Radio Frequency Identification (RFID)-enabled smart cards have been the technology of choice in successful implementations of other integrated fare systems, including those mentioned in the previous section. There are three main components of this technology: the card, the reader, and the network.

Smart Cards contain an embedded RFID chip and antenna that has on-board flash storage for storing data. When the smart card is placed in proximity to a reader, the electro-magnetic field generated by the reader powers the on-board RFID chip. When the smart-card receives power, it broadcasts the information stored on it back to the reader to initiate the transaction. The reader connects to the smart card network, processes the transaction, and then updates the information stored on the smart card to reflect the changes made by the transaction (2).



Source: AlphaCard at www.alphacard.com

Fig. 1: Cross-section of an RFID card

RFID technology has been standardized since the 1990s and is reliable, cheap, and secure. It is this technology that will be assessed as the primary means for implementing an integrated fare system for the remainder of the paper since both the case study and proposed GTA implementation utilize it.

OVERVIEW

This paper will investigate the feasibility of implementing an integrated fare system within the Greater Toronto Area. Through the investigation of an in-depth case study regarding the implementation of the Octopus fare integration system in Hong Kong, this paper will identify the challenges and lessons learned from the project. An investigation into the proposals for an integrated fare system in the Greater Toronto Area will follow. Although plans are already in motion to rollout the Presto fare integration system by 2011 (3), there are still major issues yet to be resolved including the resistance of the TTC, the GTA's largest urban transit agency, to adopt the new system.

CASE STUDY: THE HONG KONG OCTOPUS CARD

BACKGROUND

In 1997, significant progress was made in the area of transit fare integration when Hong Kong introduced the now-ubiquitous *Octopus* card. The Octopus card is a reusable wireless 'stored value' payment card incorporating Radio-frequency identification (RFID) technology. Users gain access to the transit system by passing their card over a card reader, which is placed at turnstiles on subway and train stations, or at the boarding doors of buses or streetcars. This does not require physical contact – users need not take their cards out of their wallets or bags in order for the reader to detect the card (4).



Fig. 2: Hong Kong Octopus fare card

Hong Kong's two main passenger train operators, the Mass Transit Railway (MTR) and the Kowloon-Canton Railway (KCR), required that users with existing 'stored value tickets' switch to the new Octopus system, and within three months of implementation, three million cards were issued – nearly half of Hong Kong's population. The rapid adoption was also aided by a coin shortage in 1997 and aggressive pricing schemes designed to give customers with Octopus cards discounted fares when transferring between transit systems (4).

The Octopus card is operated by Octopus Holdings Limited, a joint-venture company between five major transit companies – including both rail operators, two bus operators, and a ferry operator (4). Initially, the company was authorized to handle mainly transit

fares, but as acceptance of the Octopus card grew and its usage changed, Octopus Holdings became a 'payment business' regulated by the Hong Kong Monetary Authority (1).

With the change in status, the Octopus card expanded its reach to include convenience stores (7-Eleven, Watsons), food retailers (McDonald's, Starbucks), as well as in vending machines, parking meters, pay phones, photo booths, and car parks (5).

In fact, the cost savings generated by the Octopus card on the city's parking meters prompted the city to convert their entire parking meter system to Octopus-based payment (6). This act implicitly acknowledged that the use of Octopus cards was not limited to transit users, but that even regular drivers had a need for and access to Octopus cards.

Use of Octopus cards has also spread to administrative tasks, such as in schools for keeping track of attendance, or in certain buildings, where a secure and personalized Octopus card can act as an access or security card.

Today, over 17 million Octopus cards are in circulation, more than double the population of Hong Kong (4). The cards are accepted not only on all major transit systems, but also in many convenience stores, vending machines, and some retail outlets. The Octopus card has transformed from a transit fare integration scheme into a comprehensive micropayment mechanism.

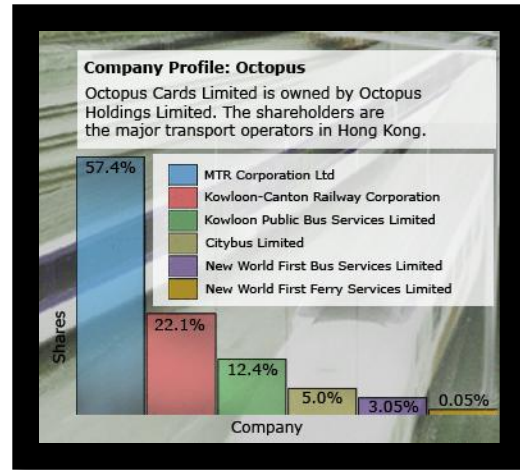


Fig. 3: Shareholders of Octopus Holdings Ltd.



Fig. 4: Octopus terminals at a parking meter (left), and as a classroom attendance tracker (right)

FARE STRUCTURE & OPERATION

The Octopus card works on a refillable declining balance stored-value system, whereby commuters with Octopus cards can refill the monetary balance on their card in designated refill stations placed in strategic locations throughout the subway, train, and various bus stations. The card is accepted on all of Hong Kong's rail and bus systems, as well as some ferry lines. To obtain an Octopus card, users pay an initial fee, which includes an initial preloaded monetary value, as well as a deposit for the card, which can be refunded if the card is returned.



Fig. 5: Octopus reader on a bus showing cost of fare and remaining card credit

Fares on most of Hong Kong's transit systems are distance-based, and the introduction of the Octopus card allowed greater penetration and flexibility of the system. Passengers travelling on the MTR subway use their card upon entry of the system, and again when they exit at their destination. Pricing on this system is based on the distance travelled along the subway between stations of entry and exit. Commuters who wish to travel between two train systems are allowed to do so without reusing their card, and the system transfer payment is automatically deducted based on where the passenger exits the system.

Similarly, bus fares are zone-based, in which passengers must pay more when boarding in certain zones – this scheme will be familiar to those acquainted with Viva Bus fares in York Region north of Toronto. With the introduction of the Octopus card, passengers no longer had to worry about differing payments (mostly done through exact change) and travel through different zones (2).

ADVANTAGES FOR THE PASSENGER

A number of advantages can be found in the Octopus card integrated fare system. For passengers, the system allows the use of a single form of payment without the use of coins, which take a great deal of time and effort to use when compared with a contactless smart card system.

Aggressive pricing schemes implemented by Hong Kong's transit authorities also give passengers discounts when transferring between modes of transit, and to have more control over their transit fees due to the distance-based fares.

Having the ability to pay securely is also a benefit of the Octopus system. A "personalized" Octopus card can be obtained by users, which can be associated with a particular person with identification. In the case where a card is stolen, the victim can

report the theft, rendering the stolen card unusable, and can receive a refund on the remaining balance of the card.

A further benefit is the ability to automatically add value to the Octopus cards. Cards can be associated with a credit card, and value can be added to the Octopus card on a monthly or weekly basis, or when the card runs out of credit. This reduces the hassle of refilling the card, and also reduces fee handling time for both passenger and transit operator (4).



Fig. 6: A customer waving an Octopus card over a card reader mounted on a subway turnstile

Moreover, for passengers, the time required to read an Octopus card with the contactless RFID system is only 0.3 seconds, compared with the 1-2 seconds for a magnetic swipe card like the TTC's Metropass. This does not even include time for insertion and extraction of the card from a bag or wallet, which is not required by the Octopus system. Needless to say, the Octopus card system is also much faster for passengers than using cash, especially when paying with coins.

Recent developments in RFID technology have also allowed the Octopus card to take on different forms. As the contactless reader is not bound to the card format, the Octopus RFID tags have been integrated into electronic devices such as cell phones, watches, and MP3 players, or have been made into key chain formats for

convenience to the user (7).

Promotional packages from the Octopus operators have also given users more reason to use the system. For example, a rewards program was implemented in 2005, allowing cardholders to gain reward points by using the card, which could be redeemed at merchants part of the program.

ADVANTAGES FOR THE OPERATOR

While it is certainly important for passengers to enjoy the system in order for it to become widespread, there must also be advantages for the transit companies implementing the fares. The implementation of Octopus in Hong Kong has numerous advantages for transit operators.

First, the time savings potential is immense – saving seconds on each passenger means allowing more throughput of passengers at the turnstiles, reducing queue times and increasing the efficiency of operation. Overall time savings for the operator may mean lower operation costs.

The cost of card maintenance has also been dramatically reduced for the MTR subway operators. Prior to Octopus, the MTR had been using a one-use and stored-value magnetic card system. The conversion to the contactless smart card has given a cost savings of 72% in the handling of these cards.

More importantly, the cost of handling payments can be dramatically reduced by the use of an automatic integrated payment system. Between the year 2000, when the Kowloon Motor Bus Company (KMB) implemented the Octopus system on their buses and the year 2003, the number of coins handled daily by the operator has reduced from 42 tonnes of coins to less than 14 tonnes. The drastic reduction in the number of coins being handled allows a reduction in staffing and equipment costs – the KMB reported an 80% cost savings in their cash handling operations (8).

Further, the widespread use of Octopus and its expansion into a micropayment solution has earned the Octopus system’s operators a new source of revenue. Currently, the Octopus card is accepted at many major convenience stores and retail outlets, such as 7-Eleven and Starbucks. Octopus Holdings Limited takes a 1% service charge on all payments processed outside of the transit system (1). Considering that the Octopus system handles millions of dollars in transactions daily, the potential for revenue for its shareholders – in this case the five major transit operators of Hong Kong – is immense, and an investment that has become well worth its price.

DRAWBACKS

Security concerns have been raised over wireless smartcard systems. In London, the Oyster card was hacked by a group of researchers, who were able to gain access to the transit system through security holes in the technology. While this poses a threat to the system, the technological problems were quickly fixed. Further problems can also be mitigated by choosing an appropriate technology. In the case of Hong Kong’s much older system, there has not yet been a reported case of fraud, despite the length of time it has been in service. The underlying technology behind the Octopus card manufactured by Sony, which uses ISO standard encryption for transactions, has been shown to be more secure than London’s system. Security concerns of this nature are further reduced, as the technology has had time to mature since its inception more than a decade ago.

Other concerns have been raised in the issue of privacy. Each fare card can be tracked individually, and this can lead to privacy issues if the information is used improperly. There have been cases of police using the information to help in investigations. However, these issues must be dealt with through public policy, and is dependent on the locale of implementation.

APPLICATIONS TO THE GREATER TORONTO AREA

Infrastructure in the Greater Toronto Area is in dire need of growth and revitalization. With a burgeoning populace, aging technology, and the strong demand for regional transit, it is time for the GTA to catch up with the rest of the world. Modern integrated fare systems have existed for over a decade, and have been implemented in many major cities around the world. Toronto is Canada’s largest city, and can be considered a “global” city. Toronto hosts

many major international events every year, and is Canada's largest city for tourism. Toronto has been host to extremely large events like World Youth Day, and is currently bidding for the 2015 Pan-Am Games (9).

In response to these many circumstances, Metrolinx, formerly the Greater Toronto Transit Authority, has been commissioned by the Government of Ontario to develop and oversee the implementation of a regional transportation plan. Amongst proposals of highway extensions, regional rail expansions, an express rail link to Pearson International Airport, and a light-rail transit network, Metrolinx is also overseeing the implementation of an integrated fare system named *Presto*. The new fare system, which has been contracted to Accenture, has already undergone preliminary testing. Full-scale implementation will begin in the fall of 2009. GO Transit, the GTA's regional rail and bus transit agency, has spearheaded the development of the system since they directly connect with all other local transit agencies. Presto will aim to integrate fares of 9 local and regional transit operators, including GO Transit, TTC, and various local bus operators.

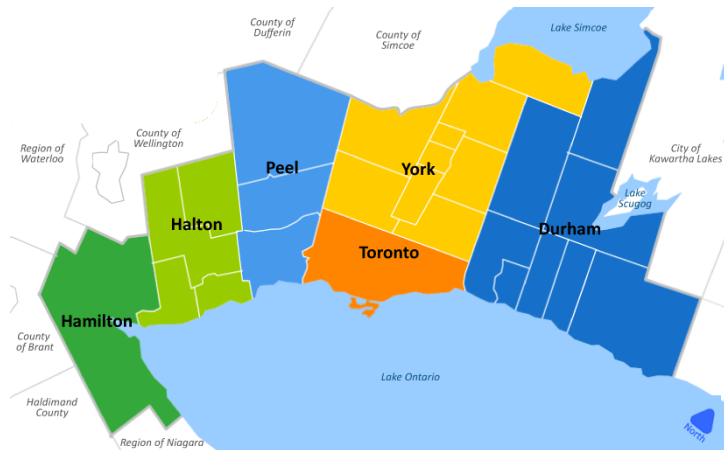


Fig. 7: GTA regions covered by Presto fare integration

BENEFITS



Fig. 8: Presto smartcard and reader

The benefits for implementing an integrated fare system are numerous. First and foremost, Integrated Fare Systems provide transit agencies with significant cost reductions. The enhanced security features of a smart card system will virtually eliminate fraudulent fares that plague systems using traditional methods of payment including paper tickets and tokens. The TTC

lost an estimated \$10 million in a 2006 token scam, and cited a 1.5% hit in 2008 due to counterfeit tickets (10). In the short term, the TTC has moved to phase out paper tickets and replaced their existing tokens with more sophisticated ones.

The Metropass (magnetic strip) system has also been subject to fraud. Further, the current Metropass system requires that the TTC issue new cards every month for regular users of the system. In January of 2009, for example, the TTC issued over a quarter million Metropasses (11). Without a Metropass return/recycling program, all of these passes are kept or later thrown out by commuters, creating both economic and environmental waste.

In contrast, the smart card used by Hong Kong's Octopus system lasts an estimated 10 000 transactions, which, at two transactions daily, can last over 12 years. Issuing such semi-permanent cards in favour of monthly disposable cards reduces both the handling cost of extra cards, as well as the environmental cost of production and disposal.

In addition to fraud prevention and environmental protection, costs will be reduced due to lower operational costs of smart card technology over traditional fare collection. The collection and processing of cash, tokens, and tickets is very time and labour intensive, whereas smart cards provide a fully automated system for processing transactions. Furthermore, it is estimated that the GTA will benefit from lower maintenance costs with the implementation of an integrated fare system.

Another major benefit of implementing an integrated fare system is better quality of service. Integrated fare systems are more convenient for commuters since they do not have to carry change or transfers with them. Smart Cards can be reloaded online or by pre-authorized payment, thereby reducing queuing at ticket counters. If adoption rates are high enough, dwell times can also be reduced, allowing for greater scheduling efficiency. As a consequence of implementing a fully-automated fare system, data collection of passenger usage is greatly streamlined, thereby allowing engineers to use accurate, real-time data with which to populate models used for transit scheduling and operations.

The ability to use fare policy to allow for flexible pricing policies is another major benefit of implementing an integrated fare system. Whereas fare structures are fairly rigid when using traditional fare methods (either zoned or fixed pricing), a more dynamic pricing model can be used with a smart card system. This pricing system can serve to moderate demand by offering different fares for peak and off-peak service. Furthermore, this pricing can better reflect the cost of operating a transit system during different time periods.

There is also the possibility of new revenue streams for the TTC and other transit agencies involved with the Presto system, if they follow the example of some other integrated transit schemes and expand the technology for use in non-transit related circumstances. Those involved in the Presto system stand to earn money if they can transform the technology into a full-fledged electronic payment mechanism, not unlike the Octopus system in Hong Kong. The Octopus, as previously shown, has found a profitable niche in replacing cash micropayment transactions at convenience stores, fast food restaurants, vending machines, phone booths, and parking meters. The TTC, however, has not been enthusiastic in this proposal due to their own uncertainty over funding and splitting of costs.

Other benefits, depending on the system in question, may include increased ridership and increased revenues, along with the environmental benefits of encouraging more people to commute by public transit.

BARRIERS TO IMPLEMENTATION

Although the technology required to implement an integrated fare system has already been developed and implemented for over a decade, there are still many barriers, mainly institutional in nature, preventing transit agencies from adopting this system.

In a region similar to the GTA, where there are nine major transit agencies, it is a challenge to get so many separate agencies to agree upon and accept a new fare system. While most transit systems will be included in the full implementation of the Presto system over the next few years, the TTC has struggled to accept the new system and is only planning to rollout Presto at major subway terminals that directly connect with regional transit (3). With a third party institution set up to manage the integrated fare system, it becomes necessary to coordinate efforts in fare collection and revenue re-allocation to individual transit agencies. For larger transit agencies, that have operated independently for many years, the integration of a new fare system poses many issues that smaller transit systems will not encounter. Specifically, larger systems will take the greater burden of capital cost required to install the new system, and hence the benefits gained may not exceed the costs required to implement the system, whereas smaller systems stand to gain many benefits for a significantly lower capital contribution.

Since the success of an implementation hinges on the fact that the system will have a high adoption rate, some transit systems have offered incentives and offers to commuters that use the new technology. When New York City first implemented their integrated fare system, they managed to increase subway ridership by 30% and bus ridership by 17% by offering free transfers between subway and bus along with a 10% fare reduction. This offer, however, cost the transit agencies \$86 million in lost revenue between the years 1997 and 1998 (4). The Octopus system, however, never had this problem since Hong Kong's previous fare system was phased out within a few months, thereby forcing commuters to switch to the new system. At this point, Metrolinx will leave let individual transit agencies decide what actions to take.

POLITICAL ISSUES

Although Metrolinx, the body responsible for implementing the integrated fare system, is well-represented by the TTC, with its chair, Adam Giambrone, serving on the board, the TTC is slated to take minimal steps towards integration whereas all other transit bodies are slated for full-scale implementation by 2011 (3).

In May of 2007, the TTC performed a business case analysis for a smart card fare system. This report was a follow-up to a previous study on possible smart card implementation in 2000. The 229-page report provides an in-depth overview of the smart card technology and provides a framework for the TTC with which to implement their system (2). This report evaluates the feasibility of smart card technology based on the Customer, Employee, Operational, and Financial impacts of the technology on the TTC system. The report does make mention of the Presto Fare System (indirectly, since the system was not dubbed Presto at the time), but makes the claim that this system does not

meet the TTC's requirements and must be amended should the TTC be expected to go ahead with it. The report concluded that while a TTC smartcard system would achieve the goals of improving customer experience, employee working conditions, and fare collection processes, it is not know if the required funding could be provided to implement this system.

Metrolinx, in charge of the Presto integration system, has repeatedly run into trouble with the TTC in trying to gain its support of the technology. Many of the issues that the TTC raises are institutional, but have prevented greater penetration of the Presto technology. While it will cost GO Transit and the suburban bus operators \$250 million to implement Presto, TTC estimates that it will cost them \$300 million to install and \$25 million annually to maintain (2). These costs, while high, can be misleading – as the previous case study on Hong Kong's Octopus system demonstrated, there are significant cost savings to be found in implementing such a scheme. Not only would the system reduce the cost of handling cash, and recapture lost revenue due to fraud, it can also potentially lead to profits. Indeed, Octopus earns millions from its transaction fees outside of the transit system, which go back to its shareholders, the transit companies.

The major problem, however, is the inability of the TTC to restructure its fare scheme to take advantage of the new technology. While having a single smartcard will add much convenience to users, the Presto card is doomed to fail if the TTC does not offer its support in providing discount on system interchanges. As it stands, users of the new Presto system will still have to pay double fares to cross into the TTC's Toronto routes. TTC's past closed-door policy of negotiating with other transit organizations has not helped the matter any. Current commuters know well that travelling on the TTC certainly means an automatic double fare, with little to no discount in transferring between systems.

Prices

	Adult	Senior/Student	Child
Cash Single fare purchase	\$2.75	\$1.85	70¢
Tickets & Tokens	5 for \$11.25 10 for \$22.50	5 tickets for \$7.50 10 tickets for \$15.00	10 tickets for \$5.00
Monthly Metropass	\$109.00	\$91.25	Not Applicable
Metropass Discount Plan (MDP)	\$100.00	\$84.00	Not Applicable
Weekly Pass	\$32.25	\$25.50	Not Applicable
Downtown Express	\$2.25 cash, token or Express Sticker	\$1.50 cash, Senior/Student Ticket, or Express Sticker	50¢ cash or Child Ticket
Other Fares			
Day Pass	\$9.00		
GTA Weekly Pass	\$47.00		

Fig. 9: TTC's rigid pricing scheme remains a barrier to fare integration for regional operators

Certainly, the TTC stands to lose some revenue if the so called “boundary penalty” is removed for users of the transit system, but it is unclear how much this loss would amount to. Further, no group has offered a solution to cover this potential loss. The government of Ontario, despite its support of Metrolinx and the new Presto system, has offered no financial aid to the TTC in this regard. It is unclear why the government is only half-heartedly pursuing this initiative – subsidizing parts of the implementation, but shunning the TTC on the other end. What is obvious, however, is that this initiative will not come to meaningful

fruition unless both the TTC and the Ontario government collaborate in an effort to reform both the fare structure, and uniformly adopt the proposed Presto smartcard.

CONCLUSION

In the past decade, a number of cities around the world have implemented integrated transit fare systems. Advancements in the field of wireless communications have allowed many of these cities to use “smartcard” technologies as part of an integrated fare payment system. Successful implementations have taken place in cities like Hong Kong, London, Singapore, Chicago, Los Angeles, and a number of others. In particular, Hong Kong has had enormous success with their Octopus system, and many cities have followed their lead. The case for implementation of an integrated transit fare system in Toronto and its accompanying issues was studied. It has been found that while Toronto is in the process of installing such a system, there are still many unresolved problems, as well as a lack of full participation from major transit operators – in particular, the TTC.

The case for implementation in the Greater Toronto Area is clear – there are nine major transit operators in the immediate region, including GO Transit, TTC, and many regional bus operators in the 905 belt. Commuters who travel between these regions currently have to pay a double fare to transfer from one system to another. This disjoint fare system is highly inconvenient for commuters, who may have to keep multiple transit passes, tickets, or tokens for regular travel. The current state of affairs can only serve to detract commuters from using public transit.

As demonstrated by successful implementations around the world, the technological problems associated with integrated systems have mostly been addressed. The major barriers to implementation in Toronto are largely institutional. The proposed Presto system from Metrolinx has promise as a next-generation payment system, but a number of problems remain to be addressed by the initiative.

Presto, when ‘fully’ implemented according to its current schedule, will be a convenient form of payment for commuters who use more than one transit system. However, it is little more than a debit card for transit users. In particular, the Presto initiative does not address the issue of the ‘zone penalty’ for commuters travelling between the 905 and 416 regions, where the TTC charges an extra fare for crossing into Toronto boundaries. Without giving users a financial incentive in this crucial area, the new initiative may never reach critical mass to sustain itself.

Further, the TTC has no plans to fully implement Presto, and when completed in 2011, Presto will only have terminals at a few major subway stops along the TTC. For many commuters, this incomplete implementation is no better than no implementation at all.

Consider the case of a commuter who travels from a station with Presto to a station without Presto – on the return trip, there is no way to use this new payment system, and hence defeat the purpose of the new technology.

The TTC's past dealings with surrounding and interconnecting transit systems have also left them with an inflexible fare pricing scheme that is not capable of adapting to an integrated fare system. Even with partial integration to Presto, the TTC is still hesitant due to their uncertainties of cost splitting and revenue sharing (12). Their refusal to provide a pricing mechanism and discount for inter-system travelers has left them without a way to deal with the new Presto system, and will leave the major fare integration issue unresolved.

Finally, the government of Ontario, which oversees Metrolinx, has not fully committed to the project. While they have publicly been in support of the system, there has been no financial support for the TTC, who require a great deal of funding to cover initial capital costs of implementing such a system. The provincial government's partial support on this issue is not enough to guarantee widespread adoption of this technology, and more is required from them to make this system a success.

WORKS CITED

1. **Mas, Ignacio and Rotman, Sarah.** Going Cashless at the Point of Sale: Hits and Misses in Developed Countries. [Online] World Bank, December 2008. [Cited: March 30, 2009.] http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/01/30/000333038_20090130002551/Rendered/PDF/472750BRI0Box31ng0cashless01PUBLIC1.pdf.
2. **TTC.** *Business Case Analysis for a Smartcard Fare Collection.* [Online] May 2007. [Cited: March 29, 2009.] http://www3.ttc.ca/PDF/Transit_Planning/smartcard_fare_collection_analysis.pdf.
3. **Metrolinx.** When is Presto Coming? *Presto Card.* [Online] [Cited: March 30, 2009.] <http://www.prestocard.ca/en/when/default.aspx>.
4. **McDonald, Noreen.** Multipurpose Smart Cards in Transportation: Benefits and Barriers to Use. [Online] December 8, 2000. [Cited: March 30, 2009.] <http://www.uctc.net/papers/630.pdf>.
5. **Lew, Alexander.** You Can't Live in Hong Kong Without an Octopus. [Online] October 16, 2007. [Cited: March 30, 2009.] <http://blog.wired.com/cars/2007/10/you-cant-live-i.html>.
6. **Hong Kong Transport Department.** Octopus Card Operated Parking Meter. [Online] [Cited: March 31, 2009.] http://www.td.gov.hk/transport_in_hong_kong/parking/parking_meters/octopus_operated_parking_meters/index.htm.
7. **International Telecommunications Union.** digital.life: ITU Internet Report 2006. [Online] 2006. [Cited: March 30, 2009.] <http://www.scribd.com/doc/7656694/Digital-Life>.
8. **Kowloon Motor Bus Co.** Development of KMB's Octopus Payment System. [Online] November 27, 2003. [Cited: March 31, 2009.] <http://www.kmb.hk/english.php?page=next&file=news/service/news3q03/news2003112701.html>.
9. **Metrolinx.** Frequently asked questions about the Georgetown South Service Expansion and Union-Pearson Rail Link. [Online] [Cited: March 30, 2009.] <http://www.metrolinx.com/gsse/FAQS/default.aspx>.
10. **Dale, Daniel.** Fraud has TTC set to get rid of tickets. [Online] Toronto Star, June 12, 2008. [Cited: March 31, 2009.] <http://www.thestar.com/News/GTA/article/441801>.
11. **CBC News.** TTC says sorry for running out of Metropasses. [Online] January 9, 2009. [Cited: March 30, 2009.] <http://www.cbc.ca/canada/toronto/story/2009/01/09/metropass-ttc.html?ref=rss>.
12. **Munroe, Steve.** Metrolinx Fare & Service Integration (Update 3). [Online] January 14, 2008. [Cited: March 30, 2009.] <http://stevemunro.ca/?p=1714>.
13. **Newmark, Gregory L.** An Institutional Analysis of Transit Fare Integration. [Online] 2007. [Cited: March 31, 2009.] <http://pubsindex.trb.org/document/view/default.asp?lbid=802748>.