RAIL TRANSIT SECURITY IN AN INTERNATIONAL CONTEXT
Lessons from Four Cities

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Open, accessible urban public transportation systems have become increasingly frequent targets for terrorists in recent years. This article draws from a series of interviews with transit officials responsible for the security of rail transit systems, as well as architects and engineers responsible for designing and operating these systems in four world cities: London, Paris, Tokyo, and Madrid. The findings show that transit security is, not surprisingly, a major and growing concern of transit operators in these cities. Collectively, the interviewees report drawing on a broad mix of strategies to respond to terrorism and, in the process, struggle mightily to balance the trade-offs between increased security on one hand and openness and attractiveness of their systems on the other. Accordingly, coordination between transit agencies and police/intelligence agencies has become a crucial component of security planning.

Keywords: *security; terrorism; public transit*

In the aftermath of September 11, security from terrorist attacks in cities rose to the forefront of political discourse and debate, particularly in the United States. As politicians and policy makers around the globe have scrambled to respond to the threats of terrorism, urban scholars have begun reflecting on how both terrorism and responses to it are affecting political discourse, urban governance, and civic life (Savitch 2003; Eisinger 2004; Gerber 2005). Subsequent terrorist attacks in different parts of the world from Indonesia to Madrid and from Moscow to London showed that September 11 was not an isolated incident, that indeed terrorism was a global issue, and that the goal of urban security could not be achieved without global cooperation and worldwide networking.

In this study, we examine one of the most common and vexing venues for terrorist attacks in cities: urban mass transit systems. Many transit systems around the world have been targeted by terrorists, including the railway systems of Paris, Tokyo, Madrid, and most recently, London. In response to terrorist threats, these systems have put in place comprehensive security protocols and processes. Case studies of these systems—as both victims and responders—can thus offer important lessons on the latest and most aggressive efforts to prevent, mitigate, and respond to terrorist attacks. Such lessons on preparedness and response likely apply to other transportation systems with similar physical and organizational characteristics, including those in the United States. But although intelligence systems have globalized rapidly in response to recent terrorist attacks, planning to prevent or mitigate terrorism on transit systems is to date far more insular. Additionally, most research on transit terrorism has centered on the role of policing and technology in mitigating attacks (Policastro and Gordon 1999; National Research Council 1993) and has devoted less attention to system design or public education.

An analysis of terrorist attack trends indicates that their frequency and lethality have increased over time (see Figure 1). In 1991, transportation systems were the target of 20 percent of all violent attacks. This rose to almost 40 percent by 1998. Jenkins' (1997, 2001) comprehensive chronologies of 900 terrorist attacks involving surface transportation from 1920 to 2000 help us identify the most salient patterns and trends. He finds that about two-thirds of the attacks were intended to kill people (as opposed to simply disrupt transit operations), whereas 37 percent of the attacks actually resulted in fatalities. Of the incidents with fatalities, about three-fourths caused more than one death and 23 percent caused ten or more deaths.

Case studies of transit terrorist attacks provide very useful, detailed accounts of the incidents (Jenkins 1997; Jenkins and Gersten 2001), but the existing literature on transit terrorism does not in general identify and compare
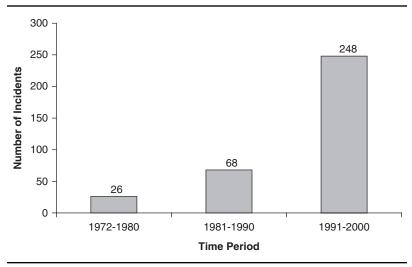
Figure 1:   Number of Railway Terrorism Incidents, 1972–2000
SOURCE: Compiled from Jenkins (1997) and Jenkins and Gersten (2001).

the strategies that transit agencies around the world are adopting to offer protection to their riders.[1] Thus, important questions remain unanswered: How are transportation systems in different world cities handling issues of transit security? What are their concerns and challenges? What mix of strategies do they use? Do transit officials around the world perceive terrorism prevention/mitigation through environmental design as a valid security strategy? What lessons can U.S. transit systems learn from the experiences of transit systems in other cities?

To answer these questions, we undertook fieldwork research on rail transit systems in four world cities—London, Madrid, Paris, and Tokyo—and in addition, we interviewed representatives from the International Union of Public Transport (UITP), which has headquarters in Brussels, Belgium. Our fieldwork consisted of interviews with transit managers and transit officials responsible for the security of the systems, as well as architects and engineers designing the operation of the systems. We also visited many stations in each system to examine some of the design measures identified in the interviews. In some cities, we were shown the control and command centers of the transit systems and visited stations that have been recently designed or renovated to comply with state-of-the-art measures of security, such as the Alto del Arenal station on Madrid's Blue Line, METEOR's (METRO Est-Ouest Rapide) Gare de Lyon Station (Line 14) in Paris, and the recently retrofitted station of St. Lazare on the EOLE line in the same city.

Case studies like the ones presented in this article are especially useful when "how" or "why" questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context (Yin 2003). All three of these conditions apply to the issue of terrorist attacks on public transit systems.

Despite their many advantages, researchers must be careful not to assume that the cases studied—either the attacks or the systems attacked—are necessarily representative. Thus, future attacks may be quite different from those that have occurred in the past, and the transit systems examined here may not reflect the conditions or trends facing the transit industry more broadly.

The cities reported on here were chosen because they operate some of the largest transit systems in the world and have experienced in the past severe and highly visible terrorist attacks (our interviews were conducted prior to the July 2005 attacks in London). The IRA attacks against the London Underground were a prolonged campaign that lasted from the early 1970s to the mid 1990s and terrorized rail passengers in Britain (Coogan 1995; O'Connor 1991; Schmidt 1991, 1992). The sarin gas release on the Tokyo metro on March 20, 1995, was the first time a chemical weapon of mass destruction was utilized by a terrorist group (Brackett 1996; Kaplan and Marshall 1996; Tu 2002). The Algerian bombing campaign against the Paris rail network was similar in nature to the IRA campaign but much shorter in duration, lasting a few years in the mid 1990s (Riding 1995; Simons 1995a, 1995b; Ibrahim 1995; White 1995; Whitney 1995a, 1995b). Finally, the recent attack against the RENFE railway system in Madrid on March 11, 2004, was the first major global Islamic terrorist attack against a major rail transit system to take place after the September 11, 2001, attacks.

In what follows, we describe and compare the policies and security strategies adopted by the transit systems in each of the four cities in response to both their terrorist attacks and the rise of global terrorism.

PARIS: A SYSTEMIC APPROACH TO SECURITY

The French perceive Paris to be at the heart of international and terrorist threats and the city's transit infrastructure an obvious target. According to the transit managers interviewed, the domestic terrorist attacks against the French transit systems by Algerian terrorists in 1995 led to considerable reflection about how to better protect transit systems. At the same time, as Francois Blasin from the French Ministry of Transportation (CERTU) indicated,

> The threat is today different. Previously, we were targeted by attacks which were limited in their scope and capacity to harm. The last years, however, witnessed a change in the nature of attacks, and we had suddenly to face not only an explosion of a man-made bomb with sharp nails but a massive attack, such as the one at the World Trade Center or in Madrid.

The French see transit security today as a global issue, but according to Francois Rambaud of CERTU, "security has become more of a goal than the reality of today." Therefore, they perceive their primary goal to be to "create a feeling of security rather than reduce the risk to zero, which is practically impossible."

Prior to the mid-1990s, different security measures were employed by different agencies in a rather ad hoc way, often with little coherence. Today, the French have developed a hierarchical system of security, consisting of a web of interlocking plans. The Office of the Prime Minister, the Ministry of Defense, the Ministry of Interior, and the Ministry of Transport draw comprehensive security plans and guidelines and identify risks and levels of threat. The French government has prepared general plans for civil security, such as Le Plan Rouge, which are under the authority of local representatives of government, known as the *prefet*. In each region, "local committees of security" exist that coordinate operators, the police, and local representatives of the government. For Paris, in particular, after the 1995 attacks against the French railway, the authorities articulated the "Vigipirate" plan, which can mobilize a large number of police forces during periods of high alert or during special occasions.

CERTU is responsible for prioritizing transit safety needs, conducting security audits of sensitive sites and evaluating potential dangers, and prescribing security responses. An area where the Ministry of Transport and other French governmental agencies have placed a great emphasis after September 11th is the protection of the transit system against chemical or biological attacks, because it was in this area where the French felt they had the least experience. As a way to prepare for and anticipate risks from chemical and biological attacks, the French authorities staged a nerve gas attack simulation in Paris in October 2003. "Piratox," a plan detailing how to respond to chemical attacks, was put in place in 2004, and similar plans exist for biological and radioactive threats.

Additionally, the two major transit operators in Paris, RATP and SNCF, have their own offices of security that evaluate risks in their systems based on information from the French ministries. They also implement the general plans issued by the Ministry of Defense, the Ministry of Transportation, and the Ministry of the Interior. SNCF translates the general policies from the

central authorities into concrete measures for each of the 23 regions in its jurisdiction. They also conduct research and gather data and statistics with respect to security.

Comprehensiveness, coordination, communication, and the adoption of a systemic approach were the keywords used repeatedly by the French officials we interviewed. They identified a "systemic approach to security" as one that takes into account all the vulnerabilities of the transit system and responds to them in a comprehensive way. According to Francois Rambaud of CERTU, effectiveness involves not only internal performance metrics but levels of coordination and strategy integration with other agencies. Coordination transcends national borders. According to Patrick Dillenseger, defense assistant at the Regie Autonome des Transports Parisiens (RATP), "The future of security of public transit resides in pan-European cooperation, and the International Union of Transportation [UITP] has the lead in this respect." Such coordination is necessary because many of the European operators have highly integrated service grids. Cooperation today takes the form of the exchange of experiences, statistics, and data, and to a lesser degree, joint simulations of terrorist attacks.

The integration of various security strategies can best be seen in the design and implementation of the new METEOR subway line. Security technology, policing, educational strategies, and environmental design compose the repertoire of strategies at METEOR stations. The line's automated trains are under constant surveillance by the command center that operates the trains and monitors the station attendants. On the platforms, glass doors enable an unobstructed view of the other platform as well as inside the trains. Locks on train doors and platforms are adjusted and can be activated to prevent the escape of criminals. Staff and security personnel are equipped with two-way radios. Uniformed staff and attendants in civilian clothes are always present and in communication with the police. Remote-control closed-circuit television (CCTV) cameras can be activated through intercoms, call buttons, and emergency alarms. They enable the command center to communicate to operators and passengers through loudspeakers.

The environment and context of the METEOR stations are quite different from the rest of the Paris Metro subway network. Absent are the narrow, maze-like access ways and tunnels to the platforms and exit doors that twist and turn at odd angles that characterize the older stations, and inhibit police response to a terrorist attack. There are few curves to obstruct sight lines, and passenger waiting and walking areas are large, giving better opportunities for surveillance. Station construction materials are mostly transparent, reflective, and resistant to graffiti or vandalism. There is maximum use of direct natural or indirect artificial light. To minimize the negative consequences of terrorist attacks and

bomb explosion, architects used new materials such as shatter-proof transparent fiberglass for windows. Finally, station entrances can be easily closed or blocked by police in the case of an attack.

The METEOR stations are models of how to integrate design strategies for transit security. The French officials also stressed, however, the difficulty and cost of retrofitting old stations. As Patrick Dillenseger argued,

> While in new construction we are taking lessons of past terrorist attacks and we are integrating design features to minimize risk, it is hard to consider any major changes in the environmental design of old segments of the network. It is indeed very costly to make major physical changes to cavernous and old access areas, platforms, and tunnels. To make these spaces more secure, there is a need to be creative, but there is very limited margin for maneuver, as we cannot break the old fabric and rebuild all the access areas or platforms.

Finally, the French interviewees also referred to the importance of information and security awareness campaigns to educate transit riders about the different aspects of threat in public transit. Francois Rampaud, from the French Ministry of Transport, claimed: "We have to combine and juxtapose environmental design, natural surveillance, policing, and information campaigns in order to create a feeling of security."

TOKYO: ONUS ON TRANSIT OPERATORS

The sarin gas attack of 1995 took the Tokyo transit operators, and Japanese society at large, by surprise. The Japanese were long accustomed to social order in their transit systems and were quite unprepared for such an incident. Shocked by the attack, Japanese transit operators took measures and initiated protocols for emergency response, but they perceived the attack as an isolated incident.[2] The event was characterized at the time as an indiscriminate large-scale murder, not a terrorist incident. It was not until the World Trade Center bombing, when the definition of terrorism became a global topic of discussion, that the Tokyo sarin attack came to be seen by many in Japan as a terrorist incident. For the operators of Tokyo's two main subway systems, the Tokyo Metro and the Toei Subway, interviewed for this research, terrorism is today "a very serious threat" to their subway systems.

Unlike the situation in France, where the national government plays a major role in transit security planning, the national government plays a much smaller role in Japan. Transit operators at times receive guidance from the national government on security issues, but this usually comes in the form of recommendations rather than regulations. Ultimately, it falls on

the transit operators to decide what security measures should be employed. According to the assistant section chief in the Safety Section of the Tokyo Metro, transit operators

> are contacted in advance by the Ministry of Land, Infrastructure, and Transport and are asked about, for example, if it is feasible to display English sentences on schedule boards at platforms. When the ministry sends an official guidance memo, usually they contact transit operators in advance to ask if their guidance is realistic enough to be implemented. Otherwise, they would end up issuing directives that transit operators cannot follow. In this manner, we get to exchange information with the government. In some cases, the police also send their guidance through the ministry.

Despite the less central role played by the national government in implementing security improvements, transit operators in Tokyo pursue some collaboration, coordination, and information exchange efforts with the General Affairs Bureau of the Tokyo Metropolitan Government, which is in charge of planning strategies against terrorism. They are also "keeping in touch" with police and fire authorities, and are informally exchanging information with other transit companies. For the two transit agencies examined here, broad security directives and strategies are decided by the board of directors, whereas smaller issues are discussed and decided on by each company's Safety Affairs Division.

The sarin attack of 1995 prompted Japanese transit operators to identify two different categories of antiterrorist measures: (1) measures aimed at restraining terrorist activities and preventing attacks, which include a mixture of surveillance, technology, information, and design strategies; and (2) measures aiming at emergency preparedness and disaster response. The second category of measures prompted a disaster response protocol, which includes the development of instructional manuals with detailed guidance to employees as to how to react and respond in the case of a terrorist incident.

In terms of priorities, Japanese transit operators tend to privilege policing and patrolling strategies by private security guards and their own staff and surveillance with the help of security cameras and CCTV technology. Following the sarin attack, officials at both the Tokyo Metro and Toei Subway chose to contract out policing to private security companies. Additional patrols were added to the Toei Subway after the Japanese government announced its intention to send forces to Iraq. In addition to the private guards, municipal police have been on patrol in the most sensitive stations since the railway bombing in Madrid. The purpose of these patrols is to identify suspicious persons and contain criminal acts, and it is hoped, intimidate potential terrorists.

Other strategies applied in Tokyo are user outreach and electronic surveillance. Posters and stickers on trains and in stations and public announcements ask passengers to report suspicious persons and objects to station staff or the police. Since the sarin attack, 2,200 security cameras have been installed throughout all stations. They are placed at strategic points covering different platform areas, ticket gates, and restrooms. Other security hardware include two metal detectors, one in Kasumigaseki Station and the other in Ginza Station, which can be operated by the police.

Prior to the attacks against the World Trade Center and the Madrid metro, crime prevention through environmental design (CPTED) strategies for security did not get much attention in Tokyo, largely because of the generally low transit crime rates. The recent terrorist events, however, have forced Japanese transit operators to reconsider their attitude. In our interviews, transit officials expressed newfound concerns with dead spaces and lack of visibility at stations. According to our interviewees, CPTED strategies are just now beginning to be incorporated into station planning and design.

Since February 2004—when the Japanese government announced its intention to send some troops to Iraq—trash cans have been removed from stations and subway trains. Authorities have also removed all cigarette receptacles, since smoking has been prohibited in all stations. These antiterrorist measures had a surprising effect. The system now has much less trash because the Japanese passengers take their trash home with them and do not discard it in the trains and stations—precisely the opposite result from the experience in London addressed below.

The adjustment from the perception of a "safe society" to a "risk society," according to those interviewed, is slowly but surely taking place in Tokyo and other Japanese cities. At the same time, the transit operators interviewed also emphasized the challenges of striking a right balance between security and passenger convenience, and between cost effectiveness and adequate security—a sentiment echoed in every one of the case studies examined here.

LONDON: A LAYERED NETWORK OF SECURITY

Because of the protracted attacks by the Irish Republican Army (IRA) over nearly three decades, Londoners have had a long and intense experience with terrorism on their railway systems. As a result, British transit officials have developed an elaborate, layered system of directives, security standards, and procedures to deal with transit terrorism.

For many years prior to 9/11, the British authorities put many strategies into action to discourage terrorist attacks on what was perceived to be the most vulnerable part of their railway network, the London Underground. But the 1995 attack against the Tokyo metro, and the more recent terrorist attacks by Al Qaeda, caused British transit security officials to consider a different brand of terrorism than the one to which they were accustomed, one that involved coordinated attacks on a much larger scale and on multiple targets, and which were carried out not by opportunists seeking to avoid detection but by determined fanatics who meticulously plan their actions without concern for escape or survival. Such attacks, of course, occurred in London in July 2005, about a year after our interviews with London officials.

Transit security in Great Britain is the focus of a web of governmental agencies, including intelligence, police, and local transit operators. Collectively, they define the criteria for prevention planning and emergency response. At the national level, the Department of Transport oversees the railway industry and mandates its security requirements. The department has a number of boards and committees, such as the Rail Safety and Standards Board, which is responsible for setting safety standards, and Transport Security, which regulates security at airports, seaports, and most recently (after 9/11), the rail transport industry. Two other important roles of the national government are informing transit operators about threat levels, which define the strategies to be followed, and funding security initiatives.

At the regional level, Transport for London coordinates all the different modes of transportation in the greater London area and facilitates the efforts of all the transportation agencies in emergency planning and disaster response. Transport for London interacts closely with the British Transport Police (BTP), the police force of the railways in England, Scotland, and Wales. BTP typically respond to incidents of a security nature, but they also give advice and informational briefings to transit operators about the implications of their security decisions.

Different transportation companies also develop an additional layer of security measures, based on advice they pull in from Transport Security, Transport for London, and the BTP. Whereas security on trains is the responsibility of transit operators, security in stations is primarily the responsibility of Network Rail, the infrastructure manager of the railway, responsible for all major railway stations in London. Transit operators, like London Underground, have their own security divisions, which provide advice to the management about the security of their system, oversee the implementation of security standards, and develop better ways to meet them.

These multiple layers of agencies from the public and private sectors—which legislate, regulate, implement, and police British transit systems—require significant levels of coordination. At the same time that the different British agencies coordinate with one another, they—like the French—are also pursuing pan-European cooperation. All of the British transit operators we interviewed stressed the importance of sharing information and knowledge about security with their neighbors on the Continent.

Our interviewees in Great Britain talked about an integration of security strategies that include a mix of security technology, customer outreach, design, and policing measures. As one official with the London Underground put it,

> I don't think one of these four strategies sits out on its own. You've got to do each one. And you've got to have an element of each one in terms of being able to combat terrorism or crime in general. Each one on its own can't work in isolation.

In terms of security technology, the London Underground vehicles and stations are equipped with an extensive system of about 6,000 CCTV cameras, some connected to alarms, and some with recording capabilities. There are two distinct CCTV systems in the London railways: (1) a CCTV system used primarily to manage and operate the railways (so that the driver, for example, can see whether the last set of doors is clear on the platform), and (2) a CCTV system that has a specific security function and recording capabilities. Images from all these cameras are fed back to a central location under police control. The difficulty of constant monitoring of the screens of the system by humans was emphasized as a weakness of CCTV. Nevertheless, according to Graham Marshall of Network Rail, surveillance technology is likely to spread to "virtually every facet of public life in the UK over the next 10 to 20 years," because this intrusion of privacy for security reasons is generally accepted by the British people. The extensiveness of the latter of these two CCTV systems recently received worldwide attention when it captured the images of some of the July 2005 attackers of the London Underground and bus systems.

Policing by the trained officers of the BTP is considered by those we interviewed as absolutely essential for the safe operation of the railways, and for this reason the number of officers has steadily increased over the last years. Currently, the London Underground employs 630 officers of the BTP. Transit operators argued that they also rely on vigilance by their staff and customers. Dressed in clearly visible blue uniforms, the transit staff

often conduct station patrols and check station entrances. They are trained on how to deal with unattended bags and how to recognize chemical/biological agents. Nevertheless, they are always instructed to call the BTP for any incident that may require immediate or large-scale response.

Additionally, transit operators in Great Britain have launched information and outreach campaigns to raise the vigilance of the public. Posters in the stations and stickers on trains remind passengers to report any suspicious activity or unattended bag. Indeed, people are so vigilant and "raise the alarm" so frequently that London Underground has to deal with reports of about 10,000 unattended items every month.

In Great Britain, the strategy of using CPTED strategies to "design out" crime and terrorism in transit facilities has emerged gradually over the last decade. According to Thom Rhys Jones, managing director of Jefferson Sheard Architects, a London-based architectural firm that specializes in the design of public transportation facilities, security is one of the major factors now considered in the design of a railway station. As he argued, "the consequences of not designing for security are overwhelmingly more dire than the consequences of maybe not achieving some of the other factors, such as good image or accessibility." He distinguished between "passive" means of security (e.g., good sight lines, good lighting, and elimination of dead spaces) and "active" security means, such as CCTV systems built into the design. Some of the design measures that transit operators in Great Britain are focusing on include the elimination of places where people can conceal explosives without being noticed. Vending machines and telephone booths are built with sloping tops, so that nothing can be hidden on top of them. Hiding places have been eliminated from the rolling stock. Trash cans are completely banned in some stations or replaced with receptacles that have a plastic ring holding a bin of see-through plastic.

London Underground officials also try to secure the in-between spaces—the walkways, escalators, storage rooms, and power supply rooms. Rooms with no public access remain locked. The system does not have one centralized control room but many scattered in different places. According to London Underground officials, this is a security measure as terrorists cannot knock out with one blow all of London's public transport.

In discussing the mix of security strategies that make up their arsenal against terrorists, our interviewees in London frequently mentioned the many hurdles and challenges they encounter. These include the inherent vulnerability of the railway systems, the difficulty of balancing security measures with passenger convenience, and the high costs of safety and security improvements. Stressing the challenges of securing an open, accessible mass transit system, a BTP official interviewed argued that

there is an inherent vulnerability; and if you want to run an open mass transit system, you live with the vulnerabilities and you probably tackle them through intelligence. You have to take them out before they pose a threat. Once they are in it, it's probably going to be quite difficult to do anything about it. . . . One of our main concerns is that we don't want to end up doing the terrorists' job for them by shutting the system down unless we absolutely have to, or maximizing the disruption over a larger area than is necessary. Therefore, having a system that rapidly proves it is alright again is actually as important as establishing what has gone wrong.

The issue of striking the right kind of balance between adequate levels of security and operational efficiency was emphasized by the officials of London Underground:

It's very difficult to apply aviation-type controls to a rapid transit system. We've got 250 access points just by stations alone. Let alone all the interchanges, that probably brings us up to 1,000 or more. You can't put those sorts of controls into place in a railway system. It's just not practical. So we have got measures in place that are suitable for the environment and for the type of system that we run, but some of the things you can't do. You don't want people to have to wait too long in the course of their travel.

For this reason, transit operators in London reject at this time the idea of mass screening of passengers, unless new sensing and radar technologies are developed.

MADRID: A TRIPLE LAYER OF SECURITY

Similar to the British, the Spaniards also have a long experience with terrorism because of the activities of the Basque autonomist organization, ETA, over the last three decades. Nevertheless, Al Qaeda's attack on the national rail system, RENFE, on March 11, 2004, took them by surprise. As a result of this attack, the Spaniards now plan for both intra- and international terrorist threats that can hit unexpectedly any commuter rail system in any country. Taking action to diffuse such threats and make passengers feel safe again has been the overriding consideration of the transit operators in Madrid since the attack of 3/11. According to Manuel Rodriguez Simons, director of the Security and Civil Protection of RENFE, the largest railway company of Spain,

We know that the security is a parameter without which nothing can work. You can have the cleanest trains in the world, you can have the most luminous stations in the world, and you can have the most comfortable trains in

the world, and you can have the most punctual trains in the world. But when you go in a train and you do not feel safe because there are people who produce insecurity, you're not going to use the train.

Although Spanish transit operators perceive security as the overriding factor for the successful operation of their system, they also believe that, first and foremost, it is the national government that should bear the onus of identifying and tackling security threats. The role of the government, according to those interviewed, is to provide information to transit operators about security threats as well as instigate regulations pertaining to security standards.

An important actor in the security of the railway systems is local police forces. Municipal police protect the Metro Madrid, whereas RENFE has its own force. At the same time, both Metro Madrid and RENFE have their own security departments that are responsible for the prevention of and response to criminal acts and accidents. Transit operators are coordinated by the Consorcio Regional de Transportes de Madrid, a public sector agency that coordinates services, networks and fares, and security strategies.

The March 11, 2004, terrorist attack on RENFE caused, not surprisingly, the promulgation of substantially increased security measures. Some of the Spanish officials we interviewed claim that such measures were primarily in response to citizen demand, as surveys have shown that riders want more security on their system. Our interviewees worried, however, that they not turn their systems into "armored bunkers." Since the March 11 attacks, RENFE and Metro Madrid have retrofitted their stations with anti-intrusion and detection systems and have added more video and security cameras. Passengers embarking on the high-speed trains of RENFE are now scanned in a passengers-only staging area. According to RENFE officials, "This is a great method from the security point of view. And contrary to what we thought when we implemented it, passengers appreciate it as something good that makes them feel calmer."

Public outreach focuses on the training of employees so that they know how to respond in cases of emergency and how to protect the system more effectively. Unlike transit operators in Great Britain who place a big emphasis on outreach campaigns with warning posters and advice for the public, the Spaniards have not pursued such a policy, fearing that they may scare their passengers. Police surveillance, however, is a critical component of Spanish transit security strategies. RENFE has contracted private security officers who constantly monitor their facilities and watch over the passengers and staff. In the first months after the March 11 attack, the national police provided an additional layer of surveillance at the stations. Similar

to the situation in Tokyo, transit operators in Spain have observed that this increased police presence has resulted in a considerable decrease in crime at the stations and on trains.

The importance of CPTED strategies was also emphasized by the transit officials we interviewed. Design guidelines for new stations include (1) the use of transparent materials in station design; (2) good lighting and the elimination of dark zones; (3) limited entrance points; (4) clearly visible, open corridors, platforms, and waiting areas; (5) the avoidance of underground passages, footbridges, and winding corridors; (6) panoramic elevators that allow good views from the outside; and (7) the elimination of space on top of or underneath vending machines.

Many of the challenges cited by transit operators elsewhere were also echoed in Madrid. Spanish transit officials are concerned with keeping a proper balance between safety and convenience. The inherent vulnerability of an open transit system to terrorist attack by those with no regard for their own lives was also discussed, and at least one Spanish official, the technical director of the Concorcio Transportes Madrid, was quite pessimistic about the effectiveness of security measures. Such an attitude was, however, the exception rather than the norm. Although most transit operators we talked to readily admitted that they had no way of measuring the effectiveness of their security measures, they tended to profess the belief that these measures did make things more difficult for potential terrorists.

Table 1 summarizes and compares the security approaches followed by the four cities and their level of perceived significance by transit managers.

LESSONS LEARNED

Although the transit systems examined here experienced very different sorts of attacks in often dissimilar political, institutional, and cultural contexts, we find that some salient themes and lessons emerge collectively from these cases—some expected, others less so. These lessons also point to a framework of policy recommendations.

First, the transit officials interviewed repeatedly told us that public transit systems are open, dynamic, and inherently vulnerable to terrorist attacks and simply cannot be closed and secured like other parts of the transportation system. Although public officials understandably call for efforts to make transit systems 100 percent safe, it is simply impossible to secure the thousands of miles of rail right-of-way and the hundreds of stations used daily by millions of passengers in most large metropolitan areas. The challenge

TABLE 1:   Comparison of Transit Security Approaches in Four Cities and Level of Their Perceived Significance by Transit Managers

	Paris	*Tokyo*	*London*	*Madrid*
Role of national government in security planning	High	Low	High	Medium
Policing	High Dedicated transit security Military special units on special occasions	High Private security officers Municipal police in selected stations	High Dedicated transit police (BTP)	High Private security officers (at RENFE)
Public outreach	High Security awareness campaigns Posters and stickers Simulation of attacks	Medium Public security announcements Posters and stickers Instructional manual for staff	High Major information campaigns Public announcements	Low Training of employees
Technology/ surveillance	Medium CCTV technology Alarm and emergency buttons	High CCTV technology Metal detectors in selected stations	Medium CCTV technology Anti-intrusion devices, alarms	High CCTV technology Anti-intrusion systems Pre-embarking area with scanners (for high-speed trains)
System/physical design	High Design of new stations with transparent and shatter-proof materials Clear lines of sight Elimination of hiding places Good lighting	Low Translucent materials on walls and elevators Removal of trash cans	Medium Elimination of hiding places Vending machines with flat tops Elimination of trash cans or see-through design	Medium Design guidelines for new stations

NOTE: CCTV = closed-circuit television.

is especially daunting given a growing wave of suicide bombers who are willing to risk capture or death to execute an attack. According to an official interviewed in Madrid:

> Security does not exist. What do exist are methods to lessen insecurity. You never know what is going to happen. I am telling you this because when the politicians tell you that these methods will guarantee our security, it is all false.

Such sentiments raise legitimate, and perhaps troubling, questions about whether transit security planning efforts are perceived by transit officials as more symbolically effective (creating a sense of safety among the public) than substantively effective (reducing the likelihood and/or magnitude of a terrorist attack). At the very least, they reflect the daunting challenges to security planning for open, accessible transit systems. But avoiding the issue of transit security in the face of these challenges is not the answer. Policy makers should consider the right balance between security measures and the necessity to provide accessibility to railway transit systems (Howitt and Makler 2005).

Second, many of those interviewed (who worked for very large transit systems in very large cities) suggested that the threat of transit terrorism is probably not universal. Indeed, most attacks in the developed world have been on the largest systems in the largest cities. Whereas Jenkins's (1997, 2001) chronology of terrorist attacks on transit systems documents hundreds of incidents occurring over many decades, the deadliest and most politically influential of these have occurred on the largest transit systems in the most politically and economically powerful world cities, such as London, Madrid, Paris, Tokyo, Moscow, and New York. This observed asymmetry of risk likely reflects both the symbolic importance of particular world cities, and the fact that transit use tends to be concentrated in the largest and most densely developed metropolitan areas.

Although the most dramatic attacks have occurred mostly on major systems in world cities, this does not mean, of course, that local bus service or smaller cities are safe from attack. In the developing world, terrorist attacks on transit are more likely to occur on buses than on trains (Jenkins, 2001). Security experts report that some terrorists have on occasion chosen to attack unexpected targets to elevate fear and anxiety among the general population. But although smaller U.S. cities are clearly not safe from terrorist attacks, the very small role played by public transit in these cities (where the mode share of trips can dip below 1%) suggests that they are a far less likely venue for an attack than in larger cities where the role and visibility of public transit are proportionally much greater. This suggests that efforts to combat transit terrorism should focus on cities, transit systems, and stations where the likelihood and potential effects of terrorism are greatest.

Third, most of the transit officials interviewed reported struggling to balance the costs and (uncertain) benefits of increased security against the costs and (certain) benefits of attracting passengers. Evidence suggests that after September 11, a disproportionate amount of funding was given to secure air travel, whereas rail or bus transit received a much smaller slice of security funding (Howitt and Makler 2005).[3] According to one transit official, transit terrorism is a tremendous burden for agencies because they "have to be lucky all the time, while the terrorists only have to be lucky once." There is, indeed, tension between what Graham Marshall of Network Rail in London called "the twin demands of security and operating a railway." Funding security improvements is always an issue for transit operators trying to run a profitable business. Striking the right balance between what will make their customers feel protected and what they can afford paying for is a challenge. One operator admitted, "As a security specialist, I could do a lot more but I'd probably ruin the business." As Marshall poignantly concluded,

> You always have to find the right balance, and this balance probably is more than the balance of money, the availability of funds to do security improvements. It is about allowing people to go about their normal daily business using the railway as part of that daily business. But in a way that brings the maximum security. And that's always a balance.

In addition to concerns over the costs of security programs that are seen as tangential to the central goals of transit agencies, many of those surveyed and interviewed also expressed concerns over the uncertain nature of the risks and the uncertain effectiveness of increased security expenditures. In response to such uncertainty, the transit systems examined for this study have pursued an array of ways to prioritize expenditures on security:

- Customizing security measures based on a detailed evaluation of risk for each site (Paris)
- Assessing risks based on station location, sociodemographics of the region, and delinquency rates of the surrounding population (Madrid)
- Focusing efforts on terminal stations, the most heavily patronized stations, and stations near government buildings (Tokyo)
- Giving top priority to securing sites with concentrations of hazardous materials because explosion of such materials may have catastrophic consequences (Paris)
- Conducting public surveys of riders' perceptions and concerns to help prioritize needs (Madrid)

The recent attacks in Madrid and London show that federal and state governments have to reassess and enhance their investment for transit security.

In light of the limited funding and the enormity of the task of protecting thousands of stations, policy makers may want to consider selective allocations of their funds based on criteria similar to those listed above.

Fourth, many of our interviewees spoke of the need for a multilayered and multipronged system of security in which various agencies play very different roles. Many transit officials with whom we spoke suggested that interagency cooperation is common to the industry, which bodes well for increased coordination with police and security agencies in the years ahead. The importance of clearly defining roles and responsibilities among actors was also emphasized. Frequent and regular interaction among agencies to share information and agree on common strategies and tactics was deemed crucial. Concluded one London interviewee, "Resilience is about coordinating and facilitating efforts of all the disparate, separate agencies to ensure better quality of performance, aiding and leading to a more effective prevention or recovery than might otherwise be the case."

According to those interviewed, increased coordination can and should take many forms: (1) coordination between neighboring transit agencies; (2) coordination among local, state, and federal law enforcement officials; (3) information sharing with the media and the public; (4) improved dissemination of best practices in security planning; (5) consistency in emergency response procedures and protocols; (6) improved integration of different security-related technologies; and (7) increased international cooperation in sharing information and best practices.

Fifth, although most of the officials surveyed and interviewed agreed that public education and outreach has become an important part of transit security planning, respondents were in general more ambivalent about education and outreach than about policing, technologies, or CPTED. In particular, many cited the challenge of raising awareness without raising fear. It is a delicate balance between creating a perception of excessive, pervasive security (which is both costly and can incite fear among passengers) and too little security (which can promote a sense of danger and unchecked lawlessness). Enlisting the public's help in security surveillance can be effective but entails risks. Excessive marketing of vigilance can create an environment of paranoia, where everything and everyone can be viewed as potential threats. Such paranoia can suppress ridership while overwhelming transit officials with security tips. Further, a strong emphasis on police and public surveillance can lead to social profiling, and with it losses of privacy and civil rights. As a Spanish official argued,

> In Spain, there would be a lot of problems and it wouldn't be convenient to start screening passengers. People will not accept being identified, profiled, and searched, even if it is a random manner, because when you select, you

> elect and you have to do this with a certain objective and clear parameters. You will be accused of discrimination because this is labeling, marking people with certain physical features.

To find the right trade-off between engaging the public in surveillance versus scaring off riders, transit managers can instigate pilot programs of public outreach and then evaluate their impact on ridership.

Finally, most of our respondents viewed CPTED as an important longer-term strategy to address both crime and terrorism on transit systems. According to one of our interviewees in Madrid, "Security is based on prevention, and prevention begins with design. A station designed without security criteria would be much more insecure and expensive to protect." Although the potential effectiveness of CPTED was widely touted by those queried, many also noted that design is a longer-term strategy. CPTED strategies can be cost-effectively incorporated into new stations and terminals. On the other hand, most interviewees argued that retrofitting old stations is extremely costly, and as one interviewee claimed, "The best you can do is to use some passive methods such as mirrors, cameras, and increased lighting." These arguments aside, design standards and guidelines should be developed with security in mind and should be systematically followed in the design of new stations or when an existing station receives a retrofit.

Security after 9/11 has become a very important concern for the transit industry in the United States and abroad. The bad news is that it is impossible to fully secure systems that are so expansive, accessible, and open to public access and use. The good news is that although public transit systems are likely to remain attractive and vulnerable targets for terrorists, today they are better coordinated, policed, and designed. Their staff and passengers are better informed and prepared than they were just a few years ago. Lessons from transit systems in other parts of the world with significant experiences with terrorism can inform the efforts of U.S. transit operators. Only the future will tell how effective these efforts will be in deterring or minimizing a terrorist attack.

NOTES

1. The literature on security in general and transit terrorism in particular has expanded significantly since September 11. For example, Web sites such as the American Public Transit Association's Public Transit and Security Issues Web site (www.apta.com/services/security) and the Federal Transit Administration's Transit Security Web site (http://transit-safety.volpe.dot.gov/Security/Default.asp) offer cities and their transit systems a wide variety of resources and information.

2. According to the assistant supervisor in the Technology Section of the Tokyo Metro Co. Ltd., these measures included (1) the creation of a manual to educate their employees as to how to respond to emergency situations such as chemical attacks, (2) evacuation procedures, and (3) and the establishment of the Disaster Prevention District Network, so that the employees at nearby stations and workplaces can come to support each other.

3. In the United States, a report to Congress estimated that the federal government allocated $9.16 per air traveler for security but less than a cent for each transit rider (Howitt and Makler 2005).

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