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PROCEEDINGS OF WORKSHOP ON METHODOLOGY FOR EVALUATING THE EFFECTIVENESS OF TRANSIT CRIME REDUCTION MEASURES IN AUTOMATED GUIDEWAY TRANSIT SYSTEMS

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FINAL REPORT

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16. Abstract

The Transportation Systems Center conducted a workshop, sponsored by the Urban Mass Transportation Administration, to discuss methodologies for evaluating the effectiveness of transit crime and vandalism reduction measures which can be used on Automated Guideway Transit systems. Senior transit security staff, transit security researchers, and transit planners contributed papers and participated in this workshop. This workshop focused on current methods of assessing the effectiveness of crime and vandalism reduction methods that are used in conventional urban mass transit systems, and on how they might be applied to new Automated Guideway Transit systems. Conventional as well as novel methods of assessment were presented and discussed. Among the major issues discussed were the use of the critical incident technique to assess the community's needs with regard to transit security; the establishment of a board similar to the National Transportation Safety Board, which will focus on security issues; and the role of security specialists and management in transit planning.

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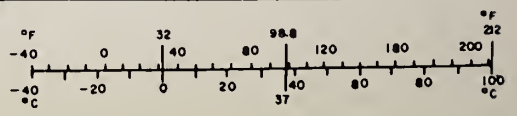
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.5	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



PREFACE

The U.S. Department of Transportation/Urban Mass Transportation Administration, Office of New Systems and Automation sponsored a security workshop conducted by the Transportation Systems Center. The purpose of this workshop was to examine the methodology employed to test the effectiveness of current transit security techniques. It was intended that the workshop serve as a forum to discuss possible new transit security evaluation methodology, with particular emphasis on Automated Guideway Transit (AGT) systems.

The U.S. Department of Transportation is conducting a program to investigate potential problems in the development of AGT systems. A part of this effort is concerned with the potential effects of crime and vandalism and the fear of crime and vandalism on passengers in these new transit systems. Transit security problems may be more acute on AGT systems than on conventional mass transit systems because of the anticipated lower number of employees.

The information presented in this report should be of interest to transit security planners and researchers, law enforcement agencies, planners of AGT systems, and in general those people who are concerned with the problems of crime and vandalism in transit systems. The reader should also be aware that, while the contents of this document are essentially valid as of this writing, the material represents opinions held and conditions existing in May 1976.

The editors wish to thank the panel chairmen Dr. Pierre de Visé, University of Illinois, Chief Richard Kenney, MBTA Police Department, and Mr. John Marino, Program Manager, Office of AGT Application, UMTA for their most valuable contributions in organizing and directing their respective groups. They also wish to express their appreciation to Mr. Bernard Greenberg, Stanford Research Institute, and Mr. Victor Rouse, W.V. Rouse & Co. for their submission of papers and stimulating discussions which led to the success of the workshop. They appreciate the support

of Dr. Duncan MacKinnon, Chief of UMTA Advanced Development Division, and his staff, who contributed to making this workshop possible. They are grateful to Mr. Leon Tritter, Raytheon Service Company, for his technical assistance in the preparation of this report.

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ILLUSTRATION

TABLES

LIST OF ABBREVIATIONS

AGT	Automated Guideway Transit
AGTT	Automated Guideway Transit Technology
APTA	American Public Transit Association
ART	Automated Rail Transit
ATA	American Transit Association
BART	Bay Area Rapid Transit
CTA	Chicago Transit Authority
CTS	Cleveland Transit System
DOT	Department of Transportation
DPM	Downtown People Mover
FRA	Federal Railroad Administration
GRT	Group Rapid Transit
LEAA	Law Enforcement Assistance Administration
MARTA	Metropolitan Atlanta Rapid Transit Authority
MBTA	Massachusetts Bay Transportation Authority
MTA	Metropolitan Transit Authority
OTA	Office of Technology Assessment
PATCO	Port Authority Transit Corporation
PRT	Personal Rapid Transit
SeaTac	Seattle-Tacoma
SEPTA	Southeast Pennsylvania Transit Authority
SLT	Shuttle Loop Transit
SPU	Special Police Unit
TERL	Transit Expressway Revenue Line
TRB	Transportation Research Board
TSC	Transportation Systems Center
UMTA	Urban Mass Transportation Administration

SECTION 1

INTRODUCTION AND SUMMARY

Crime and vandalism and the fear of crime and vandalism are significant problems on conventional mass transportation systems. These problems result in passenger injury and loss of property, damage to transit property, and loss in revenue from passengers no longer using the transit system.

There is the possibility that these problems may be more acute on Automated Guideway Transit (AGT) systems due to the planned low employee density levels and the highly centralized control of the systems.

Various methods have been developed and implemented on conventional mass transit systems to reduce crime and vandalism. These methods include the use of police dogs, randomizing police patrol schedules, closed-circuit television, alarms, exact fare boxes, improved lighting, and architectural changes. These methods have had varying degrees of success in different transit systems.

Attempts to effectively evaluate crime and vandalism reduction methods have had limited success. These limitations have been due to such problem factors as (1) regional differences in labeling the same criminal acts and (2) differences in crime recording and reporting practices.

Recognizing the need for eliminating such problems, the Urban Mass Transportation Administration's Office of New System and Automation sponsored a workshop which was conducted by the Transportation Systems Center with the purposes of evaluating procedures for determining the effectiveness of crime and vandalism reduction measures and the stimulation of the development of new, improved methods of evaluation. The workshop was conducted during the period May 25-28, 1976 at Exeter, New Hampshire. The attendees

represented three groups: (1) senior transit security staff, operating personnel, and planners; (2) transit researchers; and (3) government staff involved in transit development. The agenda included three panel discussions and two papers prepared for presentation at this meeting.

The first panel on Transit Security Operations was chaired by Chief Richard Kenney of the MBTA Police. The discussion covered practices and problems in the evaluation of security measures on mass transit systems, and the means employed to improve the effectiveness of current methods of evaluation.

The second panel on Transit Security Research was chaired by Dr. Pierre de Visé of the University of Illinois. In the discussion, new methodology was outlined to evaluate the effectiveness of transit security measures, with due consideration for limitations of both current and new methodology. Attention was also directed toward the new concept of Automated Guideway Transit (AGT) systems, discussed in much greater detail by Panel 3.

The third panel on Automated Transit Planning was chaired by Mr.John Marino of DOT. This panel's presentation consisted of describing various types of automated systems currently in use and new automated systems under development. In further discussion the panel explored the role of security in the development of these systems and how that role might be improved.

On the evenings of May 26 and 27, prepared papers were presented by Mr. Bernard Greenberg of the Stanford Research Institute and Mr. Victor Rouse of W.V. Rouse and Co.

Mr. Greenberg's paper was entitled Loss Prevention and Security for Transit Systems: A Prespective. In this paper, he assessed the financial losses and harm to persons resulting from transit-related crime and vandalism. He compared the financial losses and secruity hazards with the possible costs of insurance against loss and of physical deterrents to crime and vandalism. He emphasized that careful consideration should be given to these relative costs, since there is the possibility that costs for deterrence can far exceed the losses against which the deterrences were first contemplated. The author suggested that the planned AGT systems can serve to minimize hazards to personal safety and property loss, even though the reduction of human operators makes it inevitable that some potential hazards will still remain.

On the second evening, Mr. Rouse delivered his paper, which was entitled Developing a Methodology for Evaluating the Effectiveness of Crime Reduction Measures for Mass Transit Systems. This paper stressed the importance of obtaining meaningful data relating to the problem of safety and security on the mass transit systems. When adequate data are obtained, satisfactory problem analysis can be performed by the evaluator, and proper solutions can be arrived at for evaluating crime-reducing measures for the mass transit systems. The author paid particular attention to the relationship between crime on mass transit systems and crime in the neighborhoods in which the systems operate. With this basic approach, he developed criteria for evaluating crime reduction efforts on mass transit systems, including among the criteria analyses of cost/benefit relationships and community objectives. The methodology for evaluating the effectiveness of this approach is based on the criteria which he has already described. Particular aspects of his approach include key interviews with persons who know much about the community containing the mass transit systems, and the "critical incident technique" of obtaining information on events of the type for which crime-reducing measures will be implemented.

SECTION 2
TRANSIT SECURITY OPERATIONS

Dr. E. Donald Sussman (on behalf of TSC and UMTA) welcomed the invited guests to the opening panel discussion of the workshop proceedings held on May 25, 1976 at the Exeter Inn, Exeter, New Hampshire. In his introductory statement, he briefly discussed the continuing interest of the Department of Transportation in programs aimed at improvement of urban mass transportation. He then focused attention on a program for development of an automated guideway transit technology sponsored by the Office of New Systems and Automation at UMTA. A significant feature of this program calls for elimination of vehicle operators and reduction of station monitors and maintenance personnel. Together with the obvious advantages, the projected automated transit system creates new and different problems related to safety and security of equipment and personnel. The nature of the problems and the means for their potential solution are the main concerns of the UMTA program under which these workshop discussions were sponsored.

Dr. Sussman concluded his remarks with an introduction of the panel chairman, Richard Kenney, Chief of the MBTA Police Department, Boston, Massachusetts. Chief Kenney, in turn, introduced the remaining panel members, and also outlined the topics for the panel discussion: techniques being used throughout the country in mass transit security; evaluation of these techniques, followed by a question-and-answer exchange between panel members and among the other attendees. The participants who, together with Chief Kenney, constituted the panel membership, included:

James Delaney	Captain, Mass Transit Unit, Police Department, Chicago, Illinois
Sanford D. Garelik	Chief, New York City Transit Authority

James J. McBride	Captain, Port Authority Transit Corporation (PATCO), Camden, New Jersey
Tom G. Sowell	Chief, Bay Area Rapid Transit (BART), Oakland, California

2.1 CHICAGO MASS TRANSIT UNIT

2.1.1 Background of Unit Formation

Captain Delaney presented an overview of the security procedures in use in the Chicago transit system. The security personnel operate within an organization known as the Mass Transit Unit, which is actually an auxiliary, or support, unit of the Chicago Police Department. The unit consists of 300 men who are assigned full-time responsibility for policing the mass transit system in Chicago. This method of operation was instituted in 1971 on the order of the Mayor of Chicago when it became evident that the Chicago Transit Authority (CTA) was unable to maintain security on its own efforts.

An unfortunate aspect of the unit's inception involved the failure of the Police Department to apportion to the Mass Transit Unit an adequate number of suitably qualified men. As a result, initially mediocre representation led to mediocre results, and for the first few years of the unit's existence, crime in the transit system continued unabated, and for a time even increased. With the later appointment of a new Superintendent of Police in Chicago, and following his publicly stated commitment to restructure the unit, a noteworthy improvement in the unit's operation was attained. Crime was reduced, and ridership increased approximately five percent in each of the next two years.

2.1.2 Mode of Operation

The Mass Transit Unit operates in three general areas: foot patrol; fixed station posts manned by uniformed personnel; and tactical undercover operation.

a. Foot Patrol

Uniformed men in teams patrol a system on foot. They ride the trains, check the platforms, and check on the well-being of the patrons and the employees of the transportation system.

A survey of crime in the Chicago Transit Authority was conducted during the years 1970-1971 by Carnegie-Mellon University. The survey explored the potential use of technology in combating crime; for example, closed-circuit television, or telephone alarm hookups. The findings on technology were inconclusive; in fact, deployment of such equipment is, at the time of the workshop, in the "talking" stage. The basic recommendation of the survey, and the one implemented by the unit, was the deployment of manpower. The results of this approach have been quite satisfactory. To illustrate, the foot patrol can be used to best advantage by deployment of men in areas of high crime. This also provides for quick shifts in operation to coincide with shifts in crime areas, and therefore a high degree of flexibility.

In December 1974 a massive action was undertaken by the Chicago Police Department for a three-month period, with a Task Force of 400 men supplementing the 300 Mass Transit Unit officers. Many arrests were initially made on the transit system, and the effort has continued. The results of these increased activities have been impressive. In 1975 alone, crime on the transit system decreased by 48 percent, at a time when crime in the rest of the country was increasing.

The automobile patrol is used very little in comparison with foot patrol. In fact, its use is limited to late evening, and to the midnight shift, when the long waiting period between trains at a station, approximately 30 minutes, would render foot patrol mobility very inefficient.

The foot patrol of the Mass Transit Unit obtains some assistance from the Chicago Transit Authority, which also has a small security organization of about 60 uniformed police. They concentrate their efforts on the internal security of the Chicago Transit Authority and the security of the authority's equipment, while the

Mass Transit Unit personnel provide security for the riding public. Thus, there is no conflict between the respective functions of the separate groups.

b. Fixed "Uniform" Posts

A number of uniformed men remain at one station and monitor the area to ensure safety and security of personnel and equipment. This assignment is accepted with less enthusiasm than are the others, because of the boredom and tediousness which characterize this function. Nevertheless, it is a necessary part of the operation, and so is included as a regular assignment.

c. Tactical Undercover Operation

Approximately 45 people are assigned to this very important work. The people are disguised as patrons of the system, Chicago Transit Authority employees, "hippies", or as any other characters appropriate for the situation in some current investigation. This activity is a very important part of the operation; the group performs capably, and registers good returns for its efforts.

An interesting feature for the undercover operation is the use of women as decoys in situations involving pickpockets and thieves, and, in rare instances, in the pose of intended victims of some felonious assault.

2.1.3 Summary of the Mass Transit Unit Operation

Chief Delaney, in summarizing the patrol status of his unit, added another feature previously unmentioned. On infrequent occasions, the unit uses dogs. A "dog-man" team is used late at night at a subway station considered a potential danger area, never on trains, to serve as backup to the regular station attendant. The team performs basically as a deterrent; although its use is secondary to the modal functions previously described, it provides very effective assistance when its presence is considered necessary.

2.2 NEW YORK CITY TRANSIT AUTHORITY

Chief Kenney next invited Chief Sanford Garelik to describe the structure and characteristics of the New York City Transit Authority. Chief Garelik discussed a number of topics directly related to his system. The main items covered included the nature of the agency, modes of operation, fare evasion, use of auxiliary detection devices, and the problem of graffiti. (The problem of graffiti is discussed in paragraph 2.4.11.)

2.2.1 Makeup of Department

The New York City Transit Authority is an independent unit, distinct from the New York City Police Department. In 1975, it had a complement of 3284, but this number has been reduced in recent months by 17 percent through a policy of attrition and limited firings, in keeping with the financial situation in New York City. The authority, while independent, has standards which closely parallel those of the Police Department in terms of entrance requirements, pay, and promotions. Basically, it functions similarly to the average city police department. There is a quite good relationship with the New York City Police Department. In an effort to avoid duplication of effort, the authority turns over homicide investigations to the Police Department. The present membership of the authority represents a great increase over that of a decade ago, having doubled in size in response to an increase in crime and the demand for greater activity of the type provided by the authority.

2.2.2 Mode of Operation

The transit authority security system makes use of foot patrols, tactical undercover units, and decoy squads. It does not use canine patrols. Until Chief Garelik assumed his duties, the department was very centralized. Since then the department has undergone an intensive reorganization and decentralization.

The department is mainly an operational unit. It does not have public and community relations units as specific agencies. The functions are confined, rather, to the operational activities directly related to monitoring the transit system, preventing crime where possible, and apprehending criminals who commit felonies on property controlled by the authority.

The department operates primarily with officers on foot patrol. The system does make limited use of cars, chiefly for line-to-line operations, assistance in emergencies, and general assistance around the perimeter of the system's stations. The foot patrol officers operate singly or in pairs, as conditions require. In the system complex of 460 stations, conditions can vary from station to station. Therefore, in addition to the uniformed patrols, detectives and police women also operate on the lines. From the uniformed police and the detective groups, a number of men and women are chosen to act as decoys in apprehending pick-pockets, robbers, and sex offenders.

Chief Garelik made a significant change in the assignment of working hours for the men in his department. According to the Chief, for the ten-year period prior to his appointment it was normal to assign two-thirds of his men to a shift between 8 p.m. and 4 a.m. On analyzing the situation he learned that two-thirds of his force were on duty during a period when only one-fifth of the crimes on the system were being committed. Since police statistics showed the crime rate to be greatest between 12 noon and 8 p.m., and particularly between 4 p.m. and 6.p.m., he reversed the work schedule to make the fullest crime-fighting capability available when it was most needed. This action greatly enhanced the performance capability of the security department.

Because of his policies of police teams, decentralization, increased tactical undercover and decoy operations, and work schedule change, results have proved very effective. During the last year his force has increased the number of arrests by 62 percent, misdemeanor arrests by 100 percent, and violation notices by about 2000 percent. Also, the number of felonies has been

reduced by 15 percent, at a time when the crime trend elsewhere is upward, and when the authority's manpower was reduced by 17 percent.

2.2.3 Fare Evasion Problem

Chief Garelik was faced with a number of pressing problems when he assumed his office in the transit system. One of the most serious problems dealt with fare evasion by violators entering the system stations. Subsequent to a fare increase to 50 cents for a single fare trip, a large increase in fare evasion was noted. Any significant level of evasion meant a great financial loss to the transit system. On a four-percent loss basis, the fare evasion impact in a $400,000,000 annual fare income represented a loss of $16,000,000. A massive effort by the security force to combat this evasion was initiated, resulting, in one year, in 90,000 apprehensions, of which 30,000 resulted in arrests. The arrest procedure was adopted to replace the previous policy of issuing summonses. The summonses had been almost completely ignored, and this deliberate flaunting of the transit system's authority placed the entire fare collecting system in jeopardy. The arrests were followed by court action, and, in some jurisdictions, by certain and severe punishment. The court system, which operates on a borough system, showed varying results in accordance with the probability of punishment. The evaluation of the effort performed by Chief Garelik indicated that for the last quarter of 1975 the rate of recidivism in the Bronx courts, which were more lenient than those in Queens, was six times as great as that in Queens. Subsequent statistics in the first quarter of 1976 substantiated the belief that certainty of punishment and severity of punishment were important considerations in the reduction of fare evasion from four percent to eight tenths of one percent.

Arrests for fare evasion by jumping the toll barrier are more prevalent in poor, depressed areas. For evasion involving slug insertion, the situation is different. Many people of middle income (students, lawyers, and teachers) attempt to enter the system by using slugs. As to why relatively affluent people would engage in such practice, the panel hypothesized the possibilities

that include a basic desire to "beat the system", and also the knowledge that nothing would happen to them if apprehended. Chief Garelik's policy of arresting people for slug insertion and the court's policy of severe fines have greatly reduced this activity in the last few months. The recidivism rate is quite low, less than one percent.

The possibility of physical improvements in the system as a deterrent to fare evasion was suggested. In reply, Chief Garelik stressed that the real problem is the need for enforcement of the law and reeducation. However, he agreed that interim possibilities might be considered, such as:

1. A turnstile that will accept the proper coin and reject the counterfeit
2. Stricter monitoring to prevent fare evaders from entering a station through a nearby exit gate instead of through payment at a turnstile
3. Improvement to the turnstile to prevent the possibility of manipulating the turnstile to permit passing through without actually inserting the coin.

An interesting observation was passed to the panel and guests on the correlation between fare evasion and the commission, or intended commission, of other crimes. Chief Garelik had previously mentioned that arrested fare evaders were listed in a computer system. He now stated that later computer checks on the same people indicated a definite relationship between fare evasion and other criminal acts. People picked up for fare evasion were also wanted on federal, state, or city charges. Additional charges had also been logged against many fare evaders, including possession of dangerous weapons and of stolen property. Mr. Garelik felt, in general, that the fare evasion arrests had deterred intended crimes appreciably.

2.3 BART SYSTEM

2.3.1 BART System Composition

Chief Tom Sowell began his description of the BART security system with an acknowledgment of the small size of his 100-man organization in comparison with those of Chicago and New York City. He classified the typical BART police officer as 33 years old, with at least 2½ years of college education, and with approximately 7½ years of law enforcement experience. These people were recruited from various jurisdictions, and hence, their backgrounds in police officer standards and training were attuned to the particular jurisdictions from which they were recruited. This initially created a problem, but in time the BART standards were adopted by the entire group to provide uniform application of crime prevention procedures.

The BART system is broken down into patrols, together with an administrative division. In a complex of 34 stations covering a span of 75 miles, there are 26 parking lots, with parking space for approximately 30,000 automobiles. The main concern of the patrols is monitoring these stations and parking lots.

The original intent of the BART system was to utilize, for policing operations, the police departments of the various jurisdictions through which the BART trains passed. The police chiefs from these local jurisdictions rejected this concept. They contended that they had already inherited parking and traffic enforcement problems in areas surrounding BART stations within their jurisdiction, and they refused to accept further responsibility for security of BART property, or system personnel, or passengers. The BART administration was therefore compelled to implement a police force of its own.

A second factor in BART's relations with the police chiefs contributed to the coolness shown to the BART police force on its inception. The BART police were classified under the Penal and

Government Codes as BART Security. According to Chief Sowell, the term Security attached to the classification implied a "Rent-A-Cop" type of operation, equivalent to a private investigating service. Because of this low-prestige classification, the police departments of the local areas through which BART extends at first provided no cooperation whatever. With passing of time, relations improved noticeably.

Of the 100 police officers in the system, 80 are on patrol duty. A Special Police Unit (SPU) of eight men serves as a theft decoy squad, concerning its operations within the parking areas.

2.3.2 Police Attire

When the BART security system was established, it began with an effort to maintain a low profile, to the extent of permitting informal dress by the officers. The first form of dress consisted of a blazer and dress shirt. To better accommodate changes in climate over the 75-mile length of system, the apparel was modified to a V-neck sweater with the blazer. This dress pattern is now being changed to traditional or conventional military type uniform, with hat being optional.

There were valid reasons for the change to formal police uniforms. The general public did not accept the blazer, or non-conventional military type, uniform. Even with a patch and a name tag on the blazer which identified the arresting individual as a policeman, the authority normally associated with police officers was lacking,sometimes leading to altercations and resistance by law violators. Also, the police officers of the neighboring jurisdictions did not accept this type of uniform. These factors pressured BART into adopting the standard military type uniform.

2.3.3 Jurisdictional Cooperation

BART police authority was discussed next. Chief Sowell explained that such authority exists for incidents originating on

BART property. In effect, BART personnel are acting as peace officers for the state. However, the area within which such permission is granted is limited to a narrow strip of about 35 yards, except at stations, for the entire 75-mile length.

There is another classification of land area for which the BART system has responsibility. Since BART owns land within the jurisdictions of Oakland, San Francisco, Concord, and Pleasant Hill, it is considered within BART's authority to investigate crimes occurring in those areas. At the same time, minor or simple cases are occasionally administered by the local police as a matter of courtesy. In its capacity as peace-keeping organization within the state, the BART administration reports its police statistics to the state and federal governments.

Relations between the BART security system and local police jurisdictions have improved from poor at its inception to excellent as of now. There is complete cooperation between BART and the other agencies. BART police use jurisdictional jailing facilities. Also, each jurisdictional unit is under contract to BART to transport prisoners to BART authorities whenever possible.

The normal patrol operation involves a "beat" of three stations. An officer rides the train to the next station, gets off and surveys the station, walks to the parking lot and checks the area, gets back to the station, and takes the next train to the next station. This routine is repeated for the third station. On completion of this procedure, he returns to his original starting point with the same sequence of observations.

A patrol car operates adjacent to the train to handle emergencies such as a local cutoff of electric power on the system. For any situation causing power shutdowns, the cars can transport police to respective stations, or they can assist passengers to their destination. Also, in case of a felony, or of a crime in progress in areas owned and operated by BART, the local jurisdictional

agency near to the crime area is contacted. The agency cooperates, and holds suspects until the BART cars come to pick them up.

2.3.4 Use of Closed-Circuit TV

Closed-circuit TV is used primarily for passenger safety in the stations. If for some reason a passenger falls or jumps to the tracks from the station platform, the station master, seeing this on the TV monitor, can cause the power to that track to be cut off, so that a train will not come in.

Monitoring of the parking lot has met with only moderate success. Overall TV scanning of the lot is possible, but there is no zoom lens capability, so that identification of people or car plates is difficult when the monitored object is distant from the camera. Aside from monitoring problems, it also takes a long time to reach the place where the crime is being committed. Chief Sowell indicated the same preference as Chief Delaney for human observation from a police officer roving the area.

2.3.5 Fare Evasion

2.3.5.1 Laws Relating to Fare Evasion. The BART system passes through four counties, each of which has a district attorney. The state law on fare evasion, and the one enforced in these counties, applies to evasion on a railroad. If the BART system is considered a railroad, then it would have to carry a fireman aboard each train, even though the system is electrically powered. On the other hand, if it is not considered a railroad, then the BART system does not have authority to apprehend a fare evader. Therefore, BART Security must decide on the matter for each jurisdiction. At present there is no problem with Alameda County. As for the others, BART is attempting to come to an understanding with them.

2.3.5.2 Citation Procedure on Violators. Fare evaders are recorded in a computer listing. The first offense calls for

a warning. The second, and any additional offense, call for citations. Statistics on recorded citations indicate the following:

(1) Twenty percent of those cited are repeaters.

(2) Of all those arrested, forty percent have other outstanding warrants from various jurisdictions.

(3) Eighteen percent of these are women, and seventy percent of these women prefer to go to jail rather than sign the citation.

The citation process has so burdened the courts that a new approach is being sought, by agreement with the counties, to apply a bail schedule. For example, let the first offense call for $15 bail, which may then be forfeited if desired. The second offense would call for $25 bail. This procedure is basically accepted, with varying degrees of cooperation or harshness, respectively, from the different counties.

2.3.5.3 Illegal Use of Slugs and Foreign Coins. This form of fare evasion is a serious problem. Several items have to be considered:

(1) Some foreign coins are sufficiently similar to coins accepted by the gates, so that turnstiles are operated when the foreign coins are inserted. For example, a particular foreign coin has been used successfully in place of dimes on the BART system.

(2) Slugs are also used to actuate the gates. Although less prevalent in their use than the foreign coins, they also present a serious problem.

(3) The computers in change machines were not programmed for pennies, creating a problem in providing change.

2.3.5.4 Violations in Use of Tickets. The BART system issues three types of tickets: blue for normal fare; red for persons under fourteen years of age, purchasable at one-fourth the price; and green for senior citizens over 65, purchasable at one-tenth regular fare. The red and green tickets can be purchased

at a bank by anyone, and without the need for identification. Therefore, by fraudulent statement, one can purchase such tickets and use them illegally. The BART system loses a great deal of revenue by this illegal activity.

Another form of ticket violation involves an individual who walks through a station entrance by showing a card which is not a BART pass. However, because the station attendant is too far away to recognize the fraud, he permits the person to pass through without questioning him.

Counterfeiting of tickets is another form of fare evasion. Here red or green tickets are used in place of the blue one after they have been modified. The authority is attempting to thwart this type of activity by adjusting its machines to prevent passing the fraudulent tickets through the space used by the blue tickets. The system also can detect a fraudulent ticket if it has succeeded in fitting the modified access space. On detection, the system provides an alarm to alert the station attendants. However, in most cases, the attendants have been cautioned to accept the loss of a ticket fare rather than to chase after the violator and risk confrontation and possible physical harm. In spite of this restriction on the attendants, the modifications to the ticket machine and the detection and alarm setup have helped somewhat to deter would-be violators.

2.3.6 Use of Canines

The use of canines on train patrol has been found very effective. Dogs have attacked without police command only twice in the total period of their use. In cities on the transit line where two-man patrols have been required, it has been possible to use, instead, one man and a dog. In addition to the effectiveness of this team, the supply of men is conserved, and a form of team police policy is still maintained.

2.3.7 Revenue Protection

The BART system has its own revenue cash building, revenue collection trucks, and revenue protection teams. The driver of the truck is not a sworn policeman. He is armed, and once he enters the truck in the morning he does not leave the cab until the operation has been completed. A radio-equipped police car follows the truck, with an officer as driver. Four other persons, not sworn policemen, are in the truck, and they perform the revenue collection and service the collection machines.

The collection route is changed every day. Neither the truck driver nor the police-car driver knows the route for that day until he is ready to start the run. The cash facility is highly secure. No one has ever attempted to relieve this facility of any of its revenue as of this writing.

The money machines at the stations are computer-operated. Although basically theft-proof, one situation presents a problem. When a machine becomes blocked and malfunctions, the station attendant can enter the machine to repair it. The repair usually involves removal of captured bills which caused the blockage. This money should be returned to the machine. However, the possibility exists that the attendant may not return the money. Additional monitoring may be necessary to avoid this problem. At the same time, the system must depend on the integrity of its working force. At present, violations of the type described are relatively small, and continuous vigilance will help to maintain it small.

An additional problem relates to a situation noted above, the presence of collection crew men who are not sworn policemen. This requires an interface between them and the sworn policemen. A typical revenue crew of six would consist of one uniformed sworn policeman, one policeman not sworn, and four unionized cash workers who service the machines. This makeup of crew requires a completely smooth interface; otherwise, it could become another difficult situation for Chief Sowell.

2.4 PORT AUTHORITY TRANSIT CORPORATION (PATCO) SYSTEM

2.4.1 General Description

Chief McBride described his system as a bi-state (New Jersey and Pensylvania) legislatively created police department with full police powers on its property in both states. The PATCO force consists of 21 officers, and the operation is a continuous one, on a 24-hour day and 7-day week basis. The officers work in four platoons of four men to each platoon, and two men are assigned specifically to anti-vandalism. One detective, one lieutenant, and Chief McBride complete the complement of 21 PATCO members.

The personnel are permitted to wear civilian clothes at all assignment areas. Three cars are available to the system for auxiliary service. The men not using the cars are equipped with walkie-talkies. The agency uses a two-channel communication system — one for the general public, and one for surveillance work.

2.4.2 Apprehension of Car Thieves

PATCO must constantly deal with the problem of car thefts from the parking lots. The officers monitor six parking lots which can park 8500 cars. A car thief with master keys can enter a car not his own and drive away without arousing suspicion, and because it is impossible to confront every person who enters a parked car without reason for suspicion, the problem always remains.

Another factor in monitoring cars deals with theft of property inside the cars. Typically, the major item stolen in 1976 was the Citizens Band radio.

2.4.3 Fare Evasion Considerations

As with the other systems described, PATCO also has fare evasion problems. Chief McBride and his assistants have instituted remedies for fare evasion practices by electronic checks. By such means, and by the rendering of stiff penalties to offenders,

cheating has been cut down appreciably, and the number of repeater offenders has been reduced to almost zero.

2.4.4 Use of Canines

PATCO patrols have dogs on duty twenty-four hours a day. Their use is highly effective in apprehending lawbreakers. Except for rare incidents in which dogs attacked innocent people, their behavior is strictly in keeping with their professional training. They do not attack unless commanded, or unless an officer is attacked. The dogs ride on late night trains, run by PATCO every half hour from 12:30 a.m. to 5:00 a.m.

2.4.5 Computer Listing of Offenders

Every person arrested, or warned, by PATCO is listed in a computer storage system. A traffic violator is given a warning on his first violation. If he repeats the offense within six months, he is issued a regular ticket, and pays either 10 dollars or 25 dollars, depending on the seriousness of the offense.

2.4.6 Vandalism and Stonings

These actions are considered serious enough by PATCO to result in arrest, in every instance, of apprehended offenders. About 50 percent of the people arrested are from the ghetto areas of Camden, New Jersey. These people, although found guilty, are often unable to pay their fine. A question not asked, but implicit in the above, is whether jail sentences for unpaid fines serve a valid purpose in lieu of reeducation of the people who commit such crimes.

2.4.7 TV Coverage

PATCO makes limited use of TV surveillance. Chief McBride feels toward TV monitoring much like the chiefs of the other transit systems. The effectiveness of TV monitoring, according to Chief McBride, is very little, if at all, greater than human monitoring.

2.4.8 Revenue Protection

There are thirteen stations in the PATCO system with bi-state policing powers. A revenue department of thirteen men services these stations in picking up daily revenues.

2.4.9 Transportation Industry Security

Chief McBride defended the concept that the transportation industry should depend less on local cities and towns for security, and devote more effort to assure its own safety and resulting greater ridership. Transportation industry security systems are in a better position to attend speedily to security problems than are the external police departments, whose interest in transportation security appears casual at best.

Chief Kenney agreed with Chief McBride. He referred to an effort made in Boston to have the Boston Police Department handle the MBTA security. However, it did not work out well, and the separate security system was reinstituted in Boston. He acknowledged that the Chicago Police Department does a good job in handling the Chicago Transit Authority security system. However, he did not consider the Chicago situation to be typical. Rather, he preferred to see separate administration of security matters by the transportation industry system itself.

An exchange between Chiefs Kenney and Delaney about the relative merits of their respective security systems brought to light an important aspect on which the possibility of advantage rested. This aspect referred to the fact that some transit systems extend through multi-jurisdictional districts, while others, like the Chicago and New York transit systems, are involved with basically single jurisdictions. At the same time, all the chiefs agree that a certain amount of help from the police departments, particularly in emergencies, was desirable even when the overall security administration was under full control of the transportation system itself. Chief Garelik endorsed Chief Kenney's thinking when he expressed preference for a transit security system separate from the New York City Police Department. He stressed that costs

involved in a merger would make such a merger less advantageous than permitting the transit security system to retain its present status.

2.4.10 Manpower Requirements

Professor de Visé sought an opinion from the chiefs on minimum manpower requirements for satisfactory operation of a security system. He noted in particular that the PATCO system was doing a good job with as few as twenty-one men. Chief McBride pointed out, in reply, that much of his success could be related to a factor other than the small size of his police team. Specifically, prior to his appointment as chief of PATCO, he had been a 25-year member of the Philadelphia Police Department. On that basis, he had such good rapport with the Philadelphia Police Department that he was able to get appreciable assistance from the department in his jurisdictional duties in the Philadelphia area. Added to that, he was also being helped by SEPTA (Southeast Pensylvania Transit Authority) in such matters as service during sporting events. In effect, then, Chief McBride suggested that the 21-man team which he controls could really be extended to perhaps 50 men under conditions where he might not receive the help that is presently available to him.

2.4.11 The Graffiti Problem

A long discussion took place on the graffiti problem. Chief Garelik spoke of the difficulties involved in eliminating this sort of activity, which the chief labeled criminal. Most of the activity was being carried on by youngsters 14 years of age, on the average. These youths had such unusual skill in applying graffiti to the outside of trains, to walls of storage car yards, and the inside of cars, that, in the opinion of some, their work was considered almost artistic. Artistic or not, the activity is still a nuisance to the transit system, and much money is spent removing it.

There was mention of the fact that Philadelphia, once the center of graffiti activity, was having better luck than New York

City in discouraging such activity. Chief McBride offered the suggestion that greater concentration of manpower in many areas helped prevent the activity, and, in cases where graffiti had already been applied, the maintenance crews made great efforts to remove it immediately.

2.4.12 AGT Program

Dr. Sussman referred to AGT operation, a system operation which would eliminate the need for vehicle operators and other personnel to make the system less labor intensive. The participants offered varying opinions, from rejection of the concept as losing deterrence value by removal of the operator and station attendants, to advocacy on the basis that violation of the law would bring severe punishment to the offenders. This discussion led to an analysis of the young people who commit such a large percentage of the country's crimes.

2.4.13 Juvenile Crime

The discussion turned to the subject of the average age of youthful law violators and the possible ways of dealing with them. Crimes attributable to young people on the transit systems, in addition to the graffiti activities, consist of pickpocketing, drug traffic, handbag snatching, and other crimes of similar magnitude. Additional statistics indicate that many of the same youngsters, by the time they've matured to young men, have added still other serious crimes to their repertoire. Security personnel, therefore, view the lawbreaker with dual concern: first, with the immediate need for preventing current commission of crime on their systems, and secondly, with a long-term goal of helping the youthful offender to avoid a future life of crime.

Several policies have been incorporated by the transit authorities to handle the problem of young offenders. Of these, curfew and truancy laws have been used most effectively. In particular, the Chicago Transit Authority has made extensive application of these

laws with good results. On the other hand, in Boston general curfew laws have met with obstacles, and have been rejected. The truancy laws are generally accepted in most cities. These truancy laws are effective only during school hours. Thus, a problem still remains as to how to deal with youths who gather at corners, or travel back and forth on the system trains without heading for any specific destination. In the latter cases the authorities break up the gatherings and question the youths in the station with respect to loitering offenses. To the extent that the law permits, the activity is carried out with a degree of success.

In addition to the above-mentioned relatively lenient attitudes, the Chicago Transit Authority, and other systems also, reserve the right to stop and search suspicious youths who are confronted at unusual hours of the night, for example, 3:00 a.m. This procedure has the sanction of a Supreme Court ruling which permits police to stop an individual who creates the suspicion of having committed, or shows intent to commit, a crime.

The question of loitering came up for further discussion when Mr. Pawlak of TSC contrasted the apparent aimlessness of loitering youths with the relatively short stay in a transit station of people who properly use the station as a transfer point for another destination. In defining loitering, the panel members in effect concluded that the transit station functions basically as a passing-through area, and is not meant for any lengthy stay by present occupants.

2.4.14 Proposed Station Modifications

The possibilities of station modification, or, in new stations, design considerations, provide possible means for reducing transit crimes. A number of suggestions were provided as pertinent to this goal:

1. Closing off part of the station during certain hours
2. Providing a view of the station from the outside where possible
3. Improving the view and lighting of platforms

and ramps

4. Rest rooms closed to the general public
5. Coaxial cable systems which would make possible communication from the street with underground stations
6. Emergency alarm devices, both audible and visible.

2.4.15 Subway System Crimes Versus Street Crimes

In spite of the dangers present in the commission of crimes in the transit system, it was generally agreed by the panel members that the crime rate for subways, both on train and in the station, is appreciably less than what exists off the transit system on the street level. This does not discount the fact that crimes do occur in the subway system, and that there are legitimate fears and apprehensions on the part of subway passengers. Nevertheless, the disadvantages associated with the possibility of entrapment in a closed train and the confinement of a closed underground station suggest that the potential lawbreaker would prefer to operate in the comparatively open spaces and more accessible escape routes, and in localities with more affluent victims.

NOTE: The Transit Security Operations panel discussion was concluded during the afternoon of May 26, 1976. Mr. Bernard Greenberg presented his paper that evening on loss prevention and security for transit systems.

PAPER 1

LOSS PREVENTION AND SECURITY FOR TRANSIT SYSTEMS: A PERSPECTIVE

By
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Invited Paper Presented Wednesday Evening, May 26, 1976

SOCIETY'S FAILURE TO CONTROL CRIME

The current "bandaid" approach to coping with crime in the streets, particularly crimes committed in urban transit systems, is not proving effective. Recognizing that the literature offers few solutions to transit crime problems, particularly the problems that may arise with advanced design systems, this paper seeks to stimulate operating and planning management to examine the relevancy of current security practices.

Because of the apparent ineffectiveness of the billions of dollars that have been poured into a multitude of crime control programs in the public and private sectors since the enactment of the Safe Streets Act, there is pronounced questioning of the usefulness of many methods being employed for crime control. Researchers, government planners, legislators, law enforcement officials, concerned business management, and private citizens, as well as transit authorities, have been struggling to understand the causation of crime. This field of research has long been held to be the exclusive "turf" of criminologists. But mounting criticism has been directed at the conventional social science approach to criminal rehabilitation and at the crime control programs that have consumed enormous resources over the past two decades while failing in the objective to reduce crime.

James Q. Wilson, in his collection of essays, Thinking About Crime,[1*] seriously questions the social scientists' views of crime causation and remedies, particularly since the great upsurge of crime in the sixties. Wilson, a distinguished professor of government at Harvard and an astute analyst of crime-related policy issues, challenges the assertion that crime is basically the result of poverty, racial discrimination, and other privations. He further takes issue with the belief that the only effective strategy for reducing crime is to attack its "root causes" with programs that ameliorate those conditions.

*References are listed at the end of the paper.

Wilson's basis for disputing these beliefs is set forth in his chapter on "Crime Amidst Plenty: the Paradox of the Sixties." Massive social programs were funded under the administrations of Presidents Kennedy and Johnson, specifically aimed at inner city conditions. Although these programs were not primarily conceived for the purpose of reducing crime, their objectives were consistent with the prevailing views that, by improving the lot of youth, the poor, and the deprived, crime would inevitably be reduced. As the record shows, in the sixties crime soared to higher levels than in the thirties, and continues to rise despite the massive infusion of Omnibus Crime Control Act funds.

Wilson further observes that the prosperity of the sixties was concurrent not only with the escalating crime rate, but also with startling increases in welfare payouts, drug abuse, and high unemployment for youth. The public and private sector institutions established to deal with these problems were overwhelmed and were, to a considerable degree, incapable of responding to the demands placed on them. Although many preripheral conditions existed during this period that have been seen as contributory causes, Wilson suggests that we may never be able to adequately explain what did happen, nor what might have happened had different administrative policy approaches been taken.

ALTERNATIVE POLICY OPTIONS

Confronted with these facts and the differing solutions based on conflicting ideologies, those charged with administrating government affairs, those conducting business, and a noncriminologist-oriented sector of the research community have begun to question the need to dwell on the "root causes" of crime as a prerequisite to controlling the problem. Wilson explores a provocative concept that may be applicable to research in the fields of criminal investigation, vandalism, and loss prevention--in the public and private sectors. Wilson's notion is that:

> ... policy analysis, as opposed to causal analysis, begins with a very different perspective. It asks not what is the cause of the problem, but what is the condition one wants to bring into being; what measure we have that will tell us when the condition exists; and what policy tools does a government (or any management, for that matter) possess that might, when applied, produce at reasonable cost a desired alteration in the present conditions or progress toward the desired condition?[2]

Wilson's thesis is rational. But the real-world environment does not easily permit this approach.

Let us, for example, explore vandalism, which has become an extremely costly national problem to control. Despite the increasing exposure of vandalism in the mass media, and great expenditure of funds on hardware aids and traditional interpersonal educational approaches, the total national cost to all sectors is currently estimated to be running over a billion dollars and to be rising. The literature has attempted to describe the profile of a typical vandal, and we have participated in this endeavor. A major problem, however, in relying on the conventional sources of information to develop methods of crime control, is that the data are largely based on the apprehended population, which represent only a small proportion of those involved in reported incidents. Although the apprehended population has been generally reported to consist largely of males between the ages of 11 and 16 years, we wonder whether the undetected vandal population is typified by this group. A cynical viewpoint is that this age group has not been clever enough to escape detection. A much more difficult problem confronts us, however, in assessing the reasons why these juveniles commit acts of vandalism. We believe that most vandals largely outgrow this adolescent trait beyond age 18. Exceptions are those involved in incidents of burglary and robbery or involved in political and racial episodes (such as student anti-war protests, labor strikes, and school desegregation and other demonstrations).

Other than these incident-specific motivations, there are many, often complex, motivations that can be ascribed to youngsters committing vandalism. Frequently, the apprehended offender has no rational explanation for such actions as trashing classrooms and parks, stoning and shooting at trains, slashing seats on buses, or rowdyism in public facilities and transit systems. The view presented here, which may be supported by others, is that attempts to isolate causal factors may be futile exercises (except for satisfying the intellectual need to understand human attitudes and behavioral responses) when the exigencies of various situations clearly call for immediate problem solutions.

For example, there are miles of exposed transit systems track, switches, and signals that can be (and are) disrupted by a determined terrorist, or by some bored juvenile seeking a perverse thrill, and it matters little at the instant of an incident what motives may have been driving these diverse types of perpetrators to derail the transit equipment. The primary need is either to deny access to these facilities or to provide some means of surveillance to detect the hazard in sufficient time to avert an impending incident. Decision alternatives entail several important considerations for management, not the least of which is the cost to prevent incidents, which can frequently exceed the actual losses experienced.

THE HIGH COST OF CONTROLLING LOSSES

Major deficiencies exist in all sectors of business and public institutions regarding knowledge of the actual costs attributable to crime, particularly vandalism. Our extensive research on vandalism in public facilities has shown that record keeping is generally poor. I emphasize "costs" as contrasted to "losses." Organizations frequently fail to realize that the direct losses incurred due to physical damage or theft of property or to personal injury resulting from stranger-to-stranger crimes reflect only a portion of the associated costs. Such costs include overhead costs for repair and maintenance; insurance premiums; out-of-pocket costs resulting from the large loss-deductible provisions that are common

in insurance coverage; court litigations; extra custodial service in lieu of contract guard service; security guards; alarm systems; and miscellaneous surveillance and communication systems and structural barriers.

Many organizations experience difficulty in deciding how much security they should prudently implement when they weigh losses incurred against security costs. A recent problem involving such policy analysis was presented to us by a school district. This case demonstrates the need to evaluate the nature of the problem carefully. The district faced cancellation of property insurance coverage because of three arson fires that had occurred during a two-year period. The fire loss to the insurance company was approximately $500,000. The school district had to absorb an additional $50,000 because of the loss-deductible provision. The demand presented to the district by the underwriter was that a total intrusion alarm system--with an estimated cost of $20 million over a 10-year period--be installed in the 50-building sprawling complex within a year. The insurance company had indicated, however, that an interim contract guard service--costing $50,000 per year--would be acceptable. The irony here was that soon after the guard system had been implemented, another arson fire occurred.

Our immediate questions posed to the school authorities concerned the identification of the facilities broken into, the nature and cost of the reported losses, and the times when the incidents had occurred. Such information is basic to the understanding of loss prevention system requirements. But the district could not readily produce the data without an intensive data compilation effort. When a reasonable set of facts regarding the various incidents had been assembled, we observed that the maximum loss sustained in the last year evaluated (1975) had approximated $100,000. This loss represented about 0.3% of the district operating budget, which included a $50,000 arson loss. The remaining losses of $50,000 represented random vandalism (glass breakage, structural damage) and theft, largely in the junior and senior high schools. An astounding number of incidents of theft had been

reported with no visible sign of forcible entry.

We recommended that the district, having an annual operating budget of $32 million, install a total fire detection system (smoke detectors), which would serve to protect the district from a catastrophic fire loss at considerably less expense. The insurance company's demand for an intrusion alarm system was totally unrealistic and, furthermore, would not have provided protection against theft during the class day, or protection against the type of vandalism being experienced. Other recommendations made to the district included such protective measures as key and property control and an educational program at all levels in the school district.

TRANSIT SYSTEMS CRIME EXPERIENCE

The American Transit Association (ATA) reported similar difficulties in attempting to assess the costs of crime and vandalism on urban transit systems.[3] The ATA researchers exposed an interesting statistic which may account for the indifference that many administrators and managers show when confronted with demands to budget for loss prevention and security systems. The 1971 ATA survey of 20 selected transit systems estimated that vandalism costs expressed as percentages of operating expenses tended to be less than 0.5%. Only one system (Philadelphia, SEPTA) reached a 1.1% level of costs. Costs were not developed, however, for all the forms of crime committed in public transportation systems. But the ATA estimated that some 33,000 to 39,000 incidents occurred in 1971, representing all types of crime.[4]

The largest losses were attributable to window-breakage and seat damage. Although the ratio of losses to overall operating expenses is low, the dollar cost outlay estimated at $10 million nationally in 1971 for essentially senseless damage represents a drain on revenue. Further, the shabby, damaged, and defaced transit vehicles present an undesirable appearance to the riding public.

The 1971 ATA study was unable to establish any functional relationships such as:

City size and number of incidents of total crime on transit systems
Total crime indexes and total transit crime per 100,000 vehicle-miles
Total crime indexes and total transit crime per 100,000 revenue-passengers
Vandalism costs and vehicle-miles
Vandalism costs and revenue passengers
Vandalism costs and vehicle-hours
Vandalism costs and number of vehicles operated.

Given this inconclusive evidence of patterns in city crime levels that may affect crimes committed against operating transit systems, the ATA sought to determine the effect, if any, that reported, or witnessed crimes have on ridership. After a 1971 survey of five cities--Milwaukee, Washington, Baltimore, Cleveland, and Chicago--the ATA concluded: "It is extremely difficult to establish that a given change in ridership is caused by a single factor such as crime or vandalism. In any situation there may be a combination of factors that influence ridership and make it all but impossible to determine the degree of influence of any one factor."[5]

The ATA findings were also inconclusive on whether the riding public's perceptions of reported crimes have a significant influence on its use of alternative modes of transportation. Nonetheless, the researchers found some indications that ridership can be adversely affected in known high-crime areas during certain times.

Wilson's policy analysis notion is essentially the central theme of this discussion, and I think it is important to place certain criteria into sharp focus. The ATA study's orientation was to assess the nature and extent of crimes committed on urban transit systems, to explore alternative security measures, and to assess the effect of crimes on ridership. The function of mass transit systems is to serve the public and to provide for its

safety. The costs of performing this function and keeping transit systems in operation are currently causing considerable management stress. The large capital investment and general operating expenses have to be recovered-from the revenues received from the riding public. Current systems require subsidies to remain operational, and the erosion of revenues by lawless and senseless vandalism and by loss of patronage through fear cannot be tolerated. But a major policy issue arises similar to the school intrusion alarm example cited earlier: what aspects of physical security should management consider? Obviously, management requires an assessment of the severity of the problem and an analysis of possible solutions at a reasonable cost.

Let us look at an interesting case study SRI undertook several years ago for the Alameda/Contra Costa County Transit District in California and the U.S. Department of Transportation.[6] This was a study of assault and robbery of bus drivers. The problem had been plaguing not only this transit district, but other bus systems in the country. The motive for assaulting the drivers was primarily robbery. The initial study approach required an extensive evaluation of alternative technological and operational countermeasures designed to thwart, and to aid in the apprehension of, the perpetrators. The measures explored included signal flashers, radios, silent alarms, automatic vehicle locators, a private guard force and riders, randomized police patrol suveillance, cameras, driver protective shields, and arming of the drivers. All of these alternatives would have been costly, but all lacked a fundamental understanding of the problem and solution dynamics.

CREATIVE CONCEPTUAL SOLUTIONS

Fortunately, an alternative approach was found, already being implemented in certain bus systems elsewhere in the country. This alternative was simply removal of the object of attack: the cash fare receipts from the driver's custody. This technique proved so successful in reducing attacks on bus drivers that it is now widely employed. Also, modern commuter service systems use magnetically

encoded tickets which limit access to trains and at the same time minimize cash exposure at ticket vending stations. The cost saving in ticket "lifting" is also a major benefit. However, as we learned during a panel session, this system is capable of being defeated.

In the California exact cash fare experiment, obstacles had to be overcome before the system could be fully implemented, to convince the public that this procedure was in the best interests of all. Management had to be convinced that the inconvenience to the public of having the exact cash fare would not alienate the patrons and reduce patronage. This technique is now being widely used in vulnerable gasoline service stations with equal success.

The exact fare system could be looked on as a conceptual breakthrough in thwarting potential robberies. (But no doubt a crime displacement problem occurred.) Law enforcement has been emphasizing crime prevention measures that would effectively limit the target of opportunity. Oscar Newman's "defensible space" architectural design concept is another example of creative thinking that seeks to minimize the attacks of muggers, burglars, and assaulters in unobservable areas. Modern transit systems should certainly take these techniques into consideration. The above solutions are the result of management policy decisions that did not require extensive causal (motivation) analyses. The solutions were derived by evaluating whether these approaches would effect the goals desired, namely, denying the cash to would-be robbers and thereby reducing the threat of an assault on drivers and, in the case of building occupants, removing vision blocks to passers-by.

REVENUE PROTECTION

Another issue related to security is of vital concern to transit operating management: the safeguarding not only of property and equipment, but also of the financial resources derived from revenues. Passenger train service is vulnerable to white collar crimes, particularly with regard to ticket operations and food and beverage service operations. Manual and automated ticketing procedures can be manipulated to the detriment of the operating companies, unless

suitable internal loss control procedures are instituted to provide early detection of possible irregularities. We learned of one system's experience with the deliberate jamming and pilferage of the automated ticket-dispensing machines.

Conventional surveillance by traveling auditors and security agents can provide some measure of protection. But the cost of providing continuous surveillance is high, and the probability of apprehension of employees embezzling cash or converting illicitly obtained tickets for cash refunds may be low. Futhermore, the effect on employee morale could become a problem if such surveillance were poorly conducted.

MANAGEMENT'S POLICY ROLE

It is evident that management is confronted with a major policy decision regarding the objectives of a security program. I emphasize program as contrasted with security system. One school of management (or a security director) could assume the posture that no act of vandalism or assault and no employee's "irregular" act should go unpunished. The problem with this position lies in the inability to detect, apprehend, and successfully prosecute the perpetrator. Take vandalism, for example. In many transit systems, specifically during the peak ridership of school age juveniles, vandalism and rowdyism are a particularly difficult problem to control. Doubtless, there is no need to recite the numerous horror stories from major inner city sources.

The problem lies with the public's outrage at juvenile rowdyism and brutality and at the same time the public's reluctance toward getting involved. The driver of a bus, if he intercedes in an incident, often finds himself (or herself) suddenly the focal point of abuse and attack. Management's appeal to local law enforcement to provide protection meets with resistance because of municipal budgeting constraints. If anything significant is to be done, the transit system management must provide its own security personnel to ride the buses and trains during the periods when such problems have arisen. Consequently, operating costs are increased,

and somehow have to be recovered. But we can only speculate that the extra cost burden of providing such protection is probably greater than the economic losses incurred. Management must consciously consider both the financial and passenger safety risks involved in arriving at what obviously has to be a compromise solution.

For the sake of exploratory argument, let us examine some of the problems experienced in our convoluted juvenile justice system should a transit company insist on prosecution of, and restitution by, offenders apprehended as a result of an augmented riding and patrol security force. There is a preponderance of evidence revealing the almost immediate release of juveniles taken into custody by the juvenile authorities. In a 1972 study on railroad vandalism conducted for the Federal Railroad Administration, Sanders and Welton[7] extensively examined the literature on attempts to control vandalism by recourse to law enforcement and the courts. Their findings regarding punitive measures, directed either to the juvenile offender or the parent (under parental responsibility laws), are not encouraging. Data were largely unavailable regarding the impact of the imposition of heavy penalties on vandals, aimed at deterring the vandals from committing the crime again or at deterring others. With regard to imposing parental responsibility laws the researchers reported that:

1. Schools or railroads cannot afford the time and effort necessary to bring the case to court.
2. Courts are unwilling to impose the penalties.
3. Often parents cannot afford to pay.[8]

In sum then, management committing itself to an intensive apprehension program would find much frustration in attempting to curb the problem by recourse to this procedure.

Sanders and Welton also extensively explored other alternatives to deter the individual before he even considers committing an act of vandalism. They reported that educational programs in the schools and exposure of the problem in the media had met with little success. Our findings with similar programs conducted in the schools have also revealed mixed and uncertain results.

Physical security measures have been reported to be of some value in apprehending perpetrators and in minimizing damage. There is a whole range of surveillance equipment, alarms, lighting, and communication systems that have proved to be of value in apprehending perpetrators. But such equipment is costly and not so useful as originally believed. Furthermore, we have seen a conflicting body of literature regarding sensor false alarms, and the various systems' ultimate impact in controlling what appears to be a rising level of crimes committed.

AGT SYSTEMS SECURITY CONSIDERATIONS

Up to this point, I have been discussing historical, empirical knowledge of vandalism and crime problems affecting operational transit systems. From the research and analysis conducted during the past three or four years, it is also evident that generally only poor information is available on which to base recommendations for selecting appropriate security and loss prevention measures to control transit system crime. This being the case, planning for the security of a range of advanced design AGT (Automated Guideway Transit) systems such as Shuttle Loop Transit (SLT), Group Rapid Transit (GRT), and Personal Rapid Transit (PRT) is exercising our collective judgments to extremes. A basic problem is that none of these systems has seen commercial service in a large metropolitan area.

SLT systems are being used for special nonrevenue-generating functions, such as in airports and amusement parks. Two GRT systems have been constructed in the United States. But, again, as in the case of SLT systems, they do not serve the general public in a high-crime urban environment. The PRT systems largely remain in the "advocacy" stage; no system is in revenue service or under construction in the United States.

Consequently, security planners are forced to conjecture, to postulate alternative threat or potential hazard scenarios, and to attach probabilistic values as to the likelihood of any given problem arising that could adversely affect passenger safety and vehicle integrity. Unfortunately, there is considerable disagree-

ment as to appropriate measures of effectiveness with which to evaluate alternative security procedures. There is no consistent formula for establishing cost criteria for protection of people and facilities. The problem is further complicated by the uncertainty of system design configurations, the mode of travel (elevated, grade, subsurface, or combinations thereof), and the types of urban environments that the vehicles will traverse.

All is not completely uncertain, however. Modern AGT-type systems, such as BART in the San Francisco Bay area, have been in operation for a sufficient period of time to enable certain security provisions to be examined. I believe that BART, except for window breakage, has not experienced the vandalism or crime problems that might have been anticipated in the known high-crime areas of Oakland, Richmond, and San Francisco. The good experience may be attributable to the fact that BART does not operate during the very late evening hours, traditionally the hours when transit crimes occur. (New York has had crime patterns shifting as a result of security measures.) Also, the general BART patronage (as in PATCO) may not include the individuals who traditionally seem to cause a lot of the vandalism and general juvenile disturbance and crime problems.

There is one area of concern, however, that is germane to attracting or repelling transit system ridership: the large parking facilities provided at the suburban terminals and key way stations that are experiencing car theft and boosting incidents. If the objective is to discourage the use of automobiles in the congested inner cities, then protection must be provided for vehicles bringing commuters to the AGT stations. This is an additional cost burden that is peripheral to transit system operations, but the issue can affect ridership.

Last year's workshop report on "Security of Patrons on Urban and Public Transportation Systems" raised an interesting psychological issue regarding the territorial imperative, the tendency of individuals in a commingled situation to block out space or turf.[9] The notion raised in that paper was that riders observed on transit

systems tend to seek isolation or collocation with regard to several variables, including sex and physical appearance. If this thesis holds universally, careful consideration must be given to the minivehicle configurations which may carry two to four or any small number of passengers. If a patron chooses not to ride in a vehicle containing certain types of riders, then a severe problem of system rejection can arise. In other words, if a passenger is to be subjected to fellow riders who are deemed undesirable, and who may pose a real or imagined threat, then the system may be rejected. Whether security provisions can satisfactorily overcome this psychological issue is questionable. More validation of this observed phenomenon appears warranted.

A major objective of AGT system technology is to minimize the traditionally costly labor-intensive operations of current transit systems. But it is a matter of serious concern whether remote-sensing technology can compensate for the perceived or real crime-deterrent effect afforded by the presence of car operators or attendants. The broad questions that must be addressed for all AGT system configurations are the degree to which physical security technology can be relied on, given the state of the art, the high costs, and the current lack of knowledge of the crime-deterrent effect.

In conclusion, I would like to return to an issue that has recurred throughout the discussion, the role of operating management and security planners as co-responsible agents to ensure the success of modern AGT systems. It is only in recent years that management has become convinced that crime has a depressing effect on business operations. Some administrators choose to delegate all responsibility to a security specialist, because they see the role of operating management as being concerned only with operating trains. The security director may have had relevant experience only in law enforcement and see only one solution: apprehend a lawbreaker at all costs. As I have noted, this policy may be decidedly counterproductive. Both security and management should participate in planning in order to gain perspective on each other's functions and to benefit from each other's expertise. Such an integrated planning process would tend to avert many of the problems and issues that I have attempted to explore.

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DISCUSSION OF PAPER 1 PRESENTATION

A general discussion began following presentation of Bernard Greenberg's paper. The following summarizes the information that was presented.

The discussion opened with a strong statement of the necessity to get away from approaches to transit security based on technological feasibility alone. An innovation that is technologically feasible may in fact cost more than a traditional solution. Furthermore, every system should be examined within the context of a variety of applications and settings. An elevated system, for example, could be examined in the context of an airport, an institutional setting, and a CBD (Central Business District) distributor. What is needed is a reliable, systematic method of evaluation that takes into account the existence and interrelationship of an enormous range of variables.

This immediately raised the question as to the kind of research and data collection necessary for such evaluations, and the related question as to who should be responsible for the collection of this data. It was clear that no single property in the U.S. currently has the resources to collect the data and put it together. A great deal could be learned, however, through beginning to get groups of people working consistently in the area. The fragmentation of past research must be replaced by a growing infusion of interest and resources in order to build a field.

One suggestion was that, because of the magnitude of the problem, an office of transit security be created within UMTA to develop a program of systematic research, experimentation, and evaluation. Mr. Greenberg disagreed, calling this a "bandaid" solution. Studying the problem, he said, is simply delaying to some degree. Asked his opinion as to whether this was a DOT role or a federal role, Dr. Sussman responded that he felt it was technically a proper DOT role, as the problem of crime is vital

to the success of the present and future systems, and the success of these systems is of vital concern to Congress. He added that the Law Enforcement Assistance Administration (LEAA) could provide excellent assistance and/or collaboration with the federal agencies on problems of mutual interest.

The need to make a major national issue out of transit security was stressed, in order to get the support of Congress and the public at large. LEAA is already engaged in finding issues of national concern, one of which is a 1½-to 2-million dollar program to initiate several experiments around the country with the police agencies.

The discussion then focused on Wilson's theory of policy analysis versus causal analysis, as presented in Greenberg's paper. In the past, too much energy has been expended on establishing the root causes of crime as a prerequisite to controlling the problem instead of determining the state of affairs desired and how to bring it about. If this theory is true, DOT simply has to protect the systems it wants to protect as economically and as efficiently as possible.

There are two approaches to the protection of property: one is coercive, i.e., inculcating the fear of punishment; the other is persuasive, i.e., ascribing a sense of value to an object. An example of the latter was cited: a particular school was beset by excessive vandalism; the school was opened up at night for recreation and run by teenagers; the vandalism disappeared. If the same principle were applied to transit systems, they could possibly be turned into something valuable to teen-agers, something they want to protect.

The discussion then turned to the subject of data: is there enough available to answer some of the questions that were being raised? Perhaps, it was suggested, too little is being done with existing data, resulting in the temptation to collect data for the sake of collecting data. Ideally, transportation systems should be able to learn from one another, or at least be able to measure the comparative effectiveness of various systems. Others thought

that present data is not good enough to stand up against the (negative) scrutiny of "conventional political wisdom," i.e., if the solutions proposed conflict with public opinion, they must be based on exceptionally good data, and this kind of data is not available today.

The point was made that the underlying problem in transit security is that transit security forces are not usually an integral part of the management of the transit district or authority. BART was cited as an example of this. Their police force was added on as an afterthought. In future transit improvement programs, police problems must be anticipated and provisions made for them. The information that will be generated in carrying out these measures can then be assimilated and used to develop hypotheses.

Crime is, of course, not the only problem for automated mass transit. Ridership has been declining in many urban areas as people have left the high-density areas of cities necessary to support the system. The group was asked to consider the more basic problem of whether there is any way to enhance the feasibility of mass transit.

This feasibility depends largely on continued massive subsidy by the Federal Government. Current public support of transit subsidy is riding on an "emotional basis" concerned with safety in transit systems. Consequently, subsidy is not questioned today, but it is certain to become a serious political issue in a few years as data about losses builds up. Technical experts on the Transportation Research Board (TRB) are already beginning to ask what the gains are of massive subsidies.

The question still unanswered was how to justify the development of automated transit systems in the light of decreasing urban core density patterns. On this issue opinion differed sharply. It was impossible to project the density needed to make these systems economically feasible.

There was some discussion as to whether the problem of economic feasibility should be addressed at all. More important was a consideration of the kind of service that automated systems would be able to provide. Here, a change in transportation of the country was postulated as a result of factors like the oil crisis. In an oil crisis, the automated guideway systems would be able to provide services similar to that of private transportation, or better service, for less money. The counter-argument to this was raised: even an energy crisis would not necessarily mean a change in the nation's transportation. There would be nothing to prevent even more jobs from moving out of the cities to where the people are. Conversely, even if the jobs stay in the inner city, some people would rather take jobs in the outlying areas that pay less than face the problem of crime in the inner city.

When discussing the construction of new mass transit systems, it is necessary to draw on the experience gained from the construction of highway systems and peripheral highways around cities. The latter helped to determine the pattern of life and the character of the metropolitan and suburban areas. Examples of this are the Shirley Highway in Washington, D.C. and Route 128 in Boston. It can be argued, of course, that these highways would have had to be created, as they merely reflect a certain pattern of growth. Nevertheless, transportation planning can be used as a tool to reconfigure the living environment of a city. An example of this is the small circulation system in the Northside inner city area of Chicago, which made this area increasingly desirable. Examples of the relationship between highway building and development of city sections can be found in Washington, D.C. and Baltimore.

The point was made that public funds will certainly be necessary to build automated transit systems through high-crime areas, because the necessity for protection will discourage private investment. For the same reason, public subsidies for such projects will be unpopular.

To make the point that life issues cannot be separated from crime problems, it was remarked that some outlying stations can provoke crime without being in high-crime neighborhoods due to their lack of supervision and infrequent train connections. Another direct relationship between nature of the transport service and the incidents of crime can be seen when pickpockets use jerking trains to steal from their victims.

Good transportation, which meets the needs of its users, influences land use, quality of life and marketing opportunities as well as crime, and these issues must be seen as interrelated.

A further point was made that the provision of public transportation is the answer to widespread fear of a decrease in mobility.

Dr. Sussman then brought up for discussion Veblen's theory of conspicuous consumption, which indicates that people want to occupy as much space in as grand a manner as they can. Given their choice, and economic constraints being equal, in the aggregate people will always move out of the city, and transportation makes this movement possible. Some people (1) move out as far as they can and (2) ride as large an automobile as they can. (The small cars in Europe are an exception, because large cars are disproportionally taxed.)

There was speculation as to the future of the inner city and the nature of future population movements to and from the city. Some thought the inner city would disappear entirely; others, that there would be a re-emigration of the suburbs to the city, made possible by the transportation systems; and still others, that there would be hardly any change in flow at all. This leads to the question of how suburbanization itself came about. Some of it occurred as a result of growth of the urban areas and the building up of the center of the city, with expansion in the form of new construction in the outlying areas. In other instances, suburbanization occurred before the cities were developed, as in Boston, with the development of street railways.

The subject was changed to the question of how transportation policy is made in Washington. Mr. Marino implied that policy depends largely on the prevailing mood of the public, and that the time was now ripe for study of automated transit security. There was now sufficient interest in it, and sufficient funds were available. The current policy is to provide these systems to people who cannot get around economically by car, to provide these systems as an alternative to automobiles to save energy. Policy, however, is always subject to change. If subsidies are reduced in the next few years, then the systems will be forced to respond to the marketplace. The marketplace will put them only in areas where there will be high revenues, i.e., non-urban areas. If this happens, then the security systems will have to be substantially different from those in urban areas.

SECTION 3
TRANSIT SECURITY RESEARCH

3.1 PROBLEM RESEARCH AND CRIME SOLUTION ON PUBLIC TRANSIT

Vandalism, personal assault, passenger fear, and various other crime-related problems plague public transportation systems throughout the United States. It was the primary purpose of the second panel discussion to review different methodologies for researching and solving crime problems on public transit. The exchange of ideas focused around twelve basic questions. As presented by the moderator, Professor Pierre de Visé of tne University of Illinois at Chicago Circle, these were:

1. What is known about the incidence of crime on mass transit?
2. How is the incidence of crime affected by site, time, assailants, victim response, police intervention, presence of transit workers, injuries, and valuables taken?
3. Are there time series of consistently reported crime incidents available?
4. Are reported incidents complemented by household survey data?
5. Are there survey studies and data measuring passenger perception of the danger of crime on mass transit? Has fear of crime risen more than crime itself?
6. How significant a factor is the fear of crime as a deterrent to ridership? What are other factors of decline in transit ridership?
7. What have been the trends in ridership? What measures (other than crime reduction) are being taken to encourage ridership?
8. Is crime reduction aimed principally at improving the image of mass transit and increasing ridership?
9. What is the importance of the elasticity of demand for transit risk (i.e., as ridership decreases, fear of crime, and the crime rate itself increases)?

10. Do we know the economic, psychological, and other related factors which might explain criminal behavior on mass transit?
11. Will a program aimed at removing crime from mass transit merely result in a displacement of crime from the transit system to other locations?
12. What criteria have been used to evaluate existing crime reduction programs?

3.2 SOCIAL ENVIRONMENTS WHICH FOSTER CRIME

Professor de Vise´ suggested that the panel should concentrate its attention upon the patterns of crime within a particular transit system. For instance, what kinds of crimes occur at what kinds of stations? On a less general level, it should be asked, "What is the nature and design of the particular system that makes it vulnerable to acts of vandalism and more serious crimes?" He further suggested that various official transit policies such as scheduling, fare collection procedures, staff deployment throughout the station, and the solicitation of citizen support should be tested as crime intervention strategies.

Larry Bell, an architect, industrial designer, and urban designer, was the first panel member to emphasize the importance of understanding the relationship between the social environment and transit crime. Criminal activity is not a phenomenon which occurs solely on the transit system, and bears no relationship to the area served by the system. There exists, accordingly, a definite relationship between the social milieu and transit crimes. Each of the following environments, for instance, will likely be the site of criminal activities of various types and degrees of severity:

1. Low income residential neighborhoods
2. High income suburban areas
3. Commercial districts in thriving or deteriorating areas

4. Parking lots of park-and ride systems
5. School buses serving various types of neighborhoods
6. Central cities.

The purpose of a study organized by Westinghouse, according to Bell, was to look at the crime-environment relationship in three environments and to attempt to determine what kinds of intervention strategies might be successful for reducing crime and fear of crime. The sites chosen were a three-and-one-half mile commercial strip in Portland, Oregon, a residential neighborhood in a Minneapolis suburb, and six high schools in Fort Lauderdale, Florida.

The consortium had as its mandate the creation of programs and demonstrations of strategies that might be transferable to other sites around the country. Cities, however, differ from each other: the problems are very different; the priorities are very different; the time schedules are very different; the whole "chemistry" of the issues is very different. Thus, the notion of mounting highly generalizable programs in one community and transferring them en masse to another is not realistic.

One hypothesis was that crime and the fear of crime can be reduced by proper design and use of the existing environment. Use and design are complementary; they are interdependent and cannot effectively be isolated. A companion hypothesis was that design and use of the environment can be consistent with quality of life objectives. Every time one puts a constraint on the use of an environment, there is a cost that goes beyond that of the hardware. There is a cost in terms of convenience to people.

We have to realize, in providing transportation systems, that what we are really designing is a service. If that service is not effective, then we can expect a rise in crime, along with many other accompanying problems, and it would be a mistake to believe that the answer is simply to look at crime issues independent of the use issues. The program is supposed to have demonstrated impact

upon crime and upon fear within a short period of time (a few years). It is gratifying to show quick results, but we are dealing with some very complex issues and a set of variables that one cannot control. In seeking to demonstrate short-term impact, there is the danger of settling for quick solutions and "bandaid cures", glossing over the real problems with solutions that merely capture the imagination of the press.

The design of transit systems relates to all levels and variables within the environment of a transport system--social climate, public support--just about everything that influences the use of that environment. Guideway design, vehicle control systems, station or maintenance facilities, personnel assignments, service schedules and coordination of operational policies--all these are part of network engineering. "When you're looking at a system you're looking at the criminals, you're looking at the people who have to maintain the facility and operate it, and you're looking at the police," Bell declared.

It must also be recognized that a single route often weaves through many different environments, making an analysis of a particular system a complex matter that can more accurately be conceptualized by geographic area rather than by individual route.

3.3 ANALYSIS OF DATA, INTERNAL AND EXTERNAL VARIABLES

There are clearly many interacting variables which become critical to conducting valid research: multivariate analysis is essential. Variables emphasized during the panel discussion as vital to a holistic analysis can be split into two categories: (1) the internal variables, over which transit authorities can exercise direct control, and (2) the external variables which cannot be directly controlled by transit authorities. Key variables discussed are as follows:

Internal Variables

1. Design
2. Routing and timing
3. Security systems
4. Employees
5. Operations
   a. Fare methods of collection
   b. Maintenance procedures

External Variables

1. Type of environment
   a. Residential, commercial
   b. High or low income
2. User attributes
   a. Needs
   b. Attitudes
3. Police surveillance
4. Related institutions (political, economic, social)
5. Technology
6. Criminal characteristics (motives, psychological makeup)

An additional evaluative difficulty is that the relationship between these variables is not simply linear, but interactive. The design of a system will, for example, affect the number of employees required, passenger access, and security needs. On the other hand, factors such as the types of users, environment, crime problems, and technology all have impact in determining the type of design used for a system.

Lack of money for implementation was a major problem in the Westinghouse program. In Bell's own words:

> What we really had money for was planning and research data gathering, and evaluation. And about the only things we had to urge people to implement our program was persuasion. So, this was no small problem. Go into an area 3-1/2 miles long and say, 'Well, gee we'd like to have you implement our crime prevention program.' It took a great deal of conviction, concern and energy on the part of a whole lot of local people to get the program started.

Even though lack of funds for implementation was a problem, Bell cited the strategies attempted to reduce purse snatching of elderly riders as an example of the numerous dimensions that must be considered in finding solutions to transit crime. One feasible solution in Portland was to carry on a public campaign encouraging

people not to carry cash on their persons. Complications surfaced when Bell's group discovered many older citizens do not use banks because they have difficulty dealing with the banking system, and especially with checking accounts. One of the strategies employed to resolve this situation was to induce banks to use a system which is more convenient for older people. After gaining the cooperation of the financial institutions an advertising campaign was implemented to publicize the program for carrying no cash on public transit.

Developing and implementing a program similar to the one in Portland involves a dynamic and comprehensive process. The initial step was to isolate the key factors which, if altered, would most effectively solve the problem. In this case the carrying of cash was chosen as the essential variable from a list of alternatives (e.g., increase security, alter design, encourage senior citizens to use other modes of transit, etc). Using the "carry-no-cash" approach also required extensive negotiations with an external institution. Another integral part of the process was convincing older criminals of the fruitlessness of their activities. Obviously any research on transit crime must use a similar holistic approach and study all the pertinent internal and external variables.

3.4 DIFFERING PERSPECTIVES AND PERCEPTIONS OF TRANSIT CRIME AND SECURITY

Larry Gallagher, a former policeman and at the time of the conference Director of Criminal Justice Planning for the Southern California Association of Governments, expanded on the concept of public perceptions of transit security. He claimed that the actual physical threat is not the major problem; rather, it is the public's perception of that threat. This perception is based on the "rowdiness that exists on buses," and the "inordinate attention that the news media tends to pay to those incidents that are truly serious."

He introduced the problem of quantitative indicators of mass transit security violations. Misdemeanors are especially difficult to classify in a comparable manner across municipal and state

boundaries. A crime reported in one area as a malicious mischief or fare evasion might be considered a petty theft in another city. These discrepancies hinder comparisons among various systems. Nonuniformity in data collection is problematic when the same transit system passes through different municipalities with unrelated police departments using various reporting standards.

There is, unfortunately, very little communication between transit districts and municipal, county, or state police, and seldom an established policy regarding appropriate relationships. There is even a lack of feedback among transit operators and transit security employed in the same district. Furthermore, there is, in general, no formal employee training program for transit operators in dealing with security problems. Security issues are compartmentalized, and dealt with only in the training of security people. The responsibilities of the transit employee should be articulated as clearly as possible in the form of a "procedural guide for (the employee's) conduct during any safety and security incident." The current lack of guidelines leaves employee responsibility in this area up to the individual's discretion.

Improving the quality of communication among the management, planning engineering, and law enforcement people could have important impacts, for instance, on public safety aspects of architectural design. The different perspectives of each of these employee sections should be understood in relation to mutual problems. The placement of a corner bus stop could be a completely appropriate transportation decision, yet draw very few riders because of criminal or anti-social activities on that particular corner. Use of neighborhood crime information in the decision-making process by the law enforcement section could prevent such inefficient management decisions.

Jack Schnell, Manager of Research for the American Public Transit Association, spoke on the human evaluation aspect of transit security. According to Schnell, six basic criteria for

judgment in security evaluations are:

1. The scope of the security problem that is being measured
2. How extensively vandal-resistant materials are used in the system
3. Factors which deter crime--surveillance, protection, apprehension
4. Community and educational programs
5. Institutional cooperation or conflict among the transit, law enforcement, and judicial systems
6. Studies of public attitudes toward transit crime.

The relationship between a transit system and the news media has a significant impact on the treatment of transit crime in the press. The "glamorization of transit crime" can lead to "mushrooming" effects, as documented in a series of suicides in the Toronto rail system. The detailed news reporting of these deaths seemed to increase the rates of suicides within the rail system. When negotiations with the media led to a "cooling" of the coverage, the "suicide trend" diminished accordingly.

The concept of strong and consistent punishment for security offenders as a deterrent to further transit crime was pursued by a research group directed by Mr. Schnell. They found, however, from juvenile and court records that there were so many mitigating circumstances (such as age of offender, number of participants involved in the crime, family problems, school records, number of participants involved in the crime, number of detention facilities available, etc.) that strong judicial sentences for offenders are often not feasible and are usually ineffective. No clear relationship between recidivism and severity of punishment could be established by his research.

Dr. Shellow, Director of the Carnegie-Mellon Study of Transit Security in Chicago and current Chairman of the National Institute of Drug Abuse, Panel on Drugs and Crime, discussed the type of data that should be analyzed for further information. He

acknowledged the importance of knowing the number of crimes occurring on transit systems, the nature of the crimes, and the types of people committing them. At the same time, he stressed the need for other data of at least equal importance. He was referring to the attitudes of the public, both riders and non-riders of the transit system, towards the system security.

The data on public attitudes which Dr. Shellow rated as important as, if not more important than, the data on volume of crime included the following:

1. How many people used the transit system by choice, and how many were captive riders who had no other means of transportation?

2. How many people used the transit system under unavoidable conditions, such as traveling to and from work? How many rode regularly and of their own volition? How many used it rarely? And how many refused to ride it at all because of fear and-or access to other means of transportation?

Such data, according to Dr. Shellow, would suggest approaches to be taken by the transit system to alleviate the crime situation, while at the same time satisfying the riding public and,possibly, encouraging the non-riding public to use the system. In addition, subsequent surveys which reflected changing public attitudes could also influence the transit system to redirect its efforts to conform to these changes.

3.5 PROBLEMS OF METHODOLOGY - DATA QUALITY AND OBJECTIVITY

The difficulty in dealing with public attitudes about transit crime is that perceptions of crime on an entire system may not change unless there is an enormous change in the quality of protection or security. In order to evaluate changes in attitudes, then, surveys of public opinion may have to be broken down into small units of observation.

We do not need to understand who is committing transit crimes, because countermeasures are usually based on assumptions regarding the motives of the offenders. At present, the state of knowldege about the offenders is extremely limited. It is possible, however, to interview criminals regarding conditions under which they have attempted or would attempt a crime.

The primary methodological problem has become the potential improvement of the quality of the data used in evaluations. Aggregated data, uniform crime reports, and police department statistics are regarded with "a certain degree of cynicism." Part of the problem is that these statistics are less reliable the further removed the data collector is from the incident itself.

In an effort to address this problem of data quality and objectivity in crime investigations, Dr. Shellow reiterated and expanded on comments made by the other panelists on the need for a uniform reporting system:

> The Carnegie-Mellon study has proposed a critical event investigation team, because we recognized that police officers really initially couldn't collect the kind of data that was pertinent to our interest. And there were two ways of going about it. One was either to send in a team of our own investigators to ask questions, or some police officers or lawyers, what not, or to train police officers to do that themselves. Well, we thought that initially, at least on a demonstration basis, we'd try our own team and then work again with the local police on the system and help them learn how to do it and then maybe ultimately turn it over to them. And then do what we do every time a certain crime occurred on the system; we'd send our research team out to get critical information. And the kind of information we'd get would be information that wasn't collected ordinarily. For example: EXACTLY, at what place on the system did it occur? I mean map it, identify it--behind the stairwell, how far away from the edge of the platform, how far was it from the exit, from the turnstile, what level and so on? Try to get estimates of much clearer descriptions of the escape route of the perpetrator or perpetrators. Much of this information is, of course, unavailable in the ordinary police report, but would be critical in understanding the relation of the, if you will, the architecture, the space configuration to the event.

Comparable data is essential in making inferences on volume, patterns, and seriousness of crimes.

Possibly the initial decision that should be made in any program is what constitutes the goal of the program. The evaluation of a security program is no different; it must begin with an articulation of the present goal of the system as a whole. There can be several complementary goals, such as cost effectiveness ("...that every dollar laid out for improving security sustained ridership"), and simply the quality of the ride itself. The goals must be considered always in terms of the responsibilities of running a public transportation system.

3.6 AUTOMATED GUIDEWAY TRANSIT SYSTEMS

Issues relevant to Automated Guideway Transit (AGT) systems, which were discussed by the third panel, are potential design solutions and the deterrence potential of the presence of people, both in the station and in the transit vehicle. The panelists agreed that, regardless of the system, crime would occur in high-crime areas. Architectural solutions to transit security problems were emphasized by Dr. Shellow. He felt that stations should be situated so they will be frequented by riders as much of each day as possible. Riders should be clearly visible to each other at all times so people can provide a constant mutual surveillance.

In studies of the responses of witnesses to crimes, it has been found that the primary significant variable is the number of witnesses, according to Dr. Sussman. The probability of responses (either reporting the incident or assisting the victims) is very slim if there are many people around and is quite high when there are only a few people around. The reason for this has been hypothesized as the psychological tendency to diffuse responsibility.

Mr. Pawlak stated that the primary difference between a conventional rapid transit system and an AGT system is the presence of an operator. The job of the operator on conventional systems is to move the train and watch the doors. Security surveillance is of secondary importance to these employees, who are concerned with

specific task assignments and hampered by the design of the cars and the limited view available to each employee. The deterrence effect of the presence of transit employees on the train appears to be minimal, although some debate surrounds this point. If the deterrent effect is low, however, there would be little substantial difference between conventional rail and the AGT system in regard to security provided by operators.

3.7 RECOMMENDATIONS

Transit crime can be viewed as falling into three different categories (according to Gallagher):

> First, there is vandalism and malicious mischief; it's crime but, it's kind of a subheading kind of thing. Then you have to deal with the problem of people that are victimized personally, whether it's a personal threat or rape or robbery, the pickpocket situation; and how do we deal with those? Now, those are person-to-person crimes, where the system itself is not the victim; the individual is the victim. In the former, the system itself is generally the victim, and I think we handle those differently.
>
> And then you get the third situation, where you're dealing with the public at large to insure that they get the proper perception of the problems that exist within the system.

Bell suggested that another category of crime has been formulated when the system becomes the "instrument of victimization," where crimes of vandalism can jeopardize life and create accidents.

There is a great need for expanded research in terms of kinds of input for the planning process-both facilities planning and policy planning. Hard data is needed on the perceptions of both the prospective offender and the intended victim. The only data base that now exists is for conventional transit systems; no base has yet been developed for the AGT system.

A general uniform reporting model needs to be developed. The panel had two major suggestions concerning data collection techniques: establishing uniform definitions and codes was seen as a primary need, as comparable data is vital for engaging in a

productive evaluation of diverse transit systems; and impartial, objective collection of data is a second extremely important factor for making a viable analysis.

Panel members further suggested that objective individuals with no special interest in transit crime investigate these situations, especially for serious crimes. Such a group might be fashioned after the National Transportation Safety Board. As a multi-disciplinary group of experts, this "national transportation security board" would investigate serious crime incidence and try to determine causes, and would suggest solutions to the transit authorities. At present, reports are usually obtained from sources which represent vested interest in what the data reveals (such as police, transit employees, and insurance agents). Impartial data investigators can reduce these informational biases.

The negative repercussion of transferring results from one research project to another was pointed out. A solution or hypothesis which is applicable in New York might be impractical or inappropriate in Philadelphia. Various transit systems should be compared and common trends noted,but replicability of research findings should not be assumed.

These points derived from the panel discussion clearly indicate the need for more comprehensive and systematic research methodologies. Various studies need to be compiled, and transit systems compared. Researchers should carefully consider the substance of the data being collected in terms of relevant new knowledge and usefulness for policy planning. Uniform definitions of crime incidence and an objective reporting system used together would provide a significant contribution to the evaluation process. A comparable objective information base will provide an important foundation for the development of innovative and valid methodologies for the study of variable interrelationships.

NOTE: The Transit Security Research panel discussion was concluded during the afternoon of May 27, 1976. Mr. Victor Rouse presented his paper that evening on developing a methodology for evaluating the effectiveness of crime reduction measures.

PAPER 2

DEVELOPING A METHODOLOGY FOR EVALUATING THE EFFECTIVENESS OF CRIME REDUCTION MEASURES FOR MASS TRANSIT SYSTEMS

By

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CONSIDERATIONS RELATING EVALUATION TECHNIQUES TO CRIME REDUCTION MEASURES

My remarks this evening have a central theme, that evaluation measures which seek to reduce crime on mass transit systems must be primarily concerned with the type and quality of data which determines that a problem exists, requiring the problem analysis and solutions which lead to the selection of a particular measure. To attempt to characterize this relationship between data-problem analysis and solution, I will explore the relationship between mass transit crime and the neighborhoods in which the system operates.

Rarely can the problem of crime on mass transit systems be discussed without recognizing the importance of crime in the neighborhood in which these systems operate. Equally rarely do methodologies for evaluating crime reduction measures indicate an appreciation of neighborhood crime and its relationship to mass transit systems. If effective measures are to be developed for crime reduction on mass transit systems, they must include a translation from neighborhood objectives, characteristics, and crime types to specific transit systems and the specific techniques for crime reduction on those systems.

Crime reduction measures on mass transit systems are focused largely on some combination of the reuse of physical space, efficient allocation of personnel, and the use of technology. The extent to which such crime reduction actions are consistent with the objectives, interest, and behavior of local residents and local transit use will affect their success.

To attempt an evaluation of crime reduction techniques without recognizing this key relationship between local neighborhoods and public transit systems is to risk inaccurate evaluations.

Consider a rail transit system which traverses a highly urbanized area with public and private housing, closely associated retail facilities, possibly a nearby university, and with a serious crime problem. If the evaluator were to examine the crime problems which exist in the nearby commercial areas or public housing, he or she is likely to find that several efforts are being made to

control crime in those environments. These efforts might include the use of closed-circuit television in elevators, redesign and reuse of physical space, better lighting, and better allocation of police services. A further analysis might demonstrate that the offenders who operate in adjacent crime environments tend to be the same offenders involved in crime within the transit environment. In fact, many of the offenders and victims are often the same for both of these environments.

Some understanding of which crime reduction actions work and which do not, with regard to the surrounding environment, will be a good determinant of which evaluation measures to attempt within the transit environment. Further, an understanding of how residents, offenders, and victims view certain crime reduction strategies would also be a good indication of the acceptability and workability of these devices in the transit environment. This understanding would then become a part of the evaluation process.

For example, while cameras and TV camera surveillance have been effective in certain environments, at times they have been targets of vandalism, and therefore a source of crime in others. When a particular technology or a particular policing strategy has been demonstrated as ineffective in an environment contiguous to a rail system, its use in the transit environment should be viewed cautiously. Even before a technique in a contiguous environment can be shown through evaluation measures to be ineffective, residents of that environment might perceive its use as ineffective and transfer that view to the transit environment. In cases such as this, it might be unwise to utilize the same or similar devices, and/or policing strategies. Whether unwise or not, an evaluation approach which includes no data gathering techniques for determining such perception and its meaning has no opportunity to assess its relevance as it relates to mass transit.

In order to develop effective evaluation techniques for crime reduction measures on mass transit systems, one must isolate and systematize the relevant factors associated with the causes of that crime. (Evaluation technique is defined here as a procedure for identifying the advantages and disadvantages of

several different crime reduction strategies.) When this isolation of factors is accomplished, the possibility of determining what is and what is not significant is enhanced. If neighborhood crime and its relationship to crime on mass transit are not systematically considered, the chance of developing strategies for its control is remote. Evaluation of these strategies will necessarily be inadequate, since it would miss the ultimate objective of determining if the anticipated impact has occurred, when such a significant part of the reason for the imapct would not have been considered.

DEVELOPING CRITERIA

Developing an approach for evaluating crime reduction efforts on mass transit systems as they relate to urban neighborhoods must begin with the establishment of adequate evaluation criteria. Criteria as used here refer to those indicators which accurately define, quantify, and qualify the crime control strategies utilized in mass transportation systems, and are specifically defined by the following standards: input verification, assessment of the nature and extent of the impact achieved, and the identification and measuring of sufficient outcomes to demonstrate a linkage between input and ultimate impact. Developing such an approach is a difficult task, because these criteria must be related to urban community indicators as well as those associated with transportation issues. This is especially true of mass transit systems in urban communities, because of the heavy reliance on passenger density (and surrounding neighborhood residential density) for sufficient ridership to generate favorable cost/benefit ratios. This reliance often places mass transit systems with dense, older urban environments which have serious economic, social, and criminal problems. Thus, if evaluation of urban mass transit systems is to be effective, it must be based on criteria which satisfy transportation cost/benefit concerns as well as community objectives relating to safety and security. Examples of transportation cost/benefit concerns would include savings in travel time and cost to riders, increased numbers of riders due to an increase

in perceived security, and an increase in riders with regard to temporal ridership. Examples of community objectives would include scheduling to reduce waiting time, and thus exposure to crime, security measures which increase security in and around rail stations, bus stops with a focus on local users, and crime control strategies which are in accord with resident values and sensitivities and which act to contain and control crime in the transit environment, thus preserving neighborhood and community facilities.

The transportation cost/benefit side of the evaluation should not become the only guide to the decision maker. When it does, evaluation becomes little more than financial appraisal of crime control measures and of minimum value. The effect of crime on ridership, and in turn, on the ability of the system to pay for itself is, of course, important.

An emphasis on cost/benefit analysis, however, appears to be based on the assumption that dollars provide a satifactory common impact "measure." This assumes that the marginal utility of money is equal for all potential and current users of a mass transit system, which it is not. The implication is that, even considering the issues and objectives of the affected community, the alternative with the greatest economic return (which is the one producing the greatest number of riders) thus offers the most secure system and provides the greatest net benefit to both the community and the transportation system. This is often not the case.

Different neighborhood population groups have different needs, some of which are intangible. Each alternative will have different effects for each segment of the neighborhood population. Examples would include the difference in effect that security personnel saturation would have on local and nonlocal users, as defined by closeness of residence to the system, or the priority given security as opposed to scheduling for the dependent and nondependent mass transit user. If the differences of such effects are included, necessarily touching on some of the intangibles, an alternative

with less crime reduction efficiency may actually be found the most desirable because of the effect that it has on the stability, community-police relationships, and transit use. With the singular cost-efficiency approach, there is not the opportunity to link up the theoretical criteria for evaluation of crime reduction measures with the practical world in which these transit systems exist.

What must be developed, therefore, is an evaluation approach which addresses both cost-efficiency and transportation cost/benefit ratios, as well as community goals and objectives of an intangible nature. Any criteria for evaluating crime reduction techniques associated with mass transit systems must seek to satisfy both of these broad concerns. Since few public investments involve no net cost to any sector of society, evaluation criteria should be capable of identifying who is gaining and who is losing. Only then can shifts be made to achieve anything close to crime reduction measures which aid in both the increased use of transit and community stability.

METHODOLOGY

The criteria used in the evaluation of crime reduction measures on mass transit systems should specify the ways in which the achievements of a crime reduction strategy will be determined. The rationale for this assessment can rely on a construct which accounts for much of the success or failure of evaluation measures in the transit environment. The diagnostic criteria represented by this construct determine the extent and the way in which the evaluation measure has been recognized and adapted to the local conditions which dispose positively and negatively to the achievement of the intended results of the strategy.

The first step in developing such an improved evaluation approach involves identifying the potential tangible and intangible benefits, their distribution among various socioeconomic groups as they relate to a particular mass transit system, and the strategy employed. The first task is probably the most difficult. The

practical aspects of quantifying the benefits of a particular strategy employed in a mass transit system require that the value and backgrounds of the affected groups be known and understood. Each group is differentiated by location, residence, income, race, occupation, ethnic background, and crime problem. Each of these differences will place different values on the benefits of mass transit systems and the type of crime control measures attempted.

This very issue leads to a major weakness in present evaluations of crime control measures on mass transit systems. Traditional surveys, questionnaires, and similar devices designed to collect data are grossly inadequate. Often, that part of the population most affected has the least to say about the crime reduction measure selected--the very poor, black persons alien to on-transit interviews, persons without phones, the unemployed, the older riders, the illiterate--those who lose the most and who are the most affected by crime.

Many of the environments in which we must work today are extremely complex and difficult research areas. Neighborhood populations are often living under physical, economic, and social conditions which create great burdens for them. The extent to which a particular rider, or a transit-related resident, is likely to cooperate in research is affected by one of a number of fears, frustrations, resentments, disabilities, and priorities. A combination of biases and lack of sensitivity on the part of the researcher, plus the personal hazards which often exist for the on-site interviewer, are enough to prevent effective data collection. Similar difficulties exist for effective data collection in the environment of interest when that environment, such as a rail station, does not increase credibility for the researcher. The issue of credibility (which is always a concern), is a special problem for the researcher in such surroundings. Hence, the researcher finds himself in a temporary and public environment, certainly not as conducive for interchange as would be the home, church, or neighborhood setting of the interviewee. The severity of this problem does not characterize it as unsolvable. It does suggest that the evaluators be particularly aware of the effect that it might have on the quality of data collected.

KEY PERSON INTERVIEWS

There are approaches available to improve the quality of data collection even in difficult research environments. One approach which has been used effectively is what is called "Key Person Interviews or Self-Nominated Experts."[1] This concept is one which allows the researcher to supplement traditional concepts of information gathering. The proposition behind this procedure is a rather simple one: as the research effort gets under way, it is possible to identify persons who know a great deal about the topic being investigated, and who are willing to communicate that information accurately when questions are asked correctly. These local experts are key persons often associated with community-based volunteer organizations, and have a multi-responsibility as it relates to reaching individuals who live in difficult research environments.

1. These key persons can assist in identifying places and approaches which enable the researcher to reach and ascertain the objectives of a particular community as they relate to the matter of security.
2. These key persons can be of immeasurable help in identifying that second layer of persons who are rarely considered, but who can, better than any individual group, crystallize the objectives of transit users and the resident community adjacent to the transit systems. They are often persons, at this second-tier level, who head small local-based organizations, but who also represent persons not available to the researcher if direct contact were attempted. If referred by key persons, the possibility of making that contact is increased. This phenomenon is a familiar one in sample research: "If we really want to find out about the community perception of crime on the transit system,

[1] Secord, Paul F. and Backman, Carl W., Social Psychology, McGraw-Hill, 1964, pp 238-257.

we should talk to Y." The same name is often mentioned by several different respondents. The person whose name is frequently mentioned is usually a person who does articulate well, and whose knowledge is a reflection of the attitude of many persons in the community about the topic of interest.

A final and very important perspective represented by key persons is the ability to redirect the evaluator in terms of the emphasis being placed and the direction being pursued. This is often not the case in attitude surveys which rely on proper and scientific samples and statistical assumptions about the equal weight of each respondent. Such surveys often incur serious problems of random respondent error. This can be anticipated in advance, because of the deliberate, incorrect response, the improper response due to ignorance or misunderstanding, or erroneous assumptions based on the obtrusiveness of the interviewer.

The key person interview process becomes a valuable starting point for improved data gathering. This is not to suggest that the key person interview should replace traditional attitude surveys, but only that this concept should certainly supplement such traditional devices in these critical research environments. Both concepts should be complemented by unobtrusive measures such as observation.

The term "key persons" can refer to such persons as offenders, leaders of existing resident groups, police who have worked in the neighborhood and understand the relationship between neighborhood crime and transit crime, and residents who live near transit systems and who have to rely on transit as a means of mobility. Key persons also include staffs of community groups that work with adolescents who tend (in certain environments) to be primary offenders, outreach program managers, and pastors of local churches. The actual number of key persons sampled can vary according to the population size of the target group and type of system.

Interviews can vary in length, depending on the respondent. The first question usually should determine the nature of the respondent's experience as it relates to the issue of concern. Based on that response, the interviewer should determine from which perspective the respondent is knowledgeable about the issue at hand, that is, either as a victim, offender, user, or local resident. Based on this information, a series of questions can be adapted to be applied to persons with even more relevant information. This second "layer" of key persons is reached by asking our initial key persons to nominate others. The researcher is therefore requesting that the initial key person identify or nominate people who know what is going on and who are not going to feed the researcher what they *think* the researcher wants to know. The researcher might also ask in what context these follow-up questions should be asked. He will find that when questions are put in a proper way, many people will give really direct and honest answers. Following the development of this subject area, the researcher lists the respondent's nominations (of other key persons) in order, with the initial interviews serving essentially the same function as a pretest serves for sample research. The length of the second layer of interviews can be very brief or very long, depending on the extent to which the individual is willing and capable of providing the necessary information.

Classification of nominees must also occur. This might be according to the degree of knowledge about the target population or area of concern, the number of nominations received by a person, priority of nominations, and nature of the nominations. The outcome is likely to be a small "set", depending on target populations size and respondents for each subarea. Persons in these sets must necessarily be referred to and treated in the data collection as local experts and not as a sample of respondents. That is, responses from such interviews should not be analyzed as frequency distributions of sampled views, but only as selected, informed judgments on questions of interest to the researcher.

On the basis of the information gathered, a more informed, efficient, but yet traditional survey could be designed and implemented. The concept of experts is well established, and is often used in social research. It is, however, rarely used by researchers in matters related to transportation and security problems associated with mass transit projects. Through the use of local experts, and with proper pursuit of those persons at the second- and third-tier levels, we could avoid the waste of resources and time which ensue when traditional attitude surveys fail to adequately measure the behavior of interest.

CRITICAL INCIDENT TECHNIQUE

It is also important to utilize effective interview techniques when pursuing the key person concept. One such approach is the "Critical Incident Technique."[2] It is a conversational, flexible format, and is especially appropriate when behavioral data is being sought from respondents who may be apprehensive. The essence of the technique is to simply ask the respondent to recount "the last time" that something happened, or to give the most recent "example" of an event that is evidence of an attitude or judgment. The critical incident techinque is very effective when attempting to interview persons in other than the transit environment. This is appropriate, since many of the most difficult subjects can best be interviewed in nonhostile environments (as defined by the interviewee) such as service organizations, local community organizations, churches, and residences.

With this concept the details of the actual event are recorded, and the combined data from a series of incidents are available for post facto analysis. This can often provide very meaningful indications of the effectiveness of certain crime reduction measures, such as the use of certain policing strategies. As I indicated earlier, the use of certain strategies may provide a source of

[2] The original presentation is in John C. Flanagan's "The Critical Incident Technique," Psychological Bulletin, 51 (1954), pp. 327-328.

crime in one environment and be the ideal solution in another. Any attempt to evaluate that strategy without identifying those variables which cause the difference in impact, whether these variables be endogenous or exogenous, would be a waste of time.

The key person interview concept and the critical incident interview are only two techniques available to the researcher in his or her efforts to obtain information on the intangibles of community values as they relate to crime on transit systems. Certainly, these and others need refinement and development. I have little doubt, however, that if we are going to reduce crime in the transit environment, techniques such as these must be developed to a point of high reliability. We must therefore have quality information.

COMMUNITY OBJECTIVES

Further evidence indicates that a lot of research attention should be given to the development of techniques which can be used to better understand a neighborhood's willingness to "put up" with certain crime reduction measures. If you question the use of "put up" as regards a community's willingness to accept a crime control strategy, consider the possibility of a black community's reaction to a strategy which calls for a massive show of police on a transit route related to a particular neighborhood--a neighborhood whose residents may have negative reaction to police on that mass transit system because of critical incidents with police in that neighborhood--or a neighborhood's reaction to nontraditional attire for its security personnel.

A second major task involved in the development of effective evaluation methodology for crime measures is, consequently, the identification of very explicit community objectives. The absence of explicit objectives often leads to evaluations which offer only small variations between alternative plans for crime reduction. This is often due to the absence of explicitness and clarity in local community objectives. For example, providing crime control measures to meet the mobility needs of those persons who have the

option of either utilizing transit or the automobile might require a quite different approach than meeting the needs of local persons who are entirely dependent on transit. A very appropriate objective might be to get those persons who now use the automobile out of their cars and into mass transit. This will require developing crime reduction measures which deal with the *perception* of, as much as with, actual crime. An equally important objective would be to properly serve those persons who are entirely dependent on mass transit. No single strategy set based on criteria developed for either one is likely to meet both of these objectives, and the absence of precise delineation between the two will lead to confusing and conflicting information for the decision maker. Simply knowing that this is the case, however, doesn't help a particular transit property. It must have a good data base and problem analysis techniques which will direct it to usable solutions for crime.

STUDY BOUNDARIES

Another important problem associated with developing an evaluation approach which reflects community objectives, as well as the highly tangible issues of cost/benefit, is the extent to which the study boundaries, both physically and functionally, are defined. When considering crime on mass transit, drawing a boundary line either a half mile or a mile from the transit system is too inflexible and possibly unresponsive, often resulting in many issues being regarded as external to transit. This may lead to excluding community and neighborhood crime problems when designing either the transit system or crime control measures for that transit system. If this is the case, then transit crime generated by communities may receive little detailed analysis, and therefore, may have minimal influence on deciding which crime control measure to utilize. This can lead to a condition where intangibles receive too little attention and are not properly represented in the overall cost/benefit or cost-effectiveness measures generated. Again, without the relevant data base and the tools to analyze, the operator is not likely to consider neighborhood crime when decisions

are made to select a particular measure for control of crime. He may intuitively know that there is a relationship, but he has no basis for translating that to the system.

A fourth problem which decision makers must be aware of involves the process by which values are associated with both the intangible and tangible impact matters under consideration in an evaluation. When included as a part of the evaluation process, intangibles should be linked and quantified according to values established by the decision maker in concert with the community and not the evaluator. All too often, evaluators will include community-intangible issues as part of the evaluation process, but place too little value upon these intangibles. This often leads to a low assessment of their importance.

Finally, in the area of value establishment, a shift should be made to analyze procedures which give adequate weight to intangible community objectives, extending their period of significance over a longer period of time than a single year. This is important, since many community impacts associated with crime control techniques may materialize only after time intervals often longer than those assumed for certain cost/benefit impacts. Based on current data and a problem analysis projected for future transit and neighborhood-related problems, we should be able to predict and plan for such impacts.

For example, factors such as limited options for transit dependents may cause such dependent users to put up with crime control measures (with which they are unhappy and will not support) for longer periods than those users who are not dependent. This may be important for evaluation purposes, since the actual degree of ridership may not be related to the effectiveness of the crime control measure as much as it is related to the lack of any transportation option for persons who depend on transit. The particular type of transit system placed in a community must, consequently, be viewed as having potential long-term impact on the stability and security of the entire community.

The evaluator must, in his evaluation design, recognize that no combination of security measures will long separate the transit system from the community and its attendant problems. Therefore, if a particular transit system can be secured only if adolescent users are kept to a minimum (which would suggest that it probably shouldn't be built in the first instance), then population shifts in age composition must be viewed as a critical issue in the long-term viability of that system.

CONCLUSION

Decision makers must insist on evaluations which provide them with explicit, unconcealed analyses of both community and transit cost/benefit objectives as they relate to security measures on transit systems. Further, decision makers must insist on a better transition from data collection to problem analyses and to strategy selection.

Whatever impact analysis models are eventually developed, community objectives, as well as objectives concerned with transportation efficiency and cost-effectiveness, must be regarded as essential criteria in decision making for transit system crime reduction measures. If this is not done, mass transit decisions with regard to crime reduction measures and techniques to evaluate them will continue to be less than optimal, with increasingly serious social implications.

DISCUSSION OF PAPER 2 PRESENTATION

Mr. Victor Rouse's presentation stimulated a number of questions and comments during the discussion period. The workshop participants wanted to learn more about the "Key Person Interview" process and how the data obtained might influence the development of transit security methodology. The following is a summary of this discussion.

In response to a question on how to define a community, Mr. Rouse said that a partial solution to drawing the boundaries of a crime area can be found by determining how far offenders travel to commit a crime. Offenders who commit crimes in their own neighborhood tend to do so a short distance from their home.

In hard-to-define metropolitan areas, local community leaders such as church leaders can be useful in discovering where the boundaries of certain activities lie, what people use which transit line, and the locations, in the communities, of the key people through whom one can assess the opinion of affected citizens.

The problem was raised of trying to find sources of information, i.e., "key people", in the community who are truly representative of community opinion and not simply pressing their own biases on the researcher. Mr. Rouse acknowledged that there is no perfect solution to this problem. It can be largely solved by identifying key people through a consensus of the initial information given by various community figures such as pastor, store owner, policeman, and coordinator of adolescent activities.

There was a difference of opinion over whether such a planned approach is superior to random opinion sampling. The point was made that in a random sampling, educated middle-class people are more ready to respond and more articulate in putting across their point of view than are working-class people with less education, and that therefore a random sampling might not produce a truly representative cross-section of opinions. It is possible for random sampling to be supplemented by the planned approach advocated by Mr. Rouse.

Mr. Rouse asserted that random sampling should not be used independently of any other method, a further reason being that the potential offenders and victims would be less likely to give any usable information if questioned in this way, particularly if approached in the transit environment. Ways must be devised to reach those people least accessible to random sampling but closely affected by transit system crime. The offender himself should not be left out of the questioning process, because his perceptions of the ease of committing his offense and his opinions on other matters are important to the research. Identification of offenders for questioning should be by means other than police records, though these could be used for verification and comparison after the offender has been questioned.

One should avoid the use, in a transit system, of crime prevention measures; for example, the installation of cameras which have already been shown to be fruitless in the adjacent community.

The police and the inhabitants of a community usually have a clear and reliable knowledge of the offenders in transit system crime, despite a frequent lack of communication with those offenders.

The question was raised as to whether the considerable amount of money necessary for transit system crime research and prevention would be better spent on general community improvements, since the two problems are so closely connected. Mr. Rouse took note of the point, but stressed that many transit system crime prevention schemes which had been attempted, but without the necessary research, had also been extremely expensive, and had failed.

Mr. Rouse was then questioned on his assumption that a transit system is not capable of being controlled or structured any more than a housing project or other social institution. He countered that this would depend on the particular neighborhood environment concerned, and on whether or not the transit system there is a "no-man's-land." The point was made that a transit system cannot be entered and left as easily as a street or apartment building,

with consequent effects for the offender. However, it was agreed that even police protection in an enclosed station cannot guarantee complete security, due to such factors as the great length of platforms in metropolitan stations and the necessity for brief absences by any given police officer.

It was agreed that the design of stations could potentially have an effect on the development of transit crime, but that problems of transit crime would increase in the next five years. The rate of increase may, however, be reduced by proper station security design. The point was made that crime preventive research needs to go beyond mere statistics to underlying attitudes, particularly those of the offender. Mr. Rouse added that he believed in crime reduction through the redesign of physical space, but that in these instances, also, prior research was essential to determine the nature of the redesigning and the reasons for it.

It was asked whether relevant data for the purpose might already be available from the model cities. Mr. Rouse suggested that little if any useful data was available from these sources due to excessive participation in their research and inadequate direction of it.

Mr. Rouse was then asked to give some specific examples of how he uses his technique, considering the fact that no criminal is likely to offer information that is going to be detrimental to his activities. He cited his experiences in Minneapolis, where, surprisingly, he found some of the following attitudes among offenders: (1) willingness to give information that would help to upgrade the community; (2) confidence that they would not get caught anyway; and (3) the desire to break out of their mold. In interviewing them, he also learned that offenders were coming from adjacent neighborhoods; in fact, 50 percent of them knew their victims. Asked how he then used the information from that neighborhood, Mr. Rouse replied that it was used in conjunction with police data and a victimization survey to redirect activities of youth agencies, to better utilize police patrols, and to give direction to block-watching organizations.

Mr. Rouse stressed again that simply consulting police records without conducting interviews does not provide additional information about the offense, such as the choice of victim, the starting point, the approach to the premises, and the destination. All of these factors must be taken into account in making final, often irreversible, decisions about the kind of crime prevention program to implement.

Another dimension was brought in: questioning key people makes it possible to get feedback on the kind of strategies that are going to be accepted and supported by the community. An example of this occurred in Oregon, where the business community favored sodium vapor lighting, but the residents resisted it. If what the community will accept can be determined, this makes it possible to intervene prior to police involvement.

Asked what he would do if he encountered a split in public opinion, Mr. Rouse stated that a split was unlikely, because the people he talked to were not addressed as a community in the sense of large groups. In answer to another question about the effect on research of the turnover among offenders in a neighborhood, Mr. Rouse conceded that more research was necessary; however, he implied that even where offenders move out of a community, they tend to be replaced by others of the same type.

The question was raised as to how far one could expect suggestions for financially realistic measures from members of the general public. While offering no general comment on this question, Mr. Rouse mentioned measures for the prevention of neighborhood crime, namely, locking of back doors and cutting down of shrubberies, both of which had gained popular acceptance. He expressed confidence in the idea of the development of good systems of data collection and analysis at the national level, and the existence of considerable ability for strategic planning at the local level.

In response to a question, Mr. Rouse said that it had been proven to be more effective interviewing members of a community in groups than individually. He also reiterated the importance

of the "critical incident" technique in interviewing, partly because it frequently indicated that even in supposedly high-crime neighborhoods many interviewees could not name any specific incidents to substantiate their fears.

A certain difference of opinion emerged on the question of the most probable location for committing neighborhood crime. Mr. Rouse advanced reasons why the offender would tend to stay in his own neighborhood for this purpose; another participant believed he would go further afield. With reference to crime committed by adolescent offenders, Mr. Rouse stressed the need for far greater coordination of the efforts of the police and the community. Many community interviews had produced an impression of widespread mutual disaffection and distrust between the police and the community. The adolescent's time should be profitably occupied, especially at times and in situations when the likelihood of his committing an offense is greatest.

The question was raised whether Mr. Rouse's methodology could be of much assistance with reference to AGT systems, since these are still in an embryonic stage of development. In the ensuing discussion Mr. Rouse stressed that his methodology could indeed be used for determining whether an AGT system was right for a particular environment, as well as for deciding on desirable characteristics.

Two other research methods were then mentioned which had so far not been discussed: observation of passenger behavior, without questioning of individuals, and the ethnographic approach, in which researchers merge into the life of a community for the purpose of observing it. A participant reported on the excellent results obtained in Illinois, Florida, and elsewhere by studies using these approaches. It was noted that observation of passenger behavior could be used as a good preliminary measure before individual interviews, and was capable of leading to suitable interviews.

There followed a discussion of the practical problems raised by the research methodology proposed by Mr. Rouse. Participants wondered whether such information should be made available at the time a specific proposal was made, and whether a completed study should be required to accompany any proposal. A suggestion was made that bidders might be required to enter into a full study of the security implications when choosing a certain route for a transit system.

The final question addressed by the day's workshop was the usefulness of different levels of security planning in different locations. One participant mistrusted this idea as implying that one could tolerate a higher level of crime in one neighborhood than in another. Another assured him that it was merely a question of anticipating more crime in some neighborhoods than in others.

SECTION 4
AUTOMATED TRANSIT PLANNING

The first two panel discussions, which covered transit security operations and methods for research and solution of crime problems on mass transit systems, were followed by a third, whose primary purpose was to investigate the concept of achieving public transit security on automated mass transit systems. Concerns related to this concept included the cost of system implementation and the possible effects on the environment of the communities involved.

The principal participants in this panel discussion were Dr. Duncan MacKinnon, representing UMTA Advanced Development Branch, Mr. John Marino, at the time representing TSC's Ground Systems Division, and Mr. Robert Pawlak, also representing TSC's Ground Systems Division.

Mr Marino, in his opening statement to the group, referred to the panel discussion objectives of providing information on AGT systems and identification of the status of related TSC projects to date. He further stated that, of the transit innovations attempted by UMTA in recent years, automation had attracted special attention, and that it was therefore important to investigate the direction it should take in the next few years. He then introduced Dr. MacKinnon, who addressed the panel with an overview of automated systems, some of which are in operation and others in the development stage.

4.1 CLASSIFICATION OF AGT SYSTEMS

Dr. MacKinnon began his discussion with definitions of three classes of AGT systems previously identified by the Office of Technology Assessment (OTA) with their acronyms.

(1) Shuttle-Loop Transit (SLT)

(2) Group Rapid Transit (GRT)

(3) Personal Rapid Transit (PRT)

He described these systems in terms of vehicle size, passenger occupancy capability, degree of sophistication, use of on-line and off-line stations, and scheduled or demand-responsive types of service. These data are summarized below.

SLT Vehicle

(a) Large vehicle: 50-100 passengers, mostly standing
(b) Very simple network geometries, consisting primarily of loops and/or linear sections
(c) Very limited amount of switching (or none at all)
(d) Utilizes on-line stations
(e) Provides simple scheduled, or very limited "demand-responsive" service.

GRT Vehicle

(a) Smaller vehicle: 15-50 passengers
(b) More complex network geometries
(c) Extensive switching capabilities
(d) On-and/or off-line stations spaced 0.5 to 2 miles apart
(e) Provides shared vehicle service, with operation in a scheduled mode or limited demand-responsive mode; scheduled operation generally adopted during peak periods.

PRT Vehicle

(a) Very small vehicle: 4-6 passengers
(b) Very complex interconnected area-wide networks
(c) Off-line stations spaced 0.25 to 0.5 mile apart
(d) Normally operated in demand-responsive mode. (Vehicles can be shared by several parties during peak periods.)

These services, with the exception of the PRT vehicle, are currently in limited use. SLT systems are being used at a number of airport sites. GRT systems operate in revenue service at Dallas - Fort Worth Airport, and at Morgantown, West Virginia. UMTA is also in the process of starting a new project based on SLT type technology. This project, known as the DPM (Downtown People Mover) Demonstration Program, will show whether relatively simple, fully automated, and unmanned people mover systems can work in four urban sites. No PRT systems are in revenue service at this time.

4.2 DOMESTIC DEVELOPMENTS

Dr. MacKinnon continued his discussion with the following specific examples of work performed along the lines described in his opening remarks.

4.2.1 Westinghouse Transit Expressway System

This is the first serious development of a fully automated rubber-tired vehicle, designed primarily for line-haul applications. It was developed in the early 1960's at a two-mile test track facility near Pittsburgh. In this system, the vehicle is supported by rubber-tired wheels operating on concrete surfaces. The vehicle is guided by auxiliary wheels which ride on an I-beam centrally located between and below the two flat running surfaces.

The vehicles can be operated in a three-car train, can travel at a 50-mph top speed, and can provide service similar to that provided by a conventional rapid rail system. This project has resulted in commercially successful systems at four sites:

(a) Tampa airport
(b) Seattle-Tacoma airport
(c) Miami airport
(d) Busch Gardens.

The first two systems are briefly described below. The basic features for the latter two are similar to those of the first two.

4.2.1.1 Tampa System. The Tampa vehicle is very similar in configuration to the Westinghouse Transit Expressway vehicle, with the same center I-beam steering mechanism.

At present, the Tampa system consists of four double shuttles connecting a centrally located landside terminal to the satellite airside terminals at the ends of the spoke-like double shuttles. The system can accommodate two additional double shuttles and airside terminals if increased airport capacity is needed.

Each double shuttle consists of two totally independent systems. In case of failure of the Tampa automated system, restoration to service after shutdown can be provided in an average mean time of approximately five minutes. Since the parallel shuttles to each airside terminal are totally independent, and the probability of simultaneous shutdowns on both links is remote, the system operational availability is close to 99 percent.

The "operating" man-hour requirements of the AGT systems are significantly less than those of existing transit systems. For example, the Tampa system requires only 0.25 man-hour per vehicle hour, whereas the existing Washington Metro Bus System requires 2.5 man-hours per vehicle hour. The vehicle at Morgantown currently requires one man-hour per vehicle-hour, and current experience indicates continuing reduction in man-hour requirements per vehicle-hour.

The distance between the Tampa landside and airside terminals varies between 800 and 1000 feet. With a peak speed of about 30 mph and an average speed of 12 mph, the travel time is approximately 50 seconds.

The Tampa vehicles generally operate in a demand-responsive mode, similarly to an elevator. The parallel shuttle operations are coupled so that when one vehicle moves from an airside to a landside terminal, the other vehicle goes in the opposite direction.

4.2.1.2 Seattle-Tacoma (SeaTac) Airport System. The SeaTac automated vehicles are very similar to the Transit Expressway and Tampa system vehicles. Installed by Westinghouse at the Seattle-Tacoma airport, they operate completely underground, and consist of two loops coupled by a simple shuttle. The system operates in a multi-train mode on the loops by means of a separation control system similar to that for an automated rail system. The SeaTac system also provides for routine automatic coupling of vehicles

with passengers present in the vehicles. This feature could become an operational requirement of the UMTA - sponsored Downtown People Mover project.

4.2.2 Airtrans System

This system, in operation at the Dallas-Fort Worth airport, is the most complex system in current operation. It is a GRT system which has the following characteristics:

1. Number of single lane miles of guideway: 13
2. Number of stations: 53
3. Types of stations: On-line and off line
4. Number of vehicles: 68
5. Number of cars per train: 2
6. Operating speed of vehicles: Approximately 17 mph*
7. Temporal separation (headway) between trains: As short as 18 seconds with the current fixed block control system

Most of the control technology used in this system is similar to the fixed block control technology common to existing rapid rail systems. A major addition to this system is the use of a computer in the central control area to accomplish vehicle dispatching from stations in order to ensure uniform distribution of trains throughout the network. While the central computer is an effective means of control, the Airtrans system design is such that, if the computer shuts down, the system can still operate, though in a degraded mode.

*UMTA has an R&D program to upgrade the design to achieve 45 mph capability.

The system design also permits automatic handling of cargo such as baggage and mail by means of special cargo handling vehicles. These vehicles have containers which are automatically removed from and inserted onto the vehicles by conveyor systems. This system at present is used only to a limited extent.

4.2.3 Morgantown System

The Morgantown project, initiated in 1970, has been undergoing continuous development. The project at present comprises a network of one on-line and two off-line stations, and approximately two and one-half miles of double guideway.* Approximately twenty vehicles are operated in the system for thirteen hours each day. Passenger security is maintained by providing surveillance capability through TV monitors mounted in the main control room. In addition to the monitors, the control room contains a main power distribution control panel. This enables an operator to interrupt power to any section of the guideway in case of a failure or possible intrusion by someone onto the guideway.

The Morgantown project fare collection system employs magnetic cards, which users insert into an automatic fare processing gate. The stations have open platforms without platform doors between vehicles and the boarding platform. This differs from most other AGT systems, which do use double doors in an elevator-type configuration.

4.2.4 AGT Technologies at Transpo'72®

Four automated guideway technologies were demonstrated by UMTA in Transpo '72. These systems were presented by the four organizations which are listed below (together with a summary of the features of their products).

*Expansion to 5 stations, 4.2 miles double-lane guideway, and 73 vehicles has been approved and begun.

Bendix-Dashaveyor

This system used a smaller vehicle than the Airtrans vehicle. (A version of this technology is currently employed at the Toronto Zoo.)

Ford

This vehicle used on-board switching and a very sophisticated vehicle control system. Two commercial applications of this vehicle have resulted from its development: one in Fairlane, and the other at Bradley Field, near Hartford, Connecticut.

The Ford systems use a shuttle-bypass concept. A bypass in the center of the shuttle permits two vehicles to travel simultaneously between the ends of the shuttle. This feature doubles the service rate between the two ends without requiring double guideways, as is necessary in the Tampa system. The Bradley system provides a platform in the bypass to provide an intermediate station.

Otis-Transportation Technology Inc.

This system employed an air-bearing-supported vehicle, and on-board switching. A current version of this system is being constructed at the Duke University Medical Center.

Rohr-Monocab

The small-vehicle system demonstrated by this organization employed a vehicle with a capacity of six seated passengers. Rohr-Monocab used a monorail guideway. This approach had an advantage from the standpoint of minimizing visual impact on the environment. On the other hand, it introduced problems of evacuation.

4.2.5 Advanced GRT System

This new system, currently under study by UMTA, will feature a 12-passenger, no-standee vehicle, which can operate at three-second headways yielding a peak lane capacity of 14,400 seats

per lane per hour. Three companies are developing designs for advanced GRTs. They are listed below, together with their specific approach to the vehicle design.

Boeing Vehicle

The Boeing effort is based on vehicle design applied at Morgantown.

Otis Vehicle

This vehicle is designed with the same type of air-bearing suspension that was used by Otis in its Transpo '72® vehicle.

Rohr Vehicle

This vehicle incorporates the concept of the Rohmag integrated magnetic suspension and propulsion system. Magnetic forces between primary and secondary of a linear induction motor support the vehicle, and also propel it. Thus, the only mechanical contact between the Rohr vehicle and the guideway is through the power collection system and lateral guidance wheels.

4.3 CONCLUSIONS ON WORK TO DATE

Dr. MacKinnon concluded that limited AGT systems using large vehicles can use security measures similar to those now used in conventional rail rapid transit systems. However, he advocated continued effort to minimize security manpower requirements, especially for systems employing smaller and thus more numerous vehicles. Achieving this goal was particularly important for the Downtown People Mover project, and was also a prime requirement for justification of cost and effort involved in future implementation of GRT and PRT systems.

4.4 PRT SYSTEM CONCEPTS

Five concepts have been proposed for PRT systems. Of the five, one originated in the United States, and the rest are from foreign sources. The list below includes the development agencies, the name of the PRT system concept, and the country in which the concept originated.

1. Department of the Environment, Cabtrack (United Kingdom)
2. Aerospace Corporation, High Capacity PRT (United States)
3. Messerschmitt-Bolkow-Blohm, Cabinentaxi (Germany)
4. Engins Matra, Aramis (France)
5. Society for the Promotion of Machine Industry, CVS (Japan)

The last three systems have been tested in prototype form on test tracks. A descriptive comment on each concept follows.

Cabtrack System

The Cabtrack system was initiated in Britain in the early '60's, and was developed under different sponsorships until the early '70's. The Cabtrack system concept had the following characteristics:

Number of passengers:	6
Headway :	0.6 to 1.0 second

High-Capacity PRT System

The Aerospace Corporation in the United States initiated this PRT project after the New Systems study was published in the late '60's. Through funding by the Aerospace Corporation, the project made available extensive analytical studies and a scale model demonstration of concepts.

Cabinentaxi System

The Cabinentaxi system concept originated with a corporation in Germany. The design concept from its beginning was directed toward setting up completely unmanned stations. (The extent of automation is indicated by the fact that the stations were even designed for automatic cleaning.)

Two types of vehicle are used in the Cabinentaxi system, one suspended and one supported. This permits simultaneous operation in both directions on one guideway beam, and provides the double advantage of minimal visual impact and reduced cost. The Cabinentaxi vehicles have a headway capability as short as 0.6 second at 20 mph.

The Cabinentaxi system uses manually operated doors. The system designers felt that the advantage of automatic door operation was outweighed by the design difficulties associated with

maintenance of automatic doors. Further, this conforms with current European mass transit practice.

Aramis System

The Aramis system was demonstrated on a small test track at Orly Airport, near Paris. The system uses small four-passenger vehicles which are operated at about 30-centimeter separation in groups (platoons). The Aramis vehicles have the shortest headway capability (approximately 0.2 second) of all the systems considered.

Vehicles can be withdrawn from the platoon to enter off-line stations. They can be introduced into platoons by launching them individually from a station into the guideway ahead of a platoon.

CVS System

The CVS system, developed and tested on a test track near Tokyo, uses a four-passenger vehicle. This vehicle is designed with a multilevel emergency braking system, and a backup jaw brake with the ability to stop at rates up to two g's. With such a high braking rate, the CVS can operate at separations greater than the emergency stopping distances at one-second headways at 50 mph. Operation at one-second headways was achieved by the CVS system in January 1975.

The CVS system design also permits handling of cargo containers. The Japanese are considering use of the CVS system to automate container handling in a large harbor facility in Tokyo.

4.5 ADDITIONAL SOLUTIONS TO URBAN AREA TRANSPORTATION PROBLEMS

There are numerous other methods of solving urban area transportation problems than have already been discussed. Two examples are provided below as indicative of the types of alternate solutions which merit consideration.

The Vec system was demonstrated at La Defence, Paris, in 1974. The system uses very simple passive vehicles which move on a moving belt system driven by linear induction motors. Finally, UMTA is currently developing an accelerating walkway system which will provide 7.5-mph speeds for short urban core trips.

4.6 CONSIDERATIONS RELATING TO ADOPTION OF AGT CONCEPT

Mr. Marino followed Dr. MacKinnon's overview presentation and technical configuration analysis with an introductory statement concerning TSC's anticipated contribution to development of the automation concept in the transit industry. He noted that TSC's AGT System Operations Studies project will provide guidelines which will impact the direction to be taken in AGT system configuration for the next several years. Automation, according to Mr. Marino, has already become an established feature in other fields such as banking and insurance, and will, in all probability, find extensive applicability in the transit field. In fact, automation of most phases of transit operation has already been implemented in components of BART (Bay Area Rapid Transit) and PATCO (Port Authority Transit Corporation) systems. Mr. Marino provided two conclusive observations to substantiate the desirability of automation: (1) the high percentage of operating cost of conventional transit systems consumed by labor (50% to 90% of the total operating cost); and (2) the potential for improved security and safety methods for people and property.

4.7 TSC APPROACH TO AUTOMATED GUIDEWAY TRANSIT STUDY

One major TSC contribution to the study of transit automation feasibility consists of a systems analysis effort. Mr. Marino summarized his fundamental viewpoints in the form of viewgraphs. These viewgraphs are presented here as Tables 1, 2, and 3.

TABLE 1. THE AGT TECHNOLOGY PROGRAM AT TSC

TSC ROLE
Manage systems technology activities of AGT Technology program for UMTA.
Coordinate and provide technical support for AGT subsystem technology project.

TABLE 1. THE AGT TECHNOLOGY PROGRAM AT TSC (CONT)

PROGRAM OBJECTIVES

Conduct system level studies and analysis.

Develop models and guidelines for urban planners and DOT.

Develop, maintain, and disseminate AGT information.

TABLE 2. AGT HARDWARE RELIABILITY AND SERVICE AVAILABILITY

PROBLEM ADDRESSED

Differing system level expressions for AGT system effectiveness have been developed and used over the brief history of the development and implementation of AGT systems. No present consensus exists on measure definitions and quantitative requirements for differing systems and applications.

SPECIFIC OBJECTIVES

Refine existing "availability" procedures and develop methodology to relate system service availability to hardware requirements.

Define availability and establish goals for differing systems.

TABLE 3. AGT INFORMATION BANK DEVELOPMENT

APPROACH
Library retrieval services to be established at TSC
Data base development
Workshop on safety and passenger security (May 1976)
Workshop on AGT service availability (October 1976)

4.8 BACKGROUND TO EVALUATION OF AGT SYSTEMS

The significance of evaluating AGT systems lies in the fact that these modes offer potential options to the conventional forms of transportation. The PRT system, with its network type of distribution, easy access, and private cabins, is a potential alternative to the automobile. The GRT vehicle most nearly approximates, in capability and capacity, the conventional bus, but also provides features exceeding present bus capabilities. The SLT concept approaches the functional characteristics of the high-capacity conventional rail vehicle of mass transit. Various forms of these systems are emerging in the market, for use in airports, hospitals, and amusement parks. In the case of the Downtown People Mover project, the objective is to demonstrate the benefits of simple, fully automated transit systems, or people movers, as they are more commonly called. The GRT and PRT systems, however, are in the embryonic stage, and need further identification as to their capabilities and limitations. These factors are behind the importance of the evaluation procedures being both conducted and contemplated for the AGT systems.

4.9 SYSTEM OPERATIONS STUDIES PROJECT

TSC, with contractor assistance from General Motors and IBM, initiated a long-term (three-year) project known as the System Operations Studies project in June 1976. The system evaluation effort is directed toward analyzing the performance and costs of the different categories of automated guideway transit. The object of this project is to evaluate performance and cost of the various system concepts in differing applications. Comparisons will be made between automated guideway systems and comparable existing conventional transit systems. A typical evaluation process would provide comparison between the proposed Westinghouse TERL system with feeders and existing PATCO vehicles in corridor situations. Criteria will be established by means of which analysts and system planners will be able to form comparisons, evaluate results, and make decisions on the basis of these activities. Table 4 (AGT System Operations Studies) contains a summary of the material mentioned above.

TABLE 4. AGT SYSTEM OPERATIONS STUDIES

PROBLEMS ADDRESSED

AGT systems present potential options to auto, bus, and rail, and need exists to identify system costs, performance capabilities, and impacts for differing applications.

SPECIFIC OBJECTIVES

Evaluate service and performance capabilities of generic classes of AGT systems, and identify costs and applications for each.

Develop analytic and detailed network simulation model to allow comparative analysis.

Prepare guidelines for urban planners, systems designers, and DOT.

4.10 FLOW DIAGRAM DISCUSSION OF SYSTEM OPERATIONS STUDIES

Mr. Marino presented a flow diagram of the program (Figure 1) to be carried out during the activities of the System Operations Studies project. As shown in Figure 1, inputs are provided, typical of which are the various AGT systems. These systems are processed in the form of systems analyses in conjunction with other input considerations such as implementation appraisals and operational control strategy evaluations. The output constitutes the results of these systems analyses, and is in the form of documentation and guidance data for planners and designers.

4.11 SYSTEM SAFETY AND PASSENGER SECURITY

A second aspect introduced by Mr. Marino in the evaluation of system options referred to the problem of system analysis regarding system safety and passenger security. He contended that in arriving at methods and procedures pertaining to this problem, a reference base of some sort would be needed as a starting point. The logical starting point for such a comparison would consist of the conventional methods and procedures already adopted for conventional transit systems. Therefore, he favored the use of as many of the conventional procedures as possible prior to initiation of new supplementary applications. Table 5 summarizes the problems, objectives, and approach with respect to the safety and security concepts referred to above.

4.12 SUMMARY OF TSC APPROACH

TSC's role in the attainment of an automated version of transit operations is primarily that of performing systems analyses which will provide answers to a number of questions on economic and technical feasibility and safety and security requirements. TSC will furnish simulation models which will solve problems reflecting realistic situations. By this means, the systems will be assessed for performance, cost, safety, and overall effectiveness.

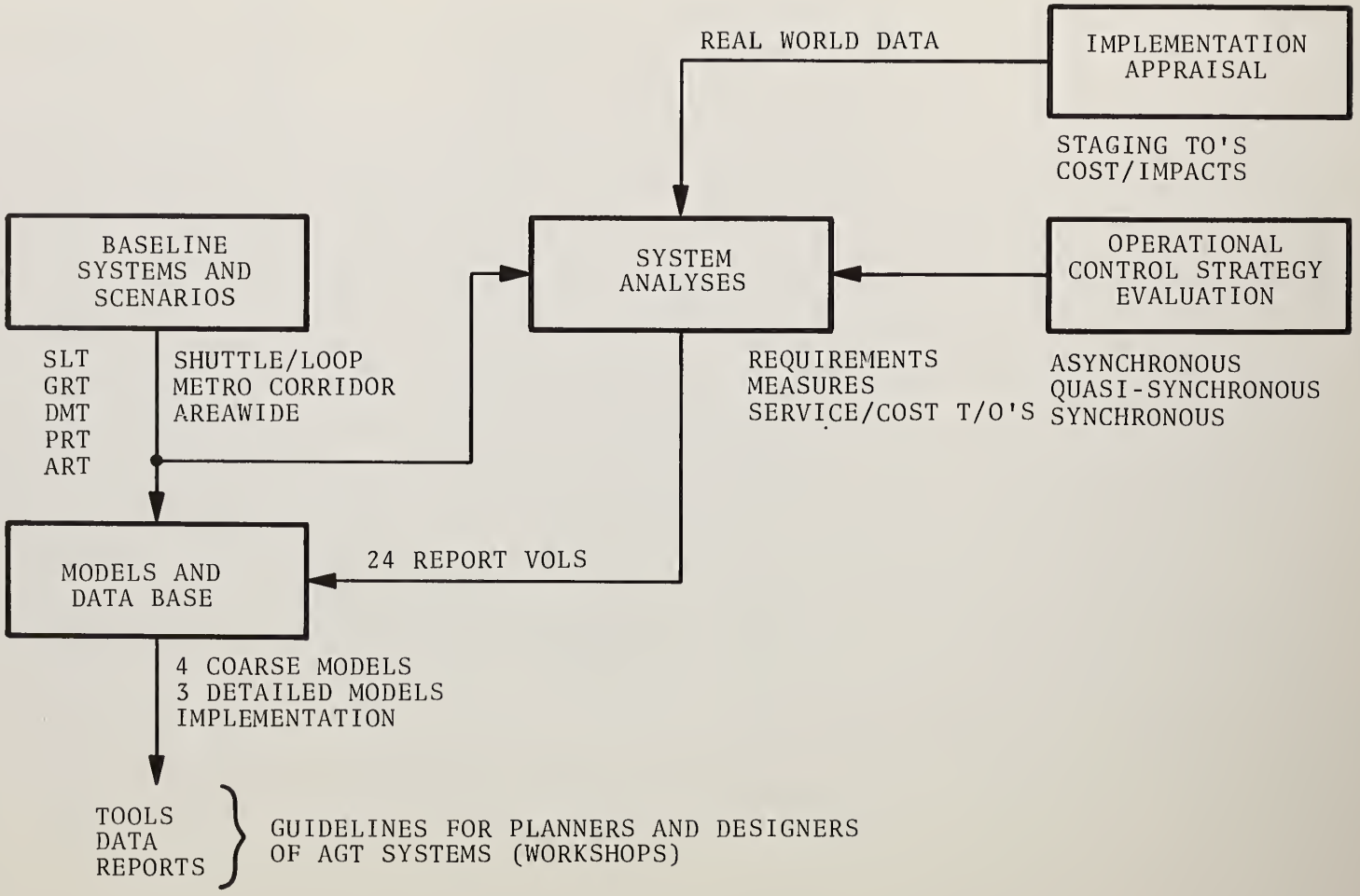

FIGURE 1. FLOW DIAGRAM OF AGT SYSTEM OPERATIONS STUDIES PROJECT

TABLE 5. AGT SYSTEM SAFETY AND PASSENGER SECURITY

PROBLEMS ADDRESSED

Increased opportunities for crime and increased fear of crime due to decreased employee presence

Need for safe emergency evacuation procedures for AGT vehicles

Need to establish safe emergency deceleration levels for AGT systems

SPECIFIC OBJECTIVES

Develop guidelines for insuring passenger security on AGT systems.

Develop understanding of passengers' perceptions of security in transit systems.

Develop guidelines for safe emergency deceleration rates and "high retention seats" for AGT systems.

APPROACH

Review of currently available safety and security enhancement techniques

Development of AGT safety and security scenarios

Performance of field studies to evaluate new crime countermeasures

Development of passenger security value model

Performance of experiments to determine safe limits of deceleration for AGT passengers

Preparation of guidelines for safety and security in AGT systems

Review of guidelines by government and industry experts

4.13 SYSTEM SAFETY AND PASSENGER SECURITY CONSIDERATIONS

Following his summary of TSC's role in evaluation of AGT systems, Mr. Marino introduced Mr. Robert Pawlak of TSC. Mr. Pawlak was asked to speak on the status of TSC efforts in the area of safety and security in public transportation systems, and on the possibility of integrating the results of these efforts into the automated guideway field. The following material summarizes his remarks.

Mr. Pawlak described his role as that of a systems engineer. He performs a number of system-related functions, among them consideration of the security problems in public transportation. He deals with problems of the transit system from the fundamental requirements to problem solutions calling for decisions at the general manager level. These problems include not only hardware system design, but also relations with contractors and consultants and their interaction with UMTA and the local community. Mr. Pawlak attempted to develop his analysis by placing himself in the hypothetical position of chief design engineer and future general manager of a new automated guideway system currently under development.

He identified two initial questions which must be dealt with:

(1) Who actually makes top level decisions on resources to be spent on security for a new system?

(2) How can the members of this panel, singly or collectively, influence the quality of these decisions?

Mr Pawlak presented some basic facts on the nature of UMTA spending. Observing that UMTA capital assistance expenditures totaled about 1.1 billion dollars a year, Mr. Pawlak pointed out that, of this total, half of the assessment took care of buses and new or replacement rail cars, and the remaining half was available for guideways and fixed stations. Also, as "chief designer" and "general manager," he had only one chance to come up with decisions for guideways and fixed stations. These decisions

required a thorough understanding of security requirements. From the security standpoint, knowledge of numerous factors must be available, among them stations layout, vehicles, facilities for security people, spaces for surveillance, and equipment needs. Mr. Pawlak felt that decisions relating to these matters were not under "his" complete influence, nor under the influence of the panel group. He further stated that "he" should be represented by a security-conscious individual who was sympathetic to "his" views, and who would get into the operation on the ground floor, at the beginning of the system design.

An additional problem caused Mr. Pawlak concern. In contrast with its total capital assistance outlay of 1.1 billion dollars a year, UMTA allotted only about five percent, or about 50 million to 70 million dollars each year, for the UMTA R&D budget. This relatively small amount is split among bus, rail, and new systems R&D. Mr. Pawlak was keenly aware of the differences in R&D and capital assistance funding, and the limitations on spending power for any demonstration activities.

Additional potential problems presented themselves to Mr. Pawlak in "his" role of chief system designer and general manager. On the supposition that "he" had been authorized to design a brand new transit system, "he" was now confronted with four basic questions:

(1) How does "he" obtain 80 percent* of the system cost from UMTA?

(2) Whom must "he" convince of the integrity of the basic concept and final design?

(3) Whom must "he" consult within UMTA to prove the validity of security measures included in "his" design?

(4) How much importance is attached to security-related questions in comparison with the other project design considerations?

*This percent number is based on the government's willingness to absorb 80 percent of the cost of a proposed public project considered a feasible undertaking.

Another circumstance laid the decision-making problem squarely in "his" lap. According to a further assumption by Mr. Pawlak, the sponsor did not know exactly what was required, but had provided a block of money to get the job started. Mr. Pawlak, the "general manager," had also committed to the public that the system would be completed and available for use on a certain date. Such a commitment called for implementation of design decisions, among them the security measures to be taken. Mr. Pawlak sought assistance on security expertise from knowledgeable people such as the panel group members. The members, in turn, were ultra-conservative in their readiness to advise on security matters until Mr. Pawlak provided them with more detailed data and with other factors in his overall design. This response was of little value to Mr. Pawlak, who was looking for something definitive, still had "his" commitment to fulfill, and could not afford to undertake further studies. So "he" was still stuck with the question of whom "he" was to convince about the validity of "his" concepts and final design. Currently, Mr. Pawlak feels that there is no one person employed within UMTA with full-time responsibility for transit security. At best, it is a sort of distributed responsibility, and, as such, it remains a problem in the overall system design.

Mr. Marino at this point offered an alternative interpretation to the direct need for full-time responsibility for system security. He suggested that safety and security were system level concerns, and required treatment on functional levels in the design process as well as with respect to operational philosophy. But UMTA and TSC were not functionally organized. Rather, they provided funds for an entire system. Therefore, safety and security could be considered on a partial distribution basis; for example, one part of safety and security could be included under the heading of research, another part under operations analysis, and so on. With this line of reasoning, Mr. Marino questioned the approach and required resources for each DOT element to have a separate organizational element treating safety and security.

Mr. Pawlak answered Mr. Marino by contending that with the current approach there was no one at DOT to talk to concerning the

question of system security. There was still a question as to whom to influence, and as to who would make the decisions on security. The desired result would be achieved by influencing the design process where it was happening, i.e., on the property where the system was being developed, and by directly associating the general engineering contractor with this particular design activity. UMTA was, at the same time, aware of this influence to which Mr. Pawlak referred. This knowledge was filtered, first, through review procedure by the UMTA Safety and Assurance Program, and secondly, through an order given by the UMTA Administrator to the UMTA R&D Director. The Administrator's directive assigned to the R&D Director responsibility for involvement, participation, and decision-making assistance in any new-system-oriented or new-technology-oriented decision relative to a capital grant.

Mr. Pawlak elaborated on his contention with a twofold approach to the role to be exercised by UMTA with respect to system design and fixing of responsibility for security. He indicated that UMTA did not provide system level specifications. For a small system, which would be built by one contractor, the contractor could, and usually did, write a set of specifications. But if the system was a large one with a number of systems involved (e.g., MARTA*), and the system design was taking place between the system staff and the general engineering contractor, there was no overall system level specification available, because the government does not require it. The only procedure by UMTA at present is to assess major contracts exceeding an arbitrary sum of money by a capital systems process. This process provides for formal review of individual portions of the contract; for example, in the case of MARTA, every major construction job, the vehicle package, the communications systems package, and the train control package. But, in the absence of an overall system specification, where does the security program fit? The answer is that it is spread out in each of the above packages. As such, there is no definition of the overall security concept that a total system specification would provide.

*Metropolitan Atlanta Rapid Transit Authority

With this reasoning, Mr. Pawlak proceeded to his twofold suggestion: first, documentation by the government expressing the need for a set of system specifications which covered both system and subsystem requirements, and secondly, a system security program plan. This plan would provide answers to questions involving philosophy of the system design, the manner in which portions of the security plan would be incorporated in individual parts of the system, and the need for security personnel and their operation strategies.

Implementation of the design decisions for individual systems would involve participation in the design process by chiefs of respective systems. For example, it would be in order for the staff of one system, say WMATA, to review the security program of another system, such as MARTA. With respect to such a possibility, UMTA could act as catalyst to send someone from WMATA to review the security program at MARTA. Or, UMTA could determine on its own that a new system was of the APTA family, and direct the APTA group to review the new system.

A number of viewpoints and comments among the members of the panel group appeared to indicate basic agreement with Mr. Pawlak's suggestions on exchange of security information in the various existing and new systems. Mr. Pawlak then extended his concepts to include the desirability of substantiating the effectiveness of proposals based on R&D before rushing headlong into total commitment to a system design and security program. Basically, Mr. Pawlak advocated testing of the new R&D concepts in existing systems either on R&D initiative, or through encouragement from UMTA. In this respect, UMTA could again serve as a catalyst to encourage investigations of this type, and to provide guidelines for checklisting effectiveness tests.

Mr. Pawlak was concerned with two other important issues. The first issue was the relationship between the security problem and juridical, jurisdictional, and political structure. Transit organizations had to resolve jurisdiction matters such as land use and land acquisition. In these matters, it was important

that they be resolved in the early stages of design preparation, and it was equally important to seek coordination with other law enforcement agencies in order to come up with satisfactory legal criteria to ensure system security.

With respect to the judicial structure, there was the possibility of leniency in one court towards a given offense, and a stiff attitude from another court on the same offense. Mr. Pawlak recognized this potential flaw, but suggested that with passage of time, this type of problem could be mitigated, if not eliminated.

The second issue was related to the labor problem in AGT type systems. On the one hand, an important goal of the automation concept was the reduction of labor force requirements. On the other, the automated system still needed security and maintenance personnel, and, perhaps, station attendants. According to Mr. Pawlak, it would be highly desirable to utilize individuals with talents extended to several of the AGT operational requirements. In that way one individual could perform policing and maintenance, and provide assistance to passengers on the line. On large systems, there was a tendency to spread out the labor force, so that one individual was involved only in security, another in maintenance, a third as an operator, and so on. Mr. Pawlak wanted to achieve that reduction in the number of people used in the AGT system by blending the system design with the roles of particular people. This approach would help provide an optimum match between the system and the need for people. Mr Pawlak considered solution to this problem an important key to the success of the AGT type system. He also recognized that the problem was a very difficult one to solve.

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