Appendix B: TTC Use of TTS data and Madituc for Service Planning – William R. Dawson Paper

Optimising Transit Service Decisions Based on Ridership - Good for passengers and the community

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Introduction

In planning transit services, a balance must be established between the needs of individual passengers and the achievement of broader community and societal objectives. This balance must be achieved both from a service perspective, in determining how to make tradeoffs between groups of passengers with competing needs, and from a financial/economic perspective relating to the priority given to funding for transit by the community compared to other government services.

The TTC developed a strong policy framework for incrementally increasing service throughout the 1980's, in a cost-effective way based on a set of "service standards". The standards evolved as a set of agreed-upon guidelines concerning how, and where, transit services were effective in attracting passengers in an affordable way. There were large changes in the TTC's operating environment, both internal and external, in the 1990's which required management to take a much more business-based approach to decision-making throughout the organisation. This led to a reassessment of the TTC's service standards, and the development of a revised approach to decision-making about service. The revised approach is true to the underlying principles of the original service standards but is more systematic, and clearly associates individual decisions with the economic impact of those decisions on fares and taxpayer subsidies. The approach focuses on determining the system-wide ridership (and revenue) implications of implementing individual service changes.

The revised approach was used to implement a major reduction in service in 1996, while minimising ridership losses, and has since been used as a continuous process of route monitoring and assessment for incremental service changes at the TTC. The approach has contributed to the TTC's success in achieving an 80% cost-recovery ratio in the past few years.

Traditional Service Standards

Service standards have evolved at many transit properties in North America in the past two decades to provide guidelines to policy makers and planners as to how services should be planned and resources allocated in response to how passengers chose to use transit services, and what is acceptable from a community perspective. The TTC was a leader in this endeavour as it developed formal service standards which were approved by the policy board in the late 1970's. These standards evolved over the years and are typical of those now used in many North American transit properties.

Table 1 provides a summary of the standards used by the TTC throughout the 1980's(1). These standards were used for planning passenger service, and for evaluating economic performance of individual routes. From the passenger-service perspective, the standards covered topics

Table 1
Summary of Service Standards used by the TTC throughout the 1980's

Basic 24-hour Per Day Service

i) A base network of bus service is provided, at all times, within a 15 minute walk of 90% of residents of the City every 30 minutes.

ii) Any additions to this basic level of service must be warranted under the financial and service standards described below.

Route and System Design

i) Walking distances of up to 200m in areas with high seniors population, and 300m elsewhere, are acceptable; service changes will only be considered if they benefit passengers who must walk further than this to service.

ii) New services will be considered only if the benefits for new and existing passengers are greater than the adverse effects on existing riders.

iii) A grid route network of routes will be maintained which integrates surface and rapid transit routes while minimising route duplication.

Hours and Frequency of Service

i) Service will be provided at least every 30 minutes on all surface routes and every 6 minutes on rapid transit lines.

ii) Service frequencies will be increased when passenger loads exceed preset load standards, by vehicle type.

iii) Earlier or later trips, and additional time periods of operation, will be added if they are forecast to require less subsidy than the Maximum Permissible Subsidy financial standard.

Financial Standards and Comparative Evaluation

i) All routes and services must operate with a subsidy which is less than the Maximum Permissible Subsidy. The Maximum Permissible Subsidy is set at five times the system average subsidy per boarding passenger (an arbitrary ,but reasonably generous cut-off).

ii) The TTC's resources will be allocated to maximise passenger and community benefits taking into account transit accessibility, transit dependency and improved travel time for passengers through a formal comparative evaluation process.

such as walking distance, waiting times, and crowding conditions on vehicles but, for example, did not explicitly deal with transfers or in-vehicle time. To address social equity issues, specific recognition was given to areas with high transit dependency and the special needs of senior citizens using the TTC. From the economic perspective, route-specific economic performance was monitored through a variation of the typical revenue/cost ratio, which, in the TTC's case, was described in terms of "subsidy per boarding".

The Challenge of the 1990's

The standards worked well in guiding the expansion of TTC services which occurred, in response to ridership growth, over the 15-year period from 1975 to 1990. In the 1990's however, the TTC has undergone a dramatic restructuring, with ridership falling 20%, government funding being reduced by 39% and, in response, fares being increased 50% and service reduced by 12%. During this period there was also a substantial reorganisation of internal operations, with large reductions in non-operating staff and the closure of a number of out-dated facilities. This has resulted in the TTC operating with a cost recovery of 81% in 1998, which is up from the 68% target established as the funding level for the TTC throughout the 1980's.

It is hard to separate cause and effect in these situations, but a number of factors helped to drive this dramatic change including:

- a major economic downturn in the Toronto region resulting in a substantial reduction in work trips made on the TTC. The TTC's service area within the region was particularly hard hit.
- demographic factors related to age, female workforce participation and a flow of population and employment to the suburbs reduced TTC ridership.
- municipal and provincial policies to reduce funding to the TTC which resulted in fare increases and service cuts.
- two work stoppages/work-to-rule actions by the TTC's unions.

The service standards, which worked well on an incremental basis throughout the 1980's, needed to be restructured to be able to evaluate system-wide issues and the overall impact of ridership and service changes on the financial situation of the TTC. Service planning procedures were required which reflected business-based decision-making while still preserving the essential elements of the traditional service standards as they represent a strong policy consensus, developed over many years, as to what passengers and the community want from the transit operation.

Revenue/Cost Ratio

In developing a new procedure, the weaknesses of using of a route-specific revenue/cost ratio (or the mathematically-related subsidy per boarding in the TTC's case) for economic analysis, quickly became apparent. For example, when considering possible service eliminations, a route-specific revenue/cost ratio is of limited value because it does not provide any indication of the contribution that route makes to the overall system economic performance. Two routes with the same revenue/cost ratio can be quite different, from a system perspective if, for example, one of the routes is in an area where there are many other transit options, and the other is in an isolated area where no other transit options exist. In this case, elimination of the route where there are other options may lead to relatively little system-wide revenue loss, as passengers can divert to other nearby services, but elimination of the route in the isolated area could result in much higher revenue losses as many current passengers would simply stop using the service altogether.

Ridership Loss and Gain Analysis Compared to Traditional Service Standards

In the above example, a traditional application of walking distance standards would lead to a conclusion similar to that obtained from a system economic analysis. The elimination of a route in an isolated area would result in excessively long walking times where the elimination of a route in a location where other transit options exist would be more acceptable from a walking distance perspective. The traditional service standards approach does not, however, provide a mechanism for resolving differences between service design standards and economic standards.

In another example, the TTC has traditionally had a standard indicating that routes will not normally be diverted off major roads to serve individual trip generators. This reflects a concern about delaying passengers on the through-service to serve passengers at the off-route trip generator. From a system-economic perspective, however, if more passengers are gained by the diversion than are lost, then the diversion should be permitted. This approach protects the through-rider from being delayed for the benefit of a few passengers but also allows for the achievement of the community benefit of better serving a significant individual trip attractor.

The logic is similar for more complex service planning strategies, such as providing a mix of local and express service (to reduce total in-vehicle travel time), or establishing point-to-point services which reduce transfer requirements. The community benefits of these services are well reflected in the ability these services have in attracting passengers to the system, but are difficult to evaluate based on traditional service standards.

Net ridership loss, or gain, is an excellent measure of overall community benefits of any particular service. Traditional service standards were established, on an ad hoc basis, to try to reflect when, and where, transit services are effective in attracting passengers. An analysis of net ridership loss and gain provides a more systematic and comprehensive framework to achieve most of the same objectives as traditional service standards.

Transportation Modeling Approach to Ridership Forecasting

The typical four-step approach to transportation modeling incorporates mode split and network assignment procedures based on changes in weighted travel time. The different travel time components of a transit passenger's trip (walk, wait, in-vehicle time and transfers) are measured, and weights assigned to each component, based on passenger behaviour research as to how passengers actually choose one mode, or route, over another. These weighted travel times provide a basis for estimating the total passenger benefit, or disbenefit of a particular service change.

The TTC has been extensively involved in the collection of passenger travel data, and has developed a modeling process based on this data, to provide a consistent basis for preparing ridership forecasts based on changes in weighted travel time. The TTC has participated, along with other agencies in the Greater Toronto Area (GTA), in the undertaking of area-wide telephone interview surveys in 1986, 1991 and 1996 which are known as the Transportation Tomorrow Surveys (TTS)[2]. Five percent of the households in the GTA were contacted in 1996 and data collected on individual trip-making patterns of each household resident. This survey has provided the TTC with approximately 50,000 records of individual trips taken by TTC passengers with geo-coded origins and destinations, their route through the TTC network and associated demographic and household information for the trip-maker.

The TTC has worked with École Polytechnique de Montréal on a geo-coded, disaggregated approach to transit service planning, and obtained from them a network assignment model, MADITUC[3], which is specifically designed to capture the fine level of detail required to adequately represent transit trip-making in a dense grid of transit routes. The disaggregated approach works with the specific sequence of routes utilised by individual passengers, instead of aggregating trips on a zonal basis, as occurs in the more traditional, zone-based, travel demand models. This provides an opportunity to derive transit trip model parameters based on actual, individual transit passenger behaviour choices. For example, the model calibration provides a measure of the way in which passengers currently make tradeoffs between shorter walk access and more frequent service.

The model is calibrated, based on actual passenger behaviour reflected in TTS data, to provide travel time weightings for the different components of an average transit passenger's trip. The current weightings used are :

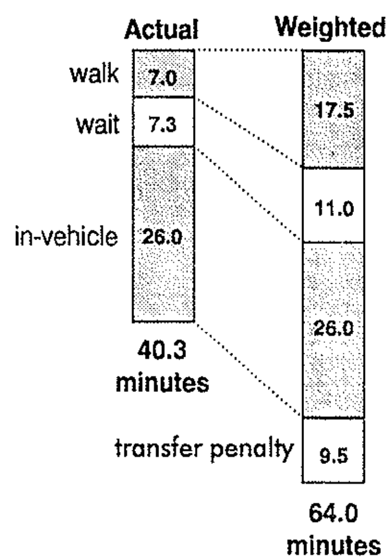
Walk	2.5 times actual walk time
Wait	1.5 times actual wait time
In-vehicle	1.0 times actual in-vehicle time
Transfers	10.0 minute penalty for each transfer

The average travel time for TTC passengers in the am peak period is approximately 40 minutes at the present time. As illustrated, however, when weightings are applied, based on the model calibration process, this expands to an average of 64 weighted person-minutes for the average passenger.

These weightings are used, in conjunction with passenger count data on individual routes and route sections, to estimate the change in total weighted travel time which would result from a

Average Weighted Travel Time

am peak 1996 TTS calibration of TTC trips



particular service change. The objective of making service decisions then becomes one of minimising total weighted passenger travel time for a given set of resources. Changes in weighted person-minutes provide a useful scale on which to compare service change alternatives. They can also be converted, in a straightforward manner, into estimates of ridership changes through the use of service elasticities.

Making Service Cuts While Minimising Ridership Loss

In 1996, falling ridership and funding pressures forced the TTC to implement both a large fare increase and a substantial number of service cuts. To minimise the ridership losses that would result from these actions, staff evaluated possible service reductions and eliminations on every route in the system, for every time period of operation, based on the effect they would have on system-wide ridership.

The procedure is now being used, continuously, to provide a basis for making month-to-month service decisions. The changes are ranked, based on the effect they would have on system-wide ridership, using the person-minutes modeling approach described above. Headway widenings are evaluated based on the increased wait time resulting from the change, and the elimination of time periods of operation (including the complete elimination of some routes) are evaluated by assigning TTS survey information to a network which excluded the service being proposed for elimination, and determining the net increase in weighted travel time resulting from the change. As many of TTC's services operate for a portion of their route on a common section with other routes, where a service elimination is being considered which included a common section, the common section passengers are evaluated separately as having only a headway widening, whereby passengers on the unique section of the route are assessed based on increased walking, wait and transfer time as appropriate.

In all cases, the modeling is used to determine the change in travel time for an average user of the service, which is then applied to the most recent count of actual ridership on the route, or route section, in question to estimate total changes in weighted person-minutes. The cost savings resulting from each possible service change was also estimated.

This procedure results in a ranked list of possible service changes that would result in the smallest increase in total person-minutes on the system for various levels of cost savings achieved through service cuts. A simple elasticity approach is then used to forecast passenger losses based on increases in weighted person-minutes. The elasticities used are derived from available literature, and previous research undertaken by the TTC, on service elasticity as described in Appendix A. This allows the ranked list to be converted to a list based on the expected number of passengers lost per net dollar of savings, after revenue losses are accounted for.

Table 2 shows an excerpt of the current list which is used for reallocating resources based on the person-minutes approach. The list is shown ranked on the simple revenue/cost ratio for these services but if the list were ranked based on passengers lost per dollar, the list would be in a dramatically different order. For example, the 39 FINCH EAST has a low revenue/cost on Saturday evenings but, because there are poor alternate services in this area at this time of night, cancellation of the route would result in many lost passengers for the TTC. In comparison, the 30 LAMBTON route in the daytime on Saturdays has the same revenue/cost ratio as the 39 FINCH EAST Saturday night service, but operates through an area that is well served by other routes in the Saturday day time period. The cancellation of this route is forecast to result in relatively few lost passengers.

Table 2
Service Resources Re-allocation List
- passengers per dollar measure

Route	Day	Period of Operation	Passengers per $	Subsidy per Boarding	Revenue / Cost
39 Finch East	Sat	Late eve	1.165	$1.24	.39
30 Lambton	Sat	Day	0.092	$1.24	.39
168 Symington	M-F	Peaks	0.112	$0.66	.54
54 Lawrence East	M-F	Peaks	0.229	$0.40	.66
126 Christie	M-F	Peaks	0.063	$0.39	.67
6 Bay	M-F	Peaks	0.129	$0.30	.72
60 Steeles West	Sun	Day	1.604	$0.30	.72
75 Sherbourne	M-F	Day	1.180	$0.12	.87
45 Kipling	M-F	Peaks	0.738	$0.10	.88
47 Lansdowne	M-F	Midday	0.581	$0.01	.98
110 Islington South	Sat	Early eve	2.366	$0.01	.98

Comparing Service Cuts to Fare Increases

With reduced funding from taxpayers, a mechanism is required to determine how much service should be cut, compared to the level of fare increase required to achieve the target reduction in subsidy. Changes in system ridership provided the common basis for making the comparison. The number of passengers lost per dollar saved can be estimated both for service cuts, and fare increases. This allows an optimum allocation to be determined between service cuts and fare increases to achieve the required subsidy reduction.

The example shown below illustrates that, in 1998, a system-wide fare increase was forecast to reduce subsidy requirements at a rate of .23 passengers lost per dollar of reduced subsidy

Passengers Lost, per Dollar of Subsidy Reduction, from a Fare Increase
TTC 1998 Example

Base Data

Annual Fare Passengers	389M
Annual Revenue	$539M
Revenue per Passenger	$1.39
Fare Elasticity	- 0.25

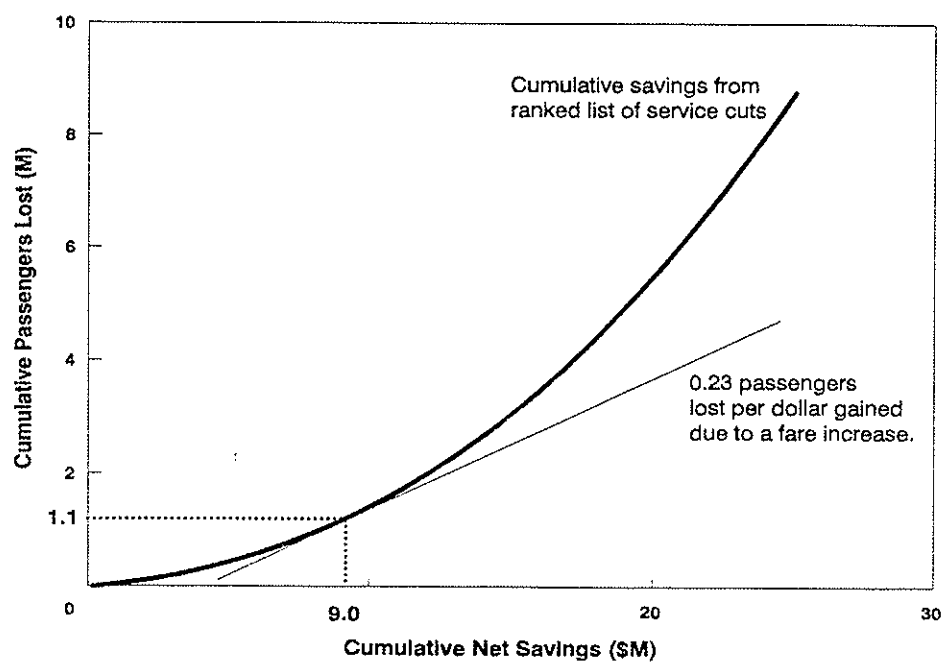
For a 10% Fare Increase:

Annual Passengers Lost:	(389M x -.25 x .1)	= 9.7M
New Annual Revenue:	((389M – 9.7M) x $1.39 x 1.1)	= $580M
Net Increase in Revenue:	($580M - $539M)	= $41M
Passengers Lost per Dollar of Reduced Subsidy	(9.7M/$41M)	= 0.23

In this example, if individual service changes could be identified which lost fewer passengers than.23 passengers lost per dollar of reduced subsidy, then overall system ridership would remain higher if the service changes were implemented before, or instead of, a fare increase. Conversely, those service changes which result in passenger losses greater than .23 passengers per dollar saved should not be implemented, as a higher system ridership would be achieved if a fare increase were to be implemented rather than a service cut.

The graph below illustrates the cumulative effect of implementing service cuts which minimise customers lost per dollar saved, compared to achieving the same result with a fare increase.

Comparing Service Cuts to Fare Increases



It shows that approximately $9M worth of service cuts could be implemented before more customers are lost than would occur with a fare increase. This defines the optimum balance point between maintaining service and increasing fares.

In 1996, using this approach, approximately 10,000 hours of service per week, 8% of all service, were identified as having fewer "customers lost per dollar saved" than would be lost with the proposed fare increase. On this basis, a package of service cuts and a fare increase were recommended to the Commission and generally accepted as the best possible approach to reducing subsidies to the TTC at the time.

Application of the Procedure

The initial use of the procedure to implement major service cuts had the (not unexpected) result of causing major upset and strong opposition within individual local communities where the service eliminations would take place. More than 80% of the service reductions identified by staff through the procedure were eventually adopted by the political Commission. The concerns expressed by the public, at the time, related primarily to lack of consultation and opposition to the reductions in funding for transit, overall. The fairness and equity of the selection process seemed to be generally accepted. From a technical point-of-view, the initial results of the procedure were successful as short-term ridership losses were somewhat less than forecast so the financial targets established for the service cuts were met.

Since the initial application of the procedure, the methodology has been refined and standardised for continuous application. Improved elasticities have been derived from follow-up surveys, as described in Appendix A, and processes established to update the analysis for individual routes, and route sections, each time new ridership information becomes available. The procedure is now the basis for developing all recommendations concerning routing changes, and for identifying routes where headway widenings can be implemented to allow resources to be reallocated to other routes where overcrowding is occurring.

In the TTC's annual Service Plan, all proposals for route and service changes are evaluated based on their potential to attract passengers, per dollar of cost required make the change. A financial cut-off is established each year on the same principle that was used in the original evaluation of service cuts; a service change is not recommended unless it will attract more passengers than would be lost through increasing fares to pay for the change.

Also published in the annual service plan is a list of the existing services which do not meet this criterion (currently about 3% of all services). These services with "poor financial performance" are recommended for elimination if a reduction in transit subsidy is required in any budget year.

Problems with the Approach

Having worked with the ridership optimisation procedure for a number of years, a number of problems and weaknesses with the procedure have become apparent:

i) **The need for high quality data and disaggregated modeling capability as the basis for forecasting changes in passenger behaviour.**

The TTC has invested significant resources to obtain data, and develop the modeling capability required, to support the current process in a credible way. Even with this investment, there remain underlying concerns about using generalised, averaging concepts such as elasticity to make specific, individual service decisions. While there is a high degree of confidence that the approach, overall, provides a good basis for decision-making, and every attempt has been made to ensure that the procedure at least provides a strong relative ranking of benefits, actual ridership changes in specific cases can vary substantially from the forecast change in ridership.

ii) **Actual passenger behaviour is more complex than is represented in the weighted person-minutes approach.**

While the weighted-person minutes approach provides a reasonable basis for assessing average passenger behaviour, it has significant limitations. For example, headway widenings of less than one minute, which do not result in overcrowding, may be imperceptible to most passengers, but in an analysis based on person-minutes, such a change may be ranked as a large negative change if it affects a large number of passengers.

Similarly, issues unrelated to travel time can dominate individual passenger's mode- and route-choice decisions. For example, walking distance is an over-riding concern for customers with mobility difficulties, but this concern is not reflected in an analysis based on person-minutes for an average user. Concerns about security at night affect some passengers' travel choices independent of travel time. As well as affecting actual passenger behaviour, these issues also have social equity implications from a community perspective, but are not easily included in the person-minutes approach.

The person-minute approach is based on the principle that each passenger has an equal right to share in the transit subsidy provided by the community. It successfully reflects social equity concerns about increased service in areas with high transit dependency because, all things being equal, a transit dependent area will tend to generate more transit passengers and, therefore, justify a higher level of service, than areas with low transit dependency. The procedure does not currently reflect other issues which result in some passengers' concerns being valued more highly than others.

A subjective weighting system could be incorporated into the procedure to reflect some of these issues but this would add complexity to an already complex approach. It would also tend to weaken the credibility of the approach, overall, by introducing subjective weightings into an approach that otherwise is completely based on actual passenger behaviour research.

iii) **The procedure is complex and difficult to communicate effectively in a public forum.**

While the procedure does provide a strong, business-based, basis for making service planning decisions, it is complex and not easily communicated quickly and simply. This may result in the procedure and, therefore, staff's recommendations, having less credibility in the public forum than would be the case if the approach were simpler and easier to communicate.

Summary

A rigorous, systematic, analysis of transit routes and services based on optimising ridership for each dollar invested, captures the primary elements of a traditional "service standards" -based comparative evaluation. It helps to ensure that resources are allocated as efficiently as possible within the service area and provides a basis for determining how to balance fare decisions with service decisions.

From the community perspective, the approach allocates service equitably across the service area in a systematic, unbiased way, based on when, and where, people actually use the service. Business-based approaches such as this also help to reassure politicians and the community that the funding provided for transit is being well managed.

Appendix A - Service Elasticity Estimates For Changes in Total Weighted Travel Time

Estimating ridership changes due to specific changes in transit service is essential when attempting to allocate service resources in an optimal way. It is, however, a complex problem reflecting passenger choice and behaviour issues in relation to the detailed characteristics of the transit service and the other travel modes available to each passenger.

In a practical decision-making sense, the TTC needs a way of, at least, ranking service change alternatives in some rational way that reflects our best understanding of potential ridership losses and gains. A simple elasticity approach was used initially, in 1995, based on available literature concerning service elasticities and some Toronto-specific research on headway elasticities [4-7]. When service eliminations were actually introduced in 1996, before-after telephone interview surveys were then undertaken to better understand passenger responses to service eliminations, specifically.

A procedure is needed to convert an estimated change in total weighted travel time (TWTT) for any particular service change into an estimate of ridership change. The literature involving service elasticity analysis typically involves only a single component of a passenger trip (walk time or wait time for example) but an implied TWTT elasticity can be derived from these results.

Table A1 shows that, while there is a large difference in travel time between passengers who transfer and those who do not, an average TTC passenger makes a 40 minute trip from origin to destination, of which 7 minutes is walking time, 7 is waiting time for service (assumed as 1/2 the headway) and 26 minutes is in-vehicle time. Most passengers also make a transfer which

Table A1
Average Weighted Travel Time of TTC Passengers
-am peak, 1996 TTS calibrated data
- based on 16,000 surveyed TTC passenger trips

	Actual	Time	(min)	Weight	All Trips
	No Transfer	With Transfer	All Trips	Factor	Weighted Time (min)
Walk	7.8	6.5	7.0	2.5	17.5
Wait	3.9	9.1	7.3	1.5	11.0
In-vehicle	13.8	32.2	26.0	1.0	26.0
Total Un-weighted Travel Time	25.1	47.8	40.3		
# of transfers	-	1.43	0.95	10.0	9.5
Total Weighted Travel Time					64.0

typically is perceived as more onerous than reflected in the simple increase in wait time involved in the transfer. Through the modeled weighting process, this total travel time is expanded to 64 total weighted person-minutes for an average TTC passenger.

A literature review provided a number of examples of specific elasticities for one component of a passenger's typical transit trip but none dealing with total travel times. For example, wait time elasticity is typically reported as in the range of -.5 to -.7 [(4)]. Using -.5 as the example, this indicates that a 10% change in wait time will result in a 5% change in ridership. For the average TTC trip, however, wait time represents only 15 % of the total weighted travel time. A 10% change in wait time is a 1.5% change in total weighted travel time and the implied total weighted travel time elasticity is -3.3. A similar logic can be applied for walk and in-vehicle time elasticities, and by extension, for transfer penalties.

Using wait time elasticities from a literature review, coupled with earlier TTC experience with headway changes [(3)], and results indicating a higher elasticity at off-peak times compared to peak services, the following elasticities were derived for total weighted travel time:

Peak -	- 1.5
Off-peak -	- 3.0

It should be noted that these are very TTC-specific elasticities which reflect Toronto's transit service network and derived modeling process, in addition to passenger behaviour. For this reason, it is unlikely that use of these elasticities is appropriate outside of the specific TTC context for which they have been derived. These elasticities were used for initial ranking and decision-making when major service cuts were implemented at the TTC in 1996.

Before-After Passenger Surveys

In advance of the service cuts being implemented, on-board surveys were conducted on 46 routes during time periods when services were to be discontinued. The surveys were to determine existing travel patterns of passengers before the cuts in service took place, and to determine their willingness to participate in a follow-up survey after the cuts were implemented. Approximately 3600 passengers were contacted of which 2700 agreed to participate in the follow-up survey. Of these 1100 were selected who indicated that they use the service daily at off-peak times. Six to eight weeks after these passengers' services were discontinued, they were contacted to determine how the change affected their travel behaviour. A total of 575 follow-up interviews were completed, recording whether or not the person was still making the trip, whether they were still using the TTC and, if so, what alternative route through the network they chose. Basic demographic data was also collected.

Of the passengers surveyed, approximately 8% had stopped using the TTC altogether since the discontinuation of their service. The remainder were typically walking further, and having to transfer more often, to complete their trip but, six to eight weeks after the change, they were still using TTC services. Ridership losses were 50% greater when evening services were discontinued compared to the discontinuation of a midday service which had the same affect on total weight person-minutes of travel time.

A number of factors need to be considered in using these results to adjust the elasticities used for total weighted travel time:

i) available literature indicates that short-term elasticities are in the range of half the long term elasticity of any particular service or fare change. A doubling of the ridership losses over the long term would mean that eventual ridership losses would be in the range of 15% to 20%.

ii) the interviewees were selected as those who use off-peak services on a daily basis, primarily to travel to work and school. These passengers represent 70% of TTC's typical weekday off-peak ridership. These passengers are highly dependent on transit and, therefore, are less likely to stop using the service than are passengers who use the service less frequently, and for non-essential trip purposes. For this reason, the survey results likely underestimate overall average ridership losses.

The original estimates of ridership loss,based on derived elasticities for total weighted travel time, was for an average 25% loss of ridership for the passengers interviewed. The survey results are generally consistent with the original estimates and have been used to modify the elasticity assumptions. The elasticity estimates currently used by the TTC for changes in total weighted travel time are:

weekday peaks	-1.5
weekday midday	-2.0
evenings and weekends	-3.0

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