Developments in transit fare policy reform

Streeting Mark[1] and Charles Prof Phil[2]
[1] Booz Allen Hamilton, Brisbane, QLD, Australia
[2] University of Queensland, Brisbane, QLD, Australia

1 Background

Transit providers around the world are progressively migrating from Automatic Fare Collection (AFC) systems employing traditional fare media (e.g. paper and magnetic stripe tickets) to state-of-the-art contactless smartcard systems. The introduction of this new technology provides a unique opportunity for transit agencies to review fares and ticketing policy and leverage the full functionality of these new ticketing systems. However, in general, it would seem that fares and ticketing policy is being addressed as an afterthought and the AFC procurement process continues to be technology rather than policy driven.

This is supported by research with United States transit agencies conducted by the Transit Cooperative Research Program (TCRP), which found that the installation of new technology was the 'trigger' event for a fare structure review in only around 30% of cases (TCRP 2003). Around half of fare structure reviews were triggered by way of either a regular review process and/or an unexpected revenue shortfall (see Figure 1) (source: TCRP 2003).

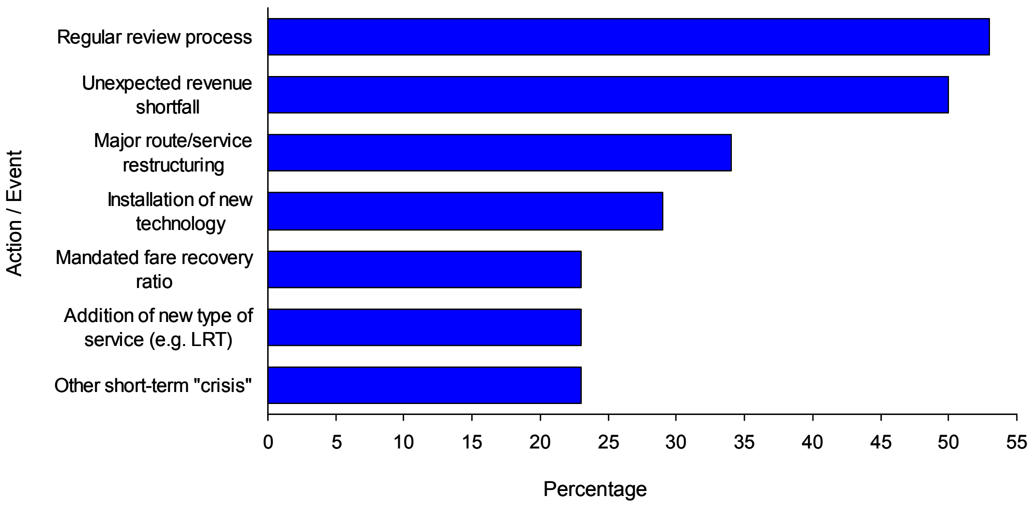

Figure 1 Triggers for agency fare structure review process (source: TCRP, 2003)

2 Introduction

A transit fare system comprises four components:

1) Fare structure: the spatial structure that supports the fare system (e.g. flat, distance-based, time-based, zonal)

2) Fare products: the range of tickets available (e.g. single, multi-ride, periodical) and associated business rules (e.g. concession availability, transfers etc)

3) Fare levels: the price of each fare product

4) Fare media: the technology used to process ticket transactions (e.g. paper tickets, tokens, magnetic stripe, smartcard)

The focus of this paper is fare structures and fare products, together with the influence that fare media, specifically ‘contactless’ smartcard technology, has played in the development of transit fares policy. Issues associated with fare levels are a major research project in itself and there is an extensive economic literature that addresses mass transit fare levels. This literature has built on the widely recognised seminal contributions made in the 1970s by authors such as Mohring (1972) and Turvey and Mohring (1975). Fare levels are only considered to the extent that they impact on fare structure decisions. Key policy issues such as the case for subsidised transit fares are not considered.

3 Fares policy development

3.1 Policy objectives

Transit fares policy has pervasive implications for a city from an economic, financial, social, political and environmental perspective. While it is inevitable that trade-offs between competing objectives will need to be made, examples of actual fares policies are extremely difficult to find. As an example, the Auckland Regional Transport Authority (ARTA) has an objective ‘to maximise patronage of public transport at a given level of maximum fares’ (ARTA personal communication, 2005).

The range of objectives that individual agencies identify with was established in a now dated fares policy survey of UITP members completed in the early 1990s by Beasley and Grimsey (1991). Figure 2 shows the seven objectives that at least 25% of respondents rated as ‘very important’.

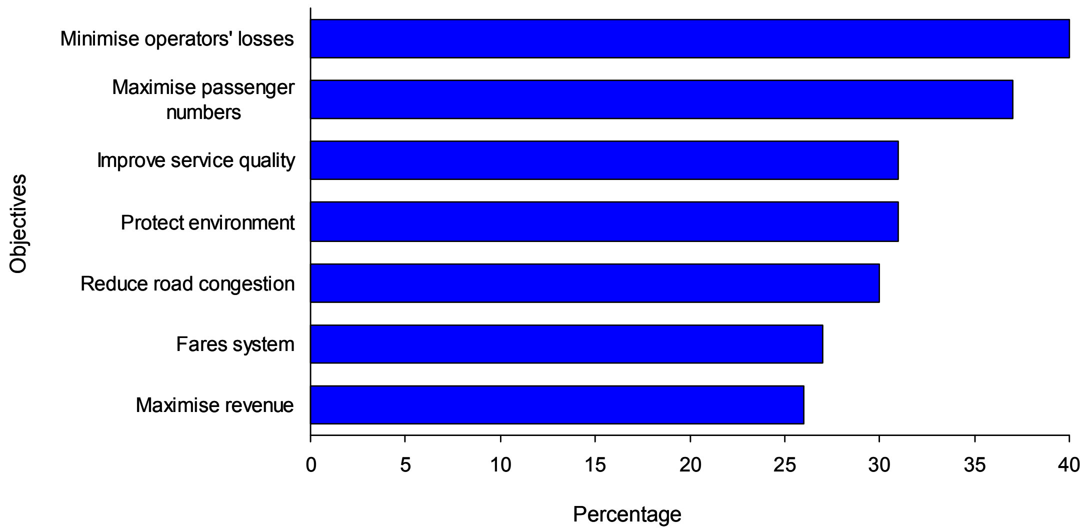

Figure 2 Major fares policy objectives

4 Fare structure

In essence, the fare structure establishes the strength of the relationship between fare levels and distance travelled. At one extreme, a 'flat' fare structure establishes a single fare regardless of the distance travel, while a point-to-point distance-based fare structure establishes a unique fare for each station or stop pair.

Table 2 in Attachment A summarises the key strengths and weaknesses of the four fundamental fare structures. With the exception of a time-based structure, a number of examples of each of these fare structures are found in major international cities. Note that a popular 'hybrid' structure is a time-based zonal structure, which facilitates transfers between services within a given time period.

From a fare structure perspective, the availability of new smartcard technology has provided the opportunity for all transit agencies to review the fare structure employed. Specifically, smartcard technology provides the opportunity to fully 'close' the fare collection system more cost effectively via the provision of ticket validators at all system entry and exit points (i.e. 'tag on – tag off'; other terminology commonly used to describe such a system includes 'swipe in – swipe out' and 'check in – check out'). In the rail context, this could previously only be accomplished via the physical closure of the system (e.g. manual checks by station staff or by the installation of fare gates). In the bus context, there was previously no means to close the fare collection system and fare evasion tied to so-called 'overriding' was an ever present problem for all systems other than those supported by flat fare structures.

The enhanced capacity to close the fare collection system via smartcard technology focuses attention on the desirability from a policy perspective of moving away from relatively simple coarse fare structures to structures that establish a more highly differentiated relationship between fare levels and the distance travelled. As noted in TCRP (2003), the principal policy arguments made for differentiated fares (e.g. by trip length) focus on issues related to economic efficiency and equity:

– From an economic efficiency perspective, it is argued that higher fare should be charged to cover the higher operating costs associated with serving longer trips such that those travelling longer distances are not cross-subsidised by those travelling shorter distances;

– Again, from an economic efficiency perspective, it is often claimed that passengers of higher cost (i.e. long distance) services are less price sensitive than those using lower cost services and hence revenue raising efficiency dictates that those travelling longer distances pay higher fares;

– From an equity perspective, it is argued that passengers perceive that a fare structure that establishes a strong relationship between the distance travelled and fare levels is fundamentally 'fair'.

From a cost perspective, Kerin (1992) sought to reconcile the range of divergent conclusions reached with respect to the relationship between economically efficient bus fares and trip distance. Kerin concluded that the distinction between *passenger* trip distance and *bus* trip distance provided a means of reconciling the observed differences in the literature regarding optimal 'first best' fare levels. 'First best' pricing equates to setting fares to marginal social costs (i.e. bus costs and bus user costs). That is:

> *… first-best fares may be approximately flat (or perhaps slightly inverse) with respect to passenger trip distance for a given bus, but probably rise with bus trip distance (Kerin 1992)*

The implication here is that different fares should be charged for different passenger trip distances on a given bus. Clearly, this finding does not support a standard distance-based tariff applied across all services. In fact, Kerin suggested that the optimal approach might be to charge a flat fare for all trips on a given bus.

The revenue raising efficiency argument is tied to the strength of the relationship between fare elasticities and distance travelled. The primary determinants of transit fare elasticities include trip purpose, the price and availability of alternative modes, income and trip length.

Recent research undertaken by the Transport Research Laboratory (TRL 2004) suggests that rail fare elasticities do tend to decline over longer distances. However, this is often associated with the effect of rail fare tapers (i.e. declining fares per unit distance) and this relationship can break down under particular circumstances under the impact of the so-called 'income effect'. The 'income effect' captures the fact that fares are higher for longer distance trips and therefore represent a higher proportion of income which (other things being equal) implies higher fare elasticities.

In the bus context, the relationship between trip distance and fare elasticities is more problematic but again reflects the interaction of the relationship between per unit fare levels and distance and fare levels and income. In summary, it is not possible to conclude on a priori grounds that fare elasticities will support the establishment of a strong, positive relationship between fare levels and trip distance.

Perhaps the strongest and least contentious argument for strongly differentiated fares according to trip length is the equity argument. Market research with transit customers around the world consistently suggests that customers consider that those fare structures that establish a strong, tangible relationship between fare levels and distance travelled are fairer than say a 'flat' fare structure. For example, recent qualitative research completed by Booz Allen Hamilton (2004) for Guangzhou Metro Corporation asked respondents whether they would prefer a flat fare structure or a distance-based fare structure. Most indicated a preference towards distance-based fare structures, especially short distance travellers.

It is important to recognise that customer attitudes towards flat fare structures are heavily dependent on the 'base' flat fare level. At relatively low 'flat' fares customer support for flat fare structures is typically strong. For example, recent qualitative research undertaken by Colmar Brunton (2005) in Auckland confirmed that there was strong support for a flat fare structure at a fare of NZ$1.00 but '… at NZ$3.00 or above this concept lost appeal almost entirely'. Similarly, in the South East Queensland context, Brisbane City Council trialled a $2 flat fare in January 1999 via the 'Busabout' ticket product. Market research undertaken with Brisbane Transport bus passengers confirmed that the customer acceptability of the Busabout concept was critically dependent on the fare level.

> *When Busabout users were questioned if they would use a similar type of ticket at a price of say $2.50, $3 or even $4, the answer was simply no – 'it is too expensive'. At these higher prices, a flat fare ticket was not considered equitable for short trip passengers when compared with longer trip passengers (Booz Allen Hamilton 2000)*

Given the increased practicality of new fare collection technology (i.e. contactless smartcard system) to support higher levels of fare structure complexity and the strong equity arguments (and potentially economic efficiency arguments in some circumstances), it is obviously of interest to consider longer term trends in transit fare structure reform.

Cervero (1980) noted that while average trip distances and the intensity of peak period transit usage had steadily increased in the United States since the 1960s, transit operators had (ironically) continued to switch from differentiated to flat fares. Cervero (1980) sought to empirically model the impact of alternative fare structure options for a number of transit operators in California and reached the following conclusions:

– Finely graduated price structures appeared the most promising in equalising price disparities and eliminating regressivity;

– More coarsely differentiated fare structures seemed best suited to improving each system's financial posture because of both their high revenue productivity and low collection costs;

– Fares differentiated by both distance steps and time-of-day appeared to provide a balance of efficiency, equity and revenue benefits.

These conclusions reached by Cervero (1980) are all still highly relevant today with one exception. The significance of fare collection costs in supporting the case for more coarsely differentiated fare structures is no longer as strong. From a fare collection cost perspective, fares policy decisions are only likely to become a strong driver of costs should (1) the fare collection system be required to support concepts such as price caps or frequent user discounts and/or (2) the fare collection system be required to support 'tag on – tag off' functionality. As such, a distance-based structure supported within a product environment will not materially increase fare collection costs relative to a simple flat fare structure (for example).

More recent evidence reveals a continuation of this trend in the United States. Between 1994 and 2000, the proportion of transit agencies in the United States employing either zonal or distance fares (apart from light rail operations) actually declined (see Table 1).

The TCRP offer the following explanation for this trend:

> *Transit agencies by and large do not seem willing to address the complexities associated with designing, implementing, administering and marketing distance-based/zonal strategies. In fact, several agencies have sought to simplify their fare structures in recent years by eliminating or reducing the number of zones (TCRP 2003)*

One such example is the fare simplification initiative adopted by WMATA in Washington DC for its Metrobus operations. In this case, the zone-based fare structure was replaced by a flat fare structure with the objectives of 1) reducing a key barrier to transit use; 2) increasing transit ridership; and 3) making better use of existing investments in the transit system (Mitchell 1999). Significantly, achieving an increase in farebox revenue was not a stated objective of the WMATA fares policy reform.

Table 1 Proportion of United States transit operators with zonal or distance-based fare structures, 1994 and 2000 (source: TCRP)

System	1994	2000	Change
Bus	37%	30%	-7%
Heavy rail	33%	20%	-13%
Light rail	21%	27%	+6%
Commuter rail	94%	89%	-5%

The UITP fares policy survey (Beasley and Grimsey (1991)) also confirmed the dominance of flat fare structures. Flat fare structures were adopted by around 70% of the euro-centric UITP membership. Zonal and distance-based structures were evident in around one-third of cases. (Note that a number of operators adopt multiple fare structures for different parts of their network of different fare products and hence multiple responses were possible.)

Although more recent consolidated data is not available, anecdotal evidence suggests a similar trend in Europe to that observed in the United States (i.e. a continued trend towards fare simplification). A number of European cities including London, Paris and Barcelona have pursued fare simplification in pursuit of so-called ‘marketability benefits’ (i.e. on the basis that this will lead to higher patronage and revenue as infrequent or non-users find the transit system easier to understand and use from a fares perspective). Informal discussions with those responsible for implementing the London reforms suggested that the suite of initiatives had added 5% to underlying London bus and tube demand over the past two decades.

The London Buses fare simplification initiative also highlights the potential importance of non-fares related issues in driving the fares policy agenda. The primary goal in London is to progressively migrate towards the ‘cashless bus’ as a means of reducing bus boarding delays and improving the reliability of bus running times (Fairhurst 2003). Prior to the fare simplification initiative, 30% of passengers paid cash and the driver was responsible for providing change and issuing tickets. Migrating to a flat fare structure in the year 2000 and promoting off-bus ticketing was the key strategy directed at this issue. Although London Buses revenue has increased significantly, the significant increase in the service subsidy requirement is consistent with the fact that this has largely been a response to the significant increase in service levels rather than the fare simplification initiative.

The Seoul Metro provides an excellent example where the functionality provided by the new contactless smartcard ticketing system (i.e. ‘T Money’) was employed to re-introduce a more strongly differentiated fare structure. Until the mid-1980s a distance-based structure (i.e. fixed fare for first 8 kilometres plus a distance component for each additional kilometre) was used. Technical limitations with the fare collection system in place at the time necessitated that the metro employ a zonal-based structure that divided Seoul up into seven districts. However, following the recent implementation of the new ‘T Money’ contactless smartcard ticketing system, Seoul has reverted to a distance-based fare structure with a view to increasing overall farebox revenue.

Although it is difficult to ignore the obvious impact that fare levels play in terms of observed farebox cost recovery levels, international evidence shows that the more commercially oriented transit operators have tended to maintain distance-based fare structures rather than embrace patronage friendly fare simplification initiatives. The Hong Kong MTRC is one such example where unique distance-based fare scales have been maintained for each line that reflect economic conditions, customer affordability and the strength of competition from alternative modes.

From an Australasian perspective, no strong policy direction is evident in policy reforms implemented over the past decade. Two smaller Australian cities (i.e. Newcastle and Canberra) have moved to flat fare structures. On the other hand, full fares integration was achieved in South East Queensland via the extension of the concentric ring model employed by Brisbane Transport for its bus operations. This has served to maintain a strong relationship between fare levels and distance travelled with 23 zones defined between the Sunshine and Gold Coasts (TransLink 2006). Both Melbourne and Auckland are currently completing fares policy reviews in conjunction with the procurement of new contactless smartcard ticketing systems and fares policy reform can be expected. In the Melbourne context, the Transport Ticketing Authority (TTA) website has already flagged that the new fare collection system will be 'tag on – tag off' and that the stored value concept will be employed (Department of Infrastructure 2006).

5 Fare products

Three core fare product concepts have traditionally been employed by transit operators:

- Single
- Multi-ride
- Period pass

Table 3 in Attachment A provides a definition of these products and their respective strengths and weaknesses.

Traditionally, these core products types have been supported by a mix of paper, token and magnetic stripe fare media. Another important characteristic of these fare product types is that they can all be supported by 'open' fare collection systems. That is, no exit controls are required to support these fare products – tickets are purchased or validated at system entry or a 'proof of payment' system operates. [A proof-of-payment system requires the passenger to carry a valid ticket or pass that can be subject to random inspection by roving ticket inspectors (TCRP 2003).]

A number of leading international rail operators have also employed magnetic stripe fare technology to support 'smart' fare product concepts:

- Stored value (i.e. initial purchase or add value monetary bonuses – see Table 3)
- Frequency-based discounts (e.g. a reduced fare payable once a trip threshold is reached)

As suggested earlier, smartcard ticketing technology provides an enhanced capacity to fully close the fare collection system (i.e. 'tag on – tag off' systems), without resorting to full physical closure in the case of rail systems and affords this opportunity for the first time in the case of bus services.

From a fare product perspective, this creates significant opportunities for product innovation. As noted by TCRP (2003), these opportunities are tied to the greater memory and processing capabilities of smartcards and the durability of a 'long life' smartcard compared to magnetic stripe ticket media.

The two concepts that seem to have attracted the greatest attention amongst transit agencies are 'fare capping' and the 'fair fares' concept.

Fare capping provides for a maximum fare to be payable over specified time periods. The fare cap could interact with specific fare products loaded onto a smartcard or fares deducted from the smartcard e-purse in accordance with a given fare scale. The fare capping concept clearly captures a core feature of a period pass (i.e. the maximum fare payable over a designated period is known with certainty) but the downside risk that the customer bears in purchasing a period pass is removed. For example, where illness or changed circumstances do not allow the transit customer to complete the intended travel.

The fare capping concept was introduced on London's 'Oyster' smartcard in February 2005 for those customers using 'Pre Pay' (i.e. the Oyster card stored value functionality). Both peak and off-peak fare caps were introduced having regard to the price of comparable one day period tickets (see Transport for London 2006). Before the introduction of these fare caps it would have been possible for persons travelling at 'Pre Pay' fares to pay more for their daily travel compared to the cost of a one day periodical fare product with the same travel entitlement.

The 'Fair Fares' price capping concept is most often associated with WMATA in Washington DC. In essence, the 'Fair Fares' concept guarantees that the customer pays the lowest fare having regard to the price of all WMATA fare products. Whereas the London fare capping concept only provides this guarantee for a 24 hour period, the proposed WMATA scheme would (for example) effectively cap fares over seven days or a month having regard to the travel undertaken over the period and the price of the comparable period pass.

The current status of the 'Fair Fares' initiative is unclear. However, the current financial position of WMATA may well be major factor affecting its implementation, given that the potential revenue dilution associated with the 'Fair Fares' initiative. WMATA is reported to be facing an average annual operating and capital shortfall of over US$300 million over the next decade (Metropolitan Washington Council of Governments 2006) and hence there is likely to be pressure to take steps to increase rather than decrease farebox revenue.

Within a product-based environment, price capping along the lines of that proposed by WMATA appears to be a logical step to provide the transit customer with the confidence of a 'lowest price guarantee'. Without such a guarantee, notwithstanding the operational and convenience benefits associated with the use of contactless smartcards in transit, the onus will continue to rest with the customer to ensure that they purchase the appropriate fare (i.e. a 'buyer beware' environment). Further, the customer purchasing a period pass will continue to bear the downside risk associated with the purchase of such a product (i.e. where intended travel is not completed).

Arguably, the Hong Kong rail mass transit operator (i.e. MTRC) has shown the most initiative in terms of implementing a range of innovative discount schemes to increase MTRC ridership and revenue. For example:

– Next trip discounts if passengers swipe their Octopus smartcard at designated temporary card readers (readers are normally placed between stations as a means of capturing existing bus passengers)

– Tenants of new housing developments are offered discounts for the first one or two years of residency

– Discounted flat fares for children and seniors on Sundays and public holidays (a key objective being to attract accompanying full fare paying passengers)

– Commemorative ticket providing unlimited travel on the first day of Chinese New Year

Such initiatives serve to exploit the full power of state-of-the-art contactless smartcard ticketing systems compared to previous generation fare collection equipment.

6 Integration dimensions

The concepts of ticketing and fares integration are often erroneously used interchangeably and this sometimes extends to those closely engaged in transit fares and ticketing policy. The two concepts can be defined as follows:

– Ticketing integration: common fare payment media (e.g. magnetic stripe tickets or smartcards)

– Fares integration: common fare structure, fare products and fare levels across all modes and operators

From a broader transit policy perspective, ticketing integration provides 'seamless' travel between all modes and services and is a necessary pre-requisite to facilitate service integration.

A more challenging issue for fares policy is the desirability of moving to full fares integration. Given that ticketing integration satisfies the policy requirement for seamless travel, the potential benefits of fares integration seemingly lie in having a single 'fare system' (i.e. to understand, use and market) and any associated incremental patronage and revenue. Significantly, it may also be possible to migrate to full fares integration and hence create a 'seamless' fares and ticketing environment before a smartcard system roll out (e.g. South East Queensland). The potential challenges tied to a move to integrated fares include sustaining stakeholder involvement, commitment and cooperation, managing farebox revenue and cost recovery impacts, managing customer fare level impacts (particularly for the 'losers') and potentially developing an acceptable and sustainable approach to farebox revenue impacts. This issue does not apply where the transit agency assumes farebox revenue risk (e.g. under a gross cost contract regime).

As suggested above, an extremely important policy issue is the patronage and revenue gains that can be reasonably expected as a result of moving to full fares integration. For example, in the first full year following the migration to full fares integration in South East Queensland (i.e. 2004/05), year-on-year patronage increased by around 10%. However, fares integration is only one factor that contributed to this increase. The reduction in bus fare levels associated with migrating to full fares integration, together with service enhancements and marketing and communications initiatives rolled out by TransLink and changes in the external environment all contributed to this result. TransLink recently commissioned Booz Allen Hamilton to complete a detailed analysis of the observed market impacts in the first year of full fares integration.

7 Conclusions

The major conclusions emerging from this paper can be summarised as follows:

– Some of the key fares policy research is now relatively old and pre-dates the roll out of all major contactless smartcard ticketing systems

– There is a need to bridge the gap between the United States-centric research completed by TCRP and the euro-centric research completed by or for UITP and to augment this with Asian and Australasian perspectives

– The on-going trend towards fare structure simplification (at least in the United States and Europe) is clearly not serving to leverage the power of state-of-the-art contactless smartcard ticketing systems and it is not always clear why this is the case

– Similarly, fare product innovation associated with the procurement of new technology fare collection systems has been slow and transit agencies have remained largely wedded to traditional product concepts

– The impacts of ticketing and fares integration, which is often an important driver of new fare collection procurement strategies, are not well understood (particularly the incremental benefits of fares integration over and above ticketing integration)

Abbreviations

AFC	Automatic Fare Collection
ARTA	Auckland Regional Transport Authority
IRTP	Integrated Regional Transport Plan
MTRC	MTR Corporation
TCRP	Transit Cooperative Research Program
TTA	Transport Ticketing Authority
UITP	International Union (Association) of Public Transport
WMATA	Washington Metropolitan Area Transit Authority

Attachment A

Table 2 Core Fare Structures - Strengths and Weaknesses (source: Booz Allen Hamilton, 2004)

Structure	Strengths	Weaknesses
Flat	– Simplicity – Low ticket issuing costs – No scope for overriding	– No relationship between fare and distance travelled – Implicit cross-subsidisation between short and long-distance trips which distorts travel patterns
Distance-based	– Establishes strong relationship between fare and distance travelled – Generally perceived to be 'fair'	– Transfers difficult but not impossible to handle – Calculation of fare for irregular journeys difficult
Time-based	– Simplicity – Facilitates straightforward transfers between services	– Late running and service cancellations may impact on ticket 'value' – No direct relationship between fare and distance travelled
Zonal	– Broad relationship between fare and distance travelled – Relatively easy to understand – Facilitates straightforward transfers between services	– 'Boundary problems' (i.e. passengers travelling a short distance across a zonal boundary)

Table 3 Core Product Range – Strengths and Weaknesses (source: adapted from TCRP, 1996)

Ticket Type	Definition	Strengths	Weaknesses
Single	– One-off ticket purchased for single trip on day of travel	– Operator – premium revenue received for trip – Minimum upfront outlay	– No discounts for customer – No customer incentive for greater system use – Inconvenience of selling and purchasing ticket each time trip is made
Multi-ride	– Multiple trips (usually 10) are pre-purchased at a discounted rate	– Convenience of purchase (i.e. a number of rides may be purchased at the one time) – (Usually) not time based – rides may be redeemed at the customer's discretion – Reduced level of fraud or revenue dilution compared with period passes (i.e. no inherent benefit of 'sharing' ticket) – Reduced cash handling – Increases 'commitment' of users compared with single trip usage	– Needs system of validation to decrement value (i.e. magnetic stripe or smartcard reader) – Upfront cost of ticket (typically equivalent to 10 trips) to achieve discounts may be prohibitive for low income earners
Period Pass	– Ticket provides unlimited rides within specific origin/destinations within specific time period (usually daily, weekly, monthly, quarterly and annual periods)	– Customer travel savings – unlimited rides within a specific period means level of effective discount increases as more trips are made – Can generate increased ridership and 'loyalty' among riders – Can generate more income although this depends on the price – Reduced cash in system – Improved cash flow – revenue captured in advance – Does not require automatic validation – can operate in low-technology manual 'flash pass' environment – Longer-term passes can often be replaced if passes lost/stolen and identification is provided	– Purchase price may be too high for lower income passengers – Operators may experience revenue dilution as a result of: (a) customers generally taking more trips than the 'break-even' trip rate and (b) potential for customers to share passes (legally or illegally)
Stored Value	– $ value can be automatically loaded on to card off-system and relevant fare automatically deducted	– Flexibility for the customer (i.e. customers may choose the value of money to be loaded at any one time) – Fare is automatically calculated in closed environment	– Requires magnetic stripe or smartcard technology

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