Public Transportation Security
Volume 3
Robotic Devices: A Guide for the Transit Environment
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Public Transportation Security:

Volume 3

Robotic Devices:  A Guide for the Transit Environment

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Subject Areas
Public Transit • Planning and Administration

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The nation’s growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands. Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the transit industry. The Transit Cooperative Research Program (TCRP) serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

The need for TCRP was originally identified in TRB Special Report 213—Research for Public Transit: New Directions, published in 1987 and based on a study sponsored by the Urban Mass Transportation Administration—now the Federal Transit Administration (FTA). A report by the American Public Transportation Association (APTA), Transportation 2000, also recognized the need for local, problem-solving research. TCRP, modeled after the longstanding and successful National Cooperative Highway Research Program, undertakes research and other technical activities in response to the needs of transit service providers. The scope of TCRP includes a variety of transit research fields including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices.

TCRP was established under FTA sponsorship in July 1992. Proposed by the U.S. Department of Transportation, TCRP was authorized as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). On May 13, 1992, a memorandum agreement outlining TCRP operating procedures was executed by the three cooperating organizations: FTA, The National Academies, acting through the Transportation Research Board (TRB); and the Transit Development Corporation, Inc. (TDC), a nonprofit educational and research organization established by APTA. TDC is responsible for forming the independent governing board, designated as the TCRP Oversight and Project Selection (TOPS) Committee.

Research problem statements for TCRP are solicited periodically but may be submitted to TRB by anyone at any time. It is the responsibility of the TOPS Committee to formulate the research program by identifying the highest priority projects. As part of the evaluation, the TOPS Committee defines funding levels and expected products.

Once selected, each project is assigned to an expert panel, appointed by the Transportation Research Board. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, TCRP project panels serve voluntarily without compensation.

Because research cannot have the desired impact if products fail to reach the intended audience, special emphasis is placed on disseminating TCRP results to the intended end users of the research: transit agencies, service providers, and suppliers. TRB provides a series of research reports, syntheses of transit practice, and other supporting material developed by TCRP research. APTA will arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by urban and rural transit industry practitioners.

The TCRP provides a forum where transit agencies can cooperatively address common operational problems. The TCRP results support and complement other ongoing transit research and training programs.
The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. On the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Bruce M. Alberts is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. William A. Wulf is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, on its own initiative, to identify issues of medical care, research, and education. Dr. Harvey V. Fineberg is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy’s purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both the Academies and the Institute of Medicine. Dr. Bruce M. Alberts and Dr. William A. Wulf are chair and vice chair, respectively, of the National Research Council.

The **Transportation Research Board** is a division of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board’s mission is to promote innovation and progress in transportation by stimulating and conducting research, facilitating the dissemination of information, and encouraging the implementation of research results. The Board’s varied activities annually engage more than 4,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation. [www.TRB.org](http://www.TRB.org)

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This third volume of TCRP Report 86: Public Transportation Security will be of interest to transit general managers, police, and security personnel as well as operations, communications, technology, training, and human resources staffs. Federal, state, and local law enforcement will also find the report useful. The objective of this report is to provide a guide to robotic devices for use in public transportation environments. The section on environments identifies the expected conditions a device must operate in and navigate through and develops a prototypical requirements specification. A second section serves as a primer on the features available for robotic devices and provides a market survey of readily available systems that are appropriate for some identified environments. The third section demonstrates how to perform a selection analysis by matching a requirements specification against the market. This volume was prepared by Science Applications International Corporation, under TCRP Project J-10B(3).

Emergencies arising from terrorist threats highlight the need for transportation managers to minimize the vulnerability of passengers, employees, and physical assets through incident prevention, preparedness, response, and recovery. Managers are seeking to reduce the chances that transportation vehicles and facilities will be targets or instruments of terrorist attacks and to be prepared to respond to and recover from such possibilities. By being prepared to respond to terrorism, each public transportation agency is simultaneously prepared to respond to natural disasters such as hurricanes, floods, and wildfires, as well as human-caused events such as hazardous materials spills and other incidents. In the last week of October 2001, the TCRP budgeted $2 million for security-related research in fiscal year 2002.

This is the third volume of TCRP Report 86: Public Transportation Security, a series in which relevant information is assembled into single, concise volumes, each pertaining to a specific security problem and closely related issues. These volumes focus on the concerns that transit agencies are addressing when developing programs in response to the terrorist attacks of September 11, 2001, and the anthrax attacks that followed. Future volumes of the report will be issued as they are completed.

To develop this volume in a comprehensive manner and to ensure inclusion of significant knowledge, available information was assembled from numerous sources, including a number of public transportation agencies. A topic panel of experts in the subject area was established to guide the researchers in organizing and evaluating the collected data and to review the final document.

This volume was prepared to meet an urgent need for information in this area. It records practices that were acceptable within the limitations of the knowledge available at the time of its preparation. Work in this area is proceeding swiftly, and readers are encouraged to be on the lookout for the most up-to-date information.

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INTRODUCTION

The need for unmanned tele-operated robotic vehicles has risen to public awareness with the successful use of such devices in the search and rescue effort following the September 11, 2001, disaster. Although robots have long been used in search efforts and homeland security missions such as explosive ordnance detection and disposal, perpetrator location and observation, and similar military applications, their major strength of interrogating areas impenetrable by humans while keeping their human operators out of harm’s way is now being realized. Robot systems include a wide variety of remotely controlled vehicles equipped with cameras, sensors, and other navigational instruments to provide feedback to the user at a control station. Payloads can include additional sensors such as X-ray cameras; nuclear, biological, and chemical hazard detectors; bomb disarming devices; weaponry; and a variety of other deployable systems such as medical supplies.

The objective of this report is to aid in the appropriate selection of a device for various transit scenarios.

Targets of Attacks on Public Surface Transportation Systems (1920–1997)

Used Against Surface Transportation Systems (1920–1997)