11. The British Columbia transit fare evasion audit

Scott DesChamps, Patricia L. Brantingham and
Paul J. Brantingham

EDITOR'S NOTE: Public transit systems rarely show a profit and many rely upon government subsidies for their continued operation. One costly drain on resources plaguing many systems is fare evasion. For example, somewhere between 5-7 percent of passengers on the New York subway failed to pay fares in 1990, at an estimated cost to the Transit Authority of $80 million (Sims, 1991b). Case Study #12 describes one solution which is to restore the inspection function lost as a result of shedding conductors and guards from transit authority workforces. Another solution implemented by subway systems such as the Metro in Washington, the London Underground and Hong Kong's new Mass Transit Railway (Gaylord and Galliher, 1991) involves the use of electronic ticket machines that will only allow passengers onto the system with pre-paid fare cards. By the end of the 90s, the New York subway will have also have adopted this method of fare collection (Sims, 1991a). This case study, originally published as a Security Journal *article (DesChamps et al., 1991), was directed by Pat and Paul Brantingham. It*

evaluates some relatively low-cost measures to combat fare evasion introduced by the Vancouver Regional Transit System (VRTS). It was found that the posting of additional attendants during rush hours to inspect the tickets of passengers entering the ferries produced an estimated 20 percent reduction in evasion, while redesign of the monthly pass to facilitate inspection achieved an even more impressive 60 percent reduction. Perhaps the most interesting finding, however, was that fare evasion on the VRTS is a collection of specific problems, each requiring its own solution. Proving once again, that in crime prevention, it pays to think small.

ONE OF THE major security issues facing any public transit system is the problem of fare evasion and how to control it.[1] Revenue lost to fare evasion can quickly mount into millions of dollars and severely effect a transit system's operating budget. Yet fare evasion is similar to much everyday crime: the loss incurred from any individual case is quite minor; only the *aggregate* effect is important. A traditional law enforcement approach stressing investigation and prosecution of individual fare evaders is not a cost effective control strategy. A situational crime prevention strategy that looks at the key characteristics of specific problems and uses prevention techniques designed to address those characteristics (Clarke, 1980) is much more likely to produce useful aggregate reductions in the problem.

Since 1986, the BC Transit Corporation, which is responsible for providing public transit across the province of British Columbia, has conducted an ongoing analysis of fareevasion in its Vancouver Regional Transit System (VRTS). It has developed a situational crime prevention *process,* based on information from periodic "fare evasion audits" of its passengers, that it uses to estimate passenger volume, to assess the level of fare evasion at specific locations under specific situations and to design and evaluate situation-specific prevention strategies.

This article describes the VRTS Fare Evasion Audit Program in some detail. In order to do this, the article must present fairly detailed descriptions of the transit system and the information collected for the Fare Evasion Audit Program followed by descriptions of several of the evasion prevention strategies tried to date.[2]

Background

Although British Columbia is larger than Texas in area, its population is almost 80 percent urban and heavily concentrated in two metropolitan regions centered on the cities of Vancouver and Victoria. Combined, the two regions

have a population of about 1.6 million, slightly more than half of the total population in the province.

BC Transit is the authority responsible for public transit systems throughout the province. BC Transit Police Services is the department of BC Transit that provides police and security services to transit facilities throughout the greater Vancouver and Victoria areas. The Fare Evasion Audit Program is administered by BC Transit Police through non-police security personnel and is centered in the Vancouver Regional Transit System.

Vancouver Regional Transit System. BCTransit Corporation's Vancouver Regional Transit System (VRTS) is the largest single transit service area in Canada. Both the Vancouver metropolitan area and its transit system are growing rapidly. The Vancouver Regional Transit System covers 1,500 square kilometers and serves more than 1.2 million people. The VRTS carried approximately 125 million revenue passengers in fiscal year 1990/91, approximately 416,000 passengers per weekday. Revenues from passenger fares contribute about one-third of the system's operating dollars: almost $ 110 million of a total operating budget of $342 million in 1989/90, for instance.

The VRTS has several major characteristics: 1) It uses a range of transit modes. 2) Fares vary by geographic zone, by time of day, by fare payment method and by passenger characteristics. In general, fares increase with the number of geographic zone boundaries crossed rather than the distance between particular destinations. 3) The system uses numerous methods for fare payment (called fare media). 4) The system tries to be open and accessible.

Range of transit modes. Greater Vancouver spreads fromcoastal mountains to the Pacific ocean astride the Fraser River valley. It is carved into segments by fjords, tidal marshes, rivers and ridges. While the topography is beautiful, it creates transit problems. No single mode of transit can serve the area effectively. The VRTS operates three majortransitmodes toprovidepublic transitacross this complex service area: a conventional bus system comprised of more than 650 diesel buses, about 250 electric trolley buses, and a variety of custom vehicles for special needs passengers such as those who use wheelchairs; a ferry system currently comprised of two custom-developed catamarans called *SeaBuses;* and an automated lightrail rapid transit system called *SkyTrain.* Both the SeaBus and the SkyTrain systems are scheduled for expansion in the immediate future.

The VRTS began operating SkyTrain in January, 1986. Primarily elevated, SkyTrain provides an automated, 24.5 kilometer long rail connection between the large and fast-growing suburbs east of the City of Vancouver and the metropolitan area's downtown core. With 17 stations and 114 cars in the system, traveling time from one terminal to the other is 32 minutes. BCTransit personnel are positioned at various points along the system to handle various technical

problems and emergencies, to check fares and to address requests for help from the public.

Fare zones and media. The Vancouver Regional Transit System is divided into three geographic fare zones. During rush hours the amount a transit passenger must pay depends on the number of fare zone boundaries crossed. Duringoff-peak(i.e.,non-rush)hours,apassenger can travel one-way anywhere on the system for the price of a single zone fare. Fares are tied to time and zone, and remain the same whether travel is by bus or trolley, by SkyTrain, by SeaBus, or by some combination of transit modes.

The VRTS uses a broad range *of fare media* (methods by which passengers pay fares) in order to make traveling on public transit attractive. There are 54 different forms of fare media. Most can be classified as either tickets or passes. The most common are:

MONTHLY FARECARD. These are transferable passes valid for one month for unlimited travel anywhere in the Vancouver Regional Transit System. There are four types of FareCards: One-Zone, Two-Zone, Three-Zone, and Concession cards for students and seniors.

SINGLE TICKET. Available from self-serve Ticket Vending machines located at all SkyTrain stations and SeaBus terminals, single tickets serve as fare receipt/transfer and are valid on all modes of travel.

FARESAVER TICKET. These are sold in books of ten at a 10% discount off single ticket prices. FareSavers have no expiry date. A FareSaver ticket is only acceptable as formal proof-of-payment when validated with date and time stamps through a Ticket Vending Machine. FareSavers are available in One-Zone, Two-Zone and Three-Zone versions and are also available for Concession fares.

DAYPASS. DayPasses can be purchased either in advance through a retail outlet or from a Ticket Vending Machine. These passes are good for one day's unlimited travel on all modes after 9:30 a.m. weekdays and all day Saturday, Sunday and holidays.

ADDFARE. One and Two-Zone FareCards, FareSaver Tickets and One-Zone Concession Tickets can be upgraded to cross additional zone boundaries during rush hours. AddFares can be purchased from Ticket Vending Machines or by depositing the additional amount in the fare box on buses.

> TRANSFER. A Transfer is required to make a transit connection on the way to a destination. Fare receipt/transfers are issued only at the time fare is paid and are valid for 90 minutes of unlimited travel.

Valid *proof-of-payment* must be carried when transferring from one transit vehicle to another, when crossing a zone boundary during rush hours and at all times when in *a fare-paid-zone*. Fare-paid-zones include all SkyTrain Cars, stations and boarding platforms; and all SeaBus vessels and terminals. All the preceding fare media constitute proof-of-payment. Persons found without valid proof-of-payment in a fare-paid-zone are subject to penalties and/or prosecution.

Open access. The introduction of SkyTrain also brought the concept *of open accessibility* to the VRTS, under which the onus is placed on riders to purchase fare media appropriate for passage. The SkyTrain system is truly open. There are no gates or turnstiles. Rather, there is a designated fare-paid-zone inside which one must be in possession of a valid proof-of- payment. SkyTrain staff conduct continuous random fare checks throughout the system.

The fare evasion problem

A complex fare schedule, such as the one used in the VRTS, that is structured around multiple geographic zones, time blocks, age concessions, and separate (yet integrated) transit modes using many different forms of fare media presents many opportunities *for fare evasion,* an irregularity in proof-of-payment that is associated with lost revenue. Fare evasion may be conscious and deliberate; or it may be produced by forgetfulness, ignorance or misunderstanding of the sometimes complicated rules that determi ne the appropriate fare for a given rider at a given time and place on the system.

The introduction of SkyTrain, with its open honor fare-payment system, increased BC Transit's awareness of the fare evasion problem. SkyTrain operating budgets were, from the outset, based on the assumption that revenue losses on the order of 1 to 2 percent of total SkyTrain revenues would accrue from fare evasion.

Early in 1986, soon after the SkyTrain began operations, Transit staff conducted some initial checks on fare payment patterns. On the basis of these exercises, staff estimated that SkyTrain was experiencing a 14 to 16 percent revenue loss from fare evasion. These SkyTrain fare checks constituted the first recorded examination of fare evasion anywhere on the Vancouver Regional Transit System. Since each percentage point of SkyTrain revenue represented approximately $200,000 in lost revenue, the results were both unexpected and shocking.

Following the initial SkyTrain fare checks, the Security Department of BC Transit Police was given responsibility for conducting a series of short *fare*

evasion audits across the entire VRTS. The audits estimated fare evasion rates on buses and trolleys, and on the SeaBus as well as on the SkyTrain. These short audits estimated that the system-wide fare evasion rate was about nine percent. Though lower than the estimates derived from the initial SkyTrain checks, this level was still unacceptably high.

Fare evasion audits

Realizing that a more rigorous fare payment monitoring process was needed to address the problem, BC Transit developed a highly structured Fare Evasion Audit Program designed to produce reliable estimates for the entire regional system. Systematic fare evasion audits began in 1987. They are conducted three times a year.

The fare evasion audit is both an information collecting process used to estimate levels of fare evasion on the system as a whole, and, on the SkyTrain in particular, a fare payment enforcement mechanism. Trained security personnel check *all* passengers present at sampled times and locations. Passengers found without proper proof-of-payment are dealt with by a BC Transit Police Constable.[3] Given resource constraints, the audit team is small. Eight full time staff audit the modes, times, and locations selected by the sampling procedure. Around 75,000 transit riders are checked in each audit.

Sampling for the initial short audits focused on perceived trouble spots. When it was realized that a more structured audit process would be required, BC Transit, using a sampling methodology developed by the Urban Mass Transportation Administration (1985) in the United States, designed a representative sample of time periods and transit routes. The sample size was determined based on a 95% confidence level and a 5% tolerance.[4] Using this more rigorous sampling frame, the evasion rate was estimated to be around 3.5 to 4 percent of all passengers. This was less than estimates derived from the initial SkyTrain fare checks and system-wide short audits, but still well above the expected 1 to 2 percent fare evasions.

Information collected. The fare evasion audits are designed to collect detailed information that reflects the complexity of the transit system including the varying levels of usage, the three major transportation modes, and the range of methods of paying fares. The audits provide details about fare evasion and how fare evasion patterns relate to the overall structure of the transit system. As a consequence, the audit process has a situational prevention capacity designed into it

Passenger volumes. The audit sample design collects information based on expected differences in daily passenger volumes. Information is collected by service categories: AM-Peak (morning rush hour); Day-Base (weekday, non-

rush hour); PM-Peak (afternoon rush hour); Evening-Base; and Saturday and Sunday blocks.

Transportation mode. Each mode is sampled. The Sky Train is divided into its 17 stations. Bus and trolley service is sampled by operating center, run and route. SeaBus riders are audited at the two terminals.

Method of fare payment. The sampling frame is designed to collect information about a broad range of fare evasion methods: almost 50 fare media/ fare evasion categories are audited.

Results of the Fare Evasion Audit Program

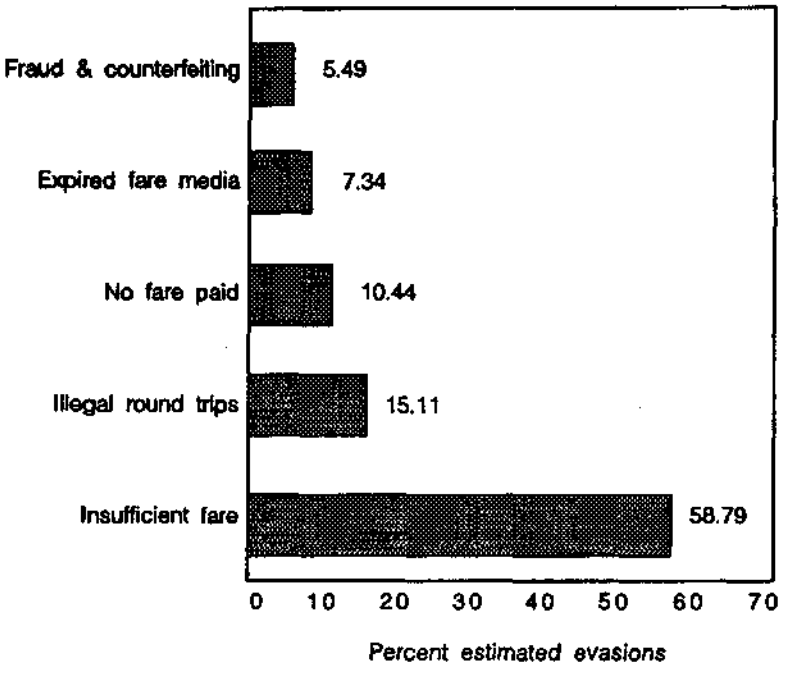
The Fare Evasion Audit Program forms the organizational basis for an established situational prevention *process*. The audits are used to identify specific fare evasion problems at particular times and places. Situational solutions to those specific problems can then be developed and implemented at those times and places. S ubsequent fare evasion audits can then be used to assess the efficacy of those solutions. Since the VRTS is an extremely complex system, fare evasion problems tend to be highly specific. Reduction in the overall fare evasion problem is pursued through a lot of small, incremental solutions addressing discrete situations at many different times and locations.

Although the early audits showed fare abuse to be most prevalent on Sky Train, they also showed fare evasion to be a pervasive problem at the SeaBus terminals and on the buses and trolley buses as well. The early audits also revealed that passengers used many methods for evading the payment of fares, though nearly all evasions fall into just five categories: payment of insufficient fare for the time and zones involved; illegal round trips; failure to pay at all; use of expired fare media; and fraud and counterfeiting. Figure 1 illustrates the relative importance these five types of fare evasion for 1989.

Most forms of fare evasion were previously unknown; no one had examined the problem of fare evasion carefully prior to SkyTrain. Passengers usually present "something" as valid proof-of-payment to transit staff when requested. The early audits showed that it was that "something" that needs close examination. Common techniques of fare evasion found in the early audits included: carrying unvalidated FareSaver tickets until caught, then claiming "I forgot to validate it"; altering FareSaver tickets to allow reuse, by erasing or "whitingout" the validation stamp or by using wax or cellophane tape so that the validation ink could simply be wiped off; and using photocopied FareCards made with sophisticated color photocopying equipment.

BC Transit Fare Inspectors and other staff are now trained in recognizing the range of fare evasion methods identified by the audits. They are specifically trained to make visual and physical examinations of all fare media produced by

FIGURE 1
FARE EVASION TYPE, 1989



passengers. They are also taught to be tactful in dealing with passengers who resist a request for proof-of-payment and are trained in handling those caught evading fares.

Current situational prevention strategies

The BC Transit Police have used the findings of the fare evasion audits to develop and implement a number of situational prevention strategies. The following sections describe four prevention programs that have been implemented, but not yet evaluated by fare evasion audits; and two prevention programs that the audits show to have had strong, continuing effects.

The four new situational prevention programs are as follows:

1. Redesigned ticket machines. The audits established the existence of a substantial number of passengers who either fail to purchase a ticket or to deposit adequate cash into bus fare boxes. Analysis of the data suggested that this type of fare evasion includes a mix of deliberate evasion and of mistakes in using automatic ticket machines.

Both British Columbia and the Vancouver region have high immigration rates; a substantial proportion of the population has trouble reading English. The first prevention effort in this area has focused on reducing fare evasion by

mistake. BC Transit has altered the design of its ticket vending machines to try to reduce their complexity. Instructions now feature simple wording and color coding. The changes have been highly graphic: color-coded maps of travel zones are tied to colored buttons that have to be pressed to determine the fare. Future fare audits should provide evidence on how much these changes have helped in reducing fare evasion by mistake; and should also give a clearer indication of the dimensions of the deliberate evasion problem.

2. Promote pass purchase. The audits have also shown that the highest evasion rate occurs among cash fare users. Asa result of this finding, BC Transit is attempting to reduce the proportion of passengers using cash fares by promoting pass purchase. This is being done through advertising.

The impact of this strategy has not yet been evaluated, but may well prove small. Cash passengers are probably infrequent public transit travelers. Frequent transit users already probably buy tickets or passes to save money. Advertising is most easily directed at frequent users, but they are the least likely cash fare evaders. Still, there are no obvious alternative solutions to this problem unless cash payments are prohibited, a policy followed in some othercities. Experience in those cities suggests that such a policy reduces overall use of public transit and may well also decrease overall system revenue. As a result, the pass promotional advertising strategy has been implemented. Its effectiveness will be tracked through future fare evasion audits.

3. Pass redesign. One of the major problems identified by the fare evasion audits was two-zone passes being used to travel through all geographic zones. The pass was redesigned to designate specifically *which* two zones are authorized. This strategy has not yet been evaluated, but it is expected that the redesign will make the misuse of the passes more difficult by making it more obvious to both the passenger and staff when a pass is being used in the wrong geographic zone.

4. Counterfeit fare media. The fare audit process has identified a number of different ways that people alter or counterfeit fare media. This type of fare evasion cannot be considered inadvertent. As a result, BC Transit Police now conduct focused investigations targeting counterfeiting and fare media alteration. Fare evasion audit data are analyzed for patterns which reveal black markets in counterfeit or forged fare media; investigations can then be directed at visible situations and suspects. In addition, BC Transit has redesigned some fare proof-of-payment media to make them more difficult to counterfeit. It is too soon to tell whether the fare media redesign has worked, but future fare evasion audits should provide evidence.

The two tested situational prevention programs are:

1. Reduced evasion on the SeaBus. The fare evasion audits revealed an

unexpectedly high incidence of fare evasion at the SeaBus terminals. These terminals have three components: an entry area where fare media can be purchased from sophisticated vending machines; a long, connecting, fare-paid-zone passageway leading to the SeaBus dock; and a passenger loading area on the dock. The loading area is entered through turnstiles where Transit staff may ask to see proof-of-payment

One source of the SeaBus fare evasion problem was traced to rush hour when the limited number of staff on duty in the passenger loading area proved unable either to examine more than a small proportion of the passengers entering the system or to project a presence that might make evading passengers think that they faced a significant chance of being caught. In response to this analysis, the number of SeaBus attendants assigned to check fare media during peak hours was increased following the Fall 1988 fare evasion audit. Before the Fall 1988 audit there were always one or two attendants on duty. After the problem was identified the minimum number of attendants, during rush hour, was set at two. The number of attendants was frequently increased during peak hours to three and sometimes four during the period when the risk of fare evasion was highest.

TABLE 1
FARE EVASION — SEABUS

	Pre-Intervention		Post-Intervention	
Audit Date	Fall '87	Fall '88	Fall '89	Fall '90
Number Audited	14,762	12,530	8,947	12,674
Number Evaders	755	626	369	520
Percent Evaders	5.11	5.00	4.12	4.10

As Table 1 shows, the SeaBus fare evasion rate has dropped 20 percent, from a little over 5 percent of audited passengers in pre-intervention fare evasion audits to a little over 4 percent of audited passengers in the post-intervention period. Moreover, the drop has been sustained over a period of two years.[5]

2. Reduced FareCard evasion. The early fare evasion audits showed that misuse of FareCard, the monthly pass, was a continuing problem. The design of the FareCard was such that it was difficult for staff to determine at a glance whether the card was valid. The FareCard was redesigned to make checking it easier and thereby discourage misuse for fare evasion. As Table 2 shows, the redesign appears to have had a significant impact, producing a continuing two-thirds reduction in the level of FareCard evasion.

TABLE 2
FARECARD EVASION

	Pre-Intervention	Post-Intervention			
Audit Date	Fall '88	Winter '89	Spring '89	Summer '89	Fall '89
FareCards in Audit	21,423	10,310	9,510	17,285	17,812
Evasions	188	33	33	44	58
Percentage	0.9%	0.3%	0.3%	0.3%	0.3%

Conclusions

Situational crime prevention strategies based on analysis of the specific conditions that make a particular crime problem possible have been shown, repeatedly, to have apowerful capacity to reduce the quantity of the crimes they address (see, e.g., Poyner, 1991a; Pease, 1991). This study further illustrates the power of situational prevention in showing how modifications of the conditions surrounding fare evasion on the SeaBus and in the use of FareCard passes were able to produce sustained reductions in fare evasion, by 20 percent in the SeaBus situation and by 67 percent in the FareCard situation.

This study also illustrates another of the important characteristics of the situational prevention approach: manycrimefacilitatingsituationsareparricular to a specific time and place. This means, we think, that many crime problems are themselves particular to the conditions found in specific spatio-temporal settings. There will be few crimes in which a single uniform prevention technique will address problems everywhere: each problem will have to be addressed by prevention tactics adapted to its specific situation. The specificity of solutions is illustrated in the way that BC Transit has tried to address different problems with different solutions: the payment of insufficient fares has been addressed by changing ticket machines to make it easier for passengers to know what the correct fares are. Counterfeiting of fare media has been addressed by making tickets and passes more difficult to copy and by focusing traditional criminal investigation techniques on the problem in order to catch the counterfeiters. The problem of evasion by cash fare passengers is being addressed through a program intended to discourage cash fare riders and make various passes and ticket books more attractive.

Finally, we note that crime problems are not static entities; they change, evolve and adapt over time as the concrete, legitimate physical and social conditions that create niches for criminal activity (Brantingham and Brantingham,

1991; Felson, 1983) and define situations in which crimes repeatedly occur (Clarke, 1980) themselves change. The BC Transit Police Fare Evasion Audit Program is both an ongoing prevention tool and an ongoing problem measurement tool. Additionally, the program provides BC Transit with its only official enforcement presence in some transit situations. While the fare audit program would doubtless benefit from additional resources allowing refinement of the situations that could be analyzed, the audit *process* has proved itself by helping identify specific problem situations and suggesting potential situational solutions. Moreover, its continuing nature allows for ongoing monitoring of the continuing effect of prevention programs and of the development of new crime problems as the transit system itself evolves and changes over time. We conclude that the development of continuing, organizationally structured crime analysis and prevention program monitoring tools, in some form, is a critical step in the development of effective situational crime prevention strategies.

The central conclusion that we draw from consideration of the Fare Evasion Audit Program is that a situational crime prevention strategy is powerfully enhanced when it is embedded in an established organizational process that identifies problems, mounts situational solutions, and tests solution efficacy on the basis of continuing, standardized measurement procedures.

NOTES

1. For discussions of vandalism problems, see Sloan-Howitt and Kelling, 1990; Sturman, 1980. For more general discussions of crime and public transit, see Brantingham, Brantingham and Wong, 1991; Felson, *et al.*, 1990; Levine and Wachs, 1985; Shellow, Romualdi and Bartel, 1974.
2. This article cannot present the complete details of the Fare Evasion Audit Program. For further information contact Constable Scott DesChamps, BC Transit Police, 1296 Station Street, Vancouver, B.C., Canada V6A 2X3.
3. BC Transit realized very quickly that the quality of the audit process might be jeopardized each time an interruption occurred due to an enforcement action. Consequently, extra manpower is factored into scheduling to allow for this. However, if an enforcement interruption does occur, the audit is stopped at that particular place and point in time. The sampling segment is rescheduled.
4. In other words, the sample estimate of evasion would be within 5% of its true value 95% of the time. The same method has been used since 1987.
5. Comparisons are made for successive Fall audits because the fare evasion data appear to fluctuate seasonally. Using data from audits conducted at similar times each year controls at least partially for this seasonal tendency.