
APPENDIX A
ORGANIZATION AND PROCEDURE FOR CONDUCTING
THE ASSESSMENT

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APPROACH

This assessment was conducted by the Office of Technology Assessment (OTA) Transportation Assessments Group. The OTA staff was augmented by two consultants who served as project principals. Mr. Frederick A. F. Cooke was the Program Director and Mr. H. William Merritt was Deputy Program Director. Both have had broad experience with PRT and other forms of Automated Guideway Transit. They were assisted in framing the assessment and directing the Service by Dr. Leon M. Cole of the Library of Congress, Congressional Research

At the outset of the study, the subjects to be examined were grouped in five general categories:

- Current Developments in the United States.
- Economics.
- Social Acceptability.
- Operations and Technology.
- International Developments.

Detailed topics within each of these categories are listed at the end of this appendix.

Five study panels were organized, one for each of the general areas. Panels were drawn from public transportation agencies, nonprofit organizations and associations, manufacturers, transit planning organizations, educational and research institutions, consulting firms and citizen organizations. A special effort was made to have a variety of points of view represented on each panel, i.e., enthusiasts and skeptics alike. (Brief biographies of panel members are provided at the end of this appendix.)

The work of each panel was organized and directed by its Chairman with the support and assistance of the Program Director. The panels met in Washington several times to discuss findings, issues and conclusions. Each panel chairman submitted a report. Abstracts of the five panel reports are attached as Appendix B.

During the course of this assessment, most of the Federal and local government officials concerned with the planning and implementation of Automated Guideway Transit projects were contacted by members of the study team, as were a majority of the significant system suppliers. About 20 members of the team were briefed in detail by UMTA Administrator, Frank C. Herringer and members of his staff. In addition, there have been many separate meetings with UMTA and DOT personnel. Special briefings were made by Dr. J. Edward Anderson, of the University of Minnesota, and Messrs Harry Bernstein and C. L. Olson of the Aerospace Corporation. Members of the team visited the Morgantown project in January and April and the AIRTRANS project at Dallas/Ft. Worth in February.

DATA BASE

During the course of this assessment, the Program Director, Deputy Program Director, and the Panel Chairmen reviewed numerous reports, studies, professional papers and general material on the subject of Automated Guideway Transit. Additionally, the views of many people of diverse backgrounds were solicited. This material forms the data base for this assessment report. It is maintained on file for ready reference in OTA'S Transportation Assessments Group. The bibliography which is attached as Appendix C lists material of general interest. Each panel report also includes a listing of reference material which is available on file.

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ACKNOWLEDGEMENTS

This assessment was made possible by the capable and enthusiastic support of the panel members, a majority of whom were made available to OTA at no cost by their parent organizations. In addition to the panel members, many other individuals participated in this effort by attending panel meetings and by preparing thoughtful responses to detailed questions. Specific acknowledgements are contained in the reports prepared by the Panel Chairman.

TOPICS ASSIGNED TO STUDY PANELS

The following pages outline in greater detail the topics assigned for investigation by each of the five panels:

I. CuRRENT DEVELOPMENTS IN THE UNITED STATES

- Identification of strong points as well as deficiencies.
 - . Levels of reliability which have been achieved.
- Safety record and analysis of causes of major accidents.
 - . Extent of public acceptance.
- Capital as well as operating and maintenance cost. Effect of varying degrees of system sophistication on such costs.
 - . How can experience to date be applied to new systems being planned?

II. ECONOMICS

Cost-benefit analysis of AGT in relation to other transportation modes:

- . As an alternative to buses as feeders to conventional rail transit system.
- . As a means of linking remote automobile parking facilities with activity centers.
- As circulation systems in congested downtown areas, airports, commercial developments, universities and other major activity centers.
- As a reasonable alternative to the private automobile in urban areas.

Economic aspects of short headway systems, ranging from three seconds to the fractional second headways required to achieve high capacity with very small vehicles:

- . Effect of large volume production on vehicle costs,
- . Projected guideway network and station costs.
- . Effect on capital as well as O & M costs of increasing levels of control sophistication.
- Measures required to achieve required levels of reliability and cost implications.

Projection of extent to which personalized service can be expected to increase ridership.

111. SOCIAL Acceptability

Safety and Security

Passenger safety:

- identification of major hazards.
- Evaluation of risks and determination of acceptable probability levels for accidents and injuries.
 - . Review of safety criteria being used as a basis of current designs for adequacy and uniformity.
- Emergency escape and rescue capabilities.

Safety of the general public:

- Review of measures being used to keep people off the guideways.
- Evaluation of alternative means of preventing injuries or damage to property resulting from vehicles running off or falling from guideways onto city streets.
- . Is further federal action required to insure that adequate safety measures are uniformly observed?

Passenger security:

- Risks to passengers—especially women traveling alone at night on station platforms and in unattended vehicles.
- Evaluation of alternative techniques to insure security, such as TV monitors, emergency communication, roving patrols, etc.
- How can public be convinced that adequate security is being provided?

System security:

- Measures required to minimize opportunities for vandalism and/or sabotage.
- Equipment design to reduce cost of repair. what further action is indicated?

Environmental Impacts and Aesthetics

- maximum allowable noise levels both inside and outside vehicles.
- Visual impact of elevated guideway systems and station structures.
- measures required to insure architectural compatibility with existing surroundings. How can public acceptance be assured?
- Effect on adjacent land values of overhead systems.
- Are current regulations governing environmental impact studies effective? Do PRTs warrant special treatment?

~Social Implications

Offsetting economic costs, how can AGT enhance the overall quality of urban life by:

- Reducing air pollution and noise levels?
- Easing traffic congestion and reducing travel and commuting time?
- Providing increased mobility for the disadvantaged, the elderly and the handicapped?

How can these benefits be evaluated or quantified?

To what extent can the social benefits of AGT be expected to foster public acceptance, i.e. :

- Willingness to approve bond issues to pay for first costs and to cover possible operating--deficits?
- Reducing reliance on the private automobile?

Under what circumstances can a case be made for providing free PRT service as is universally accepted in the case of elevators in buildings?

IV. OPERATIONS AND TECHNOLOGY**Level of Service**

What is the optimum level of service which must be provided if PRT is to become a viable alternative to the private automobile?

- How far are people willing to walk under varying circumstances?
- How long are they willing to wait?
- How important is travel time in relation to comfort?
- What is the minimum acceptable interval between stops?

Can meaningful conclusions be drawn from actual experience with existing automated vehicle systems and other transportation modes?

- Are current planning criteria based on fact or theory?

How important is it to provide point-to-point, non-stop service?

- Will ridership fall off as intermediate stops are made and to what extent?

Under what circumstances are people willing to transfer from one vehicle to another enroute?

- To what extent will transfer affect ridership?

Ride Quality and Comfort

What criteria are being used for acceleration/deceleration rates, jerk rates, sound levels, smoothness of ride, air conditioning and heating, etc?

- Is there a need to establish uniform criteria for specific types of service?
- To what extent have design objectives been met in existing systems?
- Can any meaningful conclusions be drawn as to public acceptance of varying level of comfort? How rough a ride is acceptable?

How long are people willing to ride standing versus seated?

- What has been the basis for determining number of seats versus space for standees?
- How much crowding is acceptable and safe?

To achieve an acceptable level of comfort should emphasis be placed on building guideways to precise smoothness and tolerances or on vehicle suspension systems?

- What conclusion can be drawn from experience to date?
- What further study is indicated?

Energy Considerations

Energy consumption for varying levels of **service**, vehicle sizes, means of propulsion.

Comparison with amounts of energy consumed by conventional rail systems, buses and automobiles.

Effect on ridership of continuing gasoline price escalation or shortage of supplies.

Reliability

What reliability criteria have been used to date and what results have been achieved?

- Are uniform criteria being established for similar systems?
- Are criteria consistent with experience with other transportation modes and other industries?

What cost-benefit studies have been made in determining:

Extent to which h reliability components are used?

- Use of redundancy?
- providing rapid diagnostic and repair capabilities?

How does reliability affect public acceptance

- What level of occasional breakdown will the public accept willingly?

To what extent does the current state of the art fit the degree of complexity and sophistication which can reasonably be incorporated into PRT systems?

What further work needs to be done?

V. INTERNATIONAL DEVELOPMENTS

Appraisal of PRT developments abroad:

- To what extent has foreign technology advanced beyond ours?
- How are foreign governments stimulating development and fostering export of technology and hardware to the United States and the world at large?
- How successful have foreign companies been in penetrating the United States market for PRTs? What licensing agreements have been made with United States industry? and
- What can we learn from PRT developments and actual experiences abroad in the areas of technology and public acceptance?

What is the extent of the international market for PRTs?

- What is the competitive posture of the United States engineering and industrial community? and
- What steps are being taken by the United States Government to insure a fair share of foreign projects for United States interests?

Future Directions

Does the promise of PRT as a cost effective new mode of transportation warrant a continuing investment of substantial government funds for research development and demonstration, and if so:

- In what areas?
- At what financial levels? and
- On what time schedule?

All Panels considered these questions.

PROJECT TEAM

The team assembled to conduct this assessment, under the overall direction of Dr. Gretchen S. Kolsrud and V. Rodger Digilio of the Transportation Projects staff of OTA, was composed of the following people:

ASSESSMENT PROGRAM DIRECTION

Frederick A. F. Cooke, Program Director
Consulting Engineer
On Contract with OTA

Since 1968 Mr. Cooke has been active in planning and implementing AGT systems. Earlier he directed highway and semi-metro designs in Europe. As Vice President of the Dashaveyor Company, which became a Bendix subsidiary,

he conducted numerous studies of potential applications for innovative systems. He supervised the construction, installation and testing of the Bendix-Dashaveyor TRASPO-72 demonstration at Dulles Airport.

H. Wm. Merritt, Deputy Program Director
Transportation Consultant
On contract with OTA

H. Wm. Merritt directed the Study of New Systems of Urban Transportation for HUD in 1967-1968. Until 1973 he was the Associate Administrator for Research and the Director, Special Projects, in UMTA. Since 1973, he has consulted on urban transportation planning, engineering, and energy conservation. Mr. Merritt chairs a task force of the National Academy of Sciences which publishes a Newsletter on New Concepts of Urban Transportation.

Dr. Leon M. Cole
Congressional Research Service
The Library of Congress
Consultant to OTA

Active in teaching, research and consulting in urban transportation and planning for fifteen years, Dr. Cole was co-author and editor of *Tomorrow's Transportation: New systems for the Urban Future*, published in 1968. As a former commissioner of the Texas Urban Development Commission and chairman of the City of Austin Board of Natural Resources and Environmental Quality, he has helped develop state and local governmental policies in transportation matters as well as Federal legislation. Dr. Cole also serves as a group council member of Transportation Research Board, National Academy of Sciences—National Research Council.

Panel on Current Developments in the United States

Clark Henderson, Chairman
Staff Scientist
Stanford Research Institute
Menlo Park, California

Mr. Henderson has conducted research on transportation since 1953 and has specialized in urban public transportation systems during the past decade. He was the principal author of *Future Urban Transportation Systems* prepared for the Federal government in 1968. He has conducted studies for local and regional transit agencies and for suppliers of transit systems.

John K. Howell
Transportation Consultant
Gerald D. Hines Interests
Houston, Texas

Mr. Howell was project manager of the Westinghouse Electric Transit Expressway Demonstration Project and directed the Tampa and Sea-Tac Transit Expressway projects. In consulting practice since 1970 he has completed more than 50 transit studies involving planning, engineering, specifications and proposals, economic estimates and evaluations.

John R. Jamieson
Director of Transit Development
Twin Cities Area Metropolitan Transit Commission
St. Paul, Minnesota

Mr. Jamieson has occupied his present position for five years. He has conducted a number of long range planning studies including technology assessment, optimum systems, and most recently a detailed study of small vehicle fixed guideway systems. Previous experiences included Deputy Federal Highway Administrator, Minnesota Commissioner of Highways and fifteen years in industry in various assignments ranging from field engineering to product development.

Thomas A. Lancaster
 Manager of Market Analysis
 Rohr Industries, Inc.
 Chula Vista, California

Mr. Lancaster is responsible for long-range forecasting, planning and detailed analysis of transit trends at Rohr. Earlier he was engaged in product development and engineering work with the Bendix Corporation. In 1971-1972 he participated in the President's Commission on Personnel Interchange and served as Deputy Director-Special Projects in UMTA. He is a professional engineer.

Roy Lobosco
 Supervisor, Facilities Planning
 Port Authority of New York and New Jersey
 New York, New York

Since 1965, Mr. Lobosco has been responsible for a program directed toward installation and operation of an AGT system serving Newark International Airport and connecting the terminal with a proposed PATH extension. He has supervised internal planning and the work of consultants and has negotiated with four potential suppliers regarding all technical and operational features of their proposed systems.

Panel on Economics

Dr. Lyle C. Fitch, Chairman
 President, Institute of Public Administration
 Washington, D.C.

Lyle C. Fitch is president of the Institute of Public Administration, the nation's oldest nonprofit governmental research and consulting organization. He has held numerous municipal, state and federal offices, including City Administrator of New York City. He holds a Ph.D. in economics from Columbia University and has taught at Columbia, City University of New York, Wesleyan University, and elsewhere. In 1961 he directed a study of federal urban transportation policy, commissioned by HHFA and the Bureau of Public Roads, which provided important inputs to the first federal urban mass transportation act.

Dr. J. Edward Anderson
 Regional Transportation District
 Denver, Colorado

J. Edward Anderson, PhD, P. E., is a professor of Mechanical Engineering, University of Illinois at Chicago, and a consultant to Regional Transportation District, Denver, Colorado. His academic experience includes BSIE, Iowa State University, 1949; MSIE, University of Illinois, 1955; and PhD, Massachusetts Institute of Technology, 1962. He is General Chairman of the international Conference on Personal Rapid Transit and Editor, *Personal Rapid Transit*.

Thomas B. Deen
 Vice President
 Alan M. Voorhees and Associates, Inc.
 McLean, Virginia

Mr. Thomas B. Deen has served as principal-in-charge of comprehensive transit and Urban Transportation Studies in many principle cities of the world including Washington, D. C., Atlanta, Baltimore, Caracas, Honolulu, and Rio Paulo. He formerly was director of planning for the federal agency which developed plans for the Washington Metro now under construction. His writings have been published in most of the professional journals in the urban transportation field.

Dr. Paul K. Dygert
 Senior Consultant
 Peat, Marwick, Mitchell & Company
 Washington, D. C.

Dr. Dygert has engaged in teaching, research, and consulting in transportation economics and financing for a number of years. Recently he undertook a financial feasibility analysis for a proposed personal rapid transit system, and conducted a study of Urban Mass Transportation Needs and Financing which the Secretary of Transportation transmitted to the Congress in July, 1974. He has also undertaken transportation studies for international, state, and local agencies.

Dr. Aaron J. Gellman
President
Gellman Research Associates, Inc.
Jenkintown, Pennsylvania

Dr. Gellman, since 1972, has been president of his own research consulting firm and is concurrently an adjunct professor in the Transportation and Regional Science Division of the Wharton School of Business, University of Pennsylvania. Before forming the consulting firm, Dr. Gellman was vice president for planning at the Budd Company, Philadelphia, where he was responsible for all economic planning activities of the company. His formal education took place at the University of Virginia (B.A.- Economics), the University of Chicago (M.B.A.-Transportation) and M.I.T. (Ph. D.-Economics).

Charles Hickox
Director of Ground Transportation Marketing
LTV Aerospace Corporation
Dallas, Texas

Mr. Hickox has been responsible for market planning and development for ground transportation since the inception of his company's commitment to this field of business. He has been closely associated with the development of the AIRTRAN'S system at the Dallas/Ft. Worth Airport and the licensing of this technology in both Japan and France. He has lectured extensively on automated transit.

Douglas B. Lee
Office of Comprehensive Planning
Fairfax County
Fairfax, Virginia

Dr. Lee recently left the University of California, Berkeley, where he was teaching in city planning and conducting research in the comparative costs of urban transportation modes. After spending a year working in Fairfax County's land use planning program, he will join the faculty at the University of Iowa.

Sumner Myers
Director Urban System Studies
Institute of Public Administration
Washington, D.C.

Sumner Myers, a graduate of M.I.T., is a director of Urban Systems Studies for the Institute of Public Administration in Washington, D.C. and the author of numerous publications on technological innovation and transportation. He was a participant in H.U.D.'s study of transportation technology and an editorial advisor for its final report, *Tomorrow's Transportation: New Systems for the Urban Future*.

Panel on Social Acceptability

Jacquelyn A. Ingersoll, Chairman
Citizen Advisor on Urban and Transportation Planning
St. Louis Park, Minnesota

Mrs. Ingersoll has been very active in civic planning and transportation matters in the Twin Cities for several years. She is past chairman of the St. Louis Park Planning Commission which serves a community of 50,000 people. She also serves as a member of the Citizens Advisory Committee on Transit of the Twin Cities Metropolitan Transit Commission.

Ralph Jackson
Director of Planning
Regional Transportation District
Denver, Colorado

Mr. Jackson returned to his home town of Denver in September, 1970 to accept the position as director of planning for the Regional Transportation District (RTD). Previously, he was a senior associate engineer with Barton-Aschman Associates, Inc. of Chicago, where he participated in transit planning and traffic engineering studies in over 20 cities. Prior to his employment at Barton-Aschman Associates, Inc. Jackson was a research associate with the Department of Urban Studies, University of Illinois at Chicago.

Alain L. Kornhauser
 Assistant Professor of Civil and Geological Engineering
 Princeton University
 Princeton, N.J.

Professor Kornhauser has taught courses and conducted research on transportation for the past five years, specializing in automated forms of mass transportation. He is co-editor of *Personal Rapid Transit I* and author of journal publications on design of automatic control systems, network design and analysis methodologies, energy impacts and attitudinal considerations in predicting the demand for new technologies.

Rodney K. Lay
 Group Leader, Transportation Systems Planning
 The MITRE Corporation
 McLean, Virginia

Dr. Lay has conducted and supervised the evaluation of a broad range of ground transportation systems as a member of MITRE's consultant systems engineering staff supporting the USDOT Urban Mass Transportation and Federal Rail R,D & Programs. He has directed a recent technology review and an assessment of the state of the art of personal rapid and dual mode transit systems.

John B. Schnell
 Manager-Research
 American Public Transit Association
 Washington, D.C.

Mr. Schnell has served in this position with APTA for five years and specializes in all of the technical maintenance and operation aspects of urban mass transportation and automobile transportation with the Institute of Traffic Engineers and the Keystone Automobile Club. He has been a county engineer and a township engineer.

Reed H. Winslow
 Department Head
 Transportation Systems Planning
 The MITRE Corporation

Mr. Winslow's experience includes twenty years of progressive development in transportation management, planning, and engineering. Under a contract with the Urban Mass Transportation Administration, Mr. Winslow has been involved in research and development projects for demand responsive transportation, bus propulsion systems, methods for granting priority to transit buses in traffic, automatic vehicle location and monitoring systems, urban transportation planning, and software and advanced technology for rapid transit systems.

George V. Wickstrom
 Director, Office of Technical Studies
 Metropolitan Washington
 Council of Governments
 Washington, D.C.

Mr. Wickstrom has been actively engaged in the practice of urban transportation planning for over 20 years. He has served as director of several large-scale urban transportation studies in Philadelphia, Delaware and Washington, D.C. A registered professional engineer, he is also active in transportation research, and has authored over 20 published articles on land use and traffic planning.

Panel on Operations and Technology

Robert A. Makofski, Chairman
 Manager, Urban Transportation Programs
 Applied Physics Laboratory
 The Johns Hopkins University
 Silver Spring, Maryland

Mr. Makofski has been involved in the research and development of automated transit systems since 1968. This work has covered a broad spectrum of technology in automated systems with emphasis on the command and control aspects of these systems. He is also a Senior Research Associate of the Center for Metropolitan Planning and Research of the Johns Hopkins University.

Richard H. Donlon
 Director of Operations
 Transportation Technology Division
 Otis Elevator Company
 Denver, Colorado

Mr. Donlon has 24 years of experience in a wide range of advanced technologies with emphasis on technical program management, engineering and research. He has devoted the last seven years to the development of advanced automated vehicle transit systems. Mr. Donlon was a founder of Transportation Technology, Inc.

Eugene Jones
 Senior Vice President
 Frederic R. Harris, Inc.
 Stamford, Connecticut

Mr. Jones has been involved in the planning and design of transportation facilities for over 25 years. He serves on the Board of Directors of Northeast Utilities, the State National Bank of Connecticut and the Stamford Area Commerce and Industry Association. He was Chairman of the Committee on New Towns and Urban Development for the Consulting Engineers Council,

Thomas McGean
 De Leuw, Cather and Company
 Washington, D.C.

Mr. McGean provides technology and system engineering support on a nationwide basis—most recently in studies of transit alternatives for the Twin Cities, Denver and Santa Clara. Prior to joining De Leuw, Cather he was involved in numerous major Federal transportation programs including tracked air cushion vehicle research, the TRANSPO '72 People Movers, Dual-Mode, the Rapid Rail Research Program and the HPPRT program.

David R. Phelps
 Director of Systems Technology
 Transit Development Corporation, Inc.
 Washington, D.C.

Mr. Phelps is responsible for the management of funded programs and offers technical direction in providing work scope for proposed programs. He was previously with GE where he was Manager of Development Engineering and Systems Engineering. He was responsible for advanced preliminary design and proposal activity on transit and commuter rail car design. He received a BSEE with honors from Lehigh University and is a registered professional engineer.

Stanley A. Spinwebber
 The Port Authority of New York and New Jersey
 ONE World Trade Center
 New York, New York

Mr. Spinwebber has served as Supervisor of the Ground Transportation Projects Section since 1972. He has a BS Degree from Pennsylvania State University, MS Degree from Stevens Institute of Technology, and is a licensed Professional Engineer and Planner. He is responsible for planning, developing, and implementation of all ground transportation projects for Kennedy and La Guardia Airports, including rail access, bus programs, and automated passenger and baggage handling systems.

Dr. Vukan Vuchic
 Department of Civil and Urban Engineering
 University of Pennsylvania
 Philadelphia, Pennsylvania

Dr. Vuchic holds a diploma from the University of Belgrade, Master's and Ph.D. degrees from the University of California (Berkeley). In addition to his academic work he has been consultant to many firms and to the U.S. Department of Transportation. He has lectured at a number of universities, professional and public forums and published over 30 professional papers here and in Europe. His specialties are urban transportation systems; public transportation; urban and national transportation policy.

Panel on International Developments

H. Wm. Merritt, Chairman
 Transportation Consultant
 Arlington, Virginia
 (See biography on page 87.)
 Robert A. Burco
 President Public Policy Research Associates
 Berkeley, California

Robert A. Burco specializes in urban transportation system evaluation, institutional aspects of planning and public policy and technology assessment. In 1971-1972 he assessed innovations in urban transit in Europe, North America, and Japan for OECD. Mr. Burco authored the 1968 SRI report on impacts of future urban transportation systems. He is a member of the OTA Urban Mass Transit Advisory Panel and the NAS Transportation Research Board.

Thomas H. Floyd, Jr.
 Vice President DGA International
 Washington, D.C.

Mr. Floyd is currently involved in the transfer of European technology and industrial innovations to the United States, specializing in ground transportation. Prior to his association with DGA International in 1969, Mr. Floyd was the director of research project management in the Urban Mass Transportation Administration. In this capacity, he was responsible for the planning and management of research, development and demonstration programs.

Howard R. Ross
 Transportation Consultant
 Menlo Park, California

Mr. Ross has worked in the urban transportation field for over ten years, and has specialized in problems of advanced technology systems. Since 1971, he has headed a consulting firm dealing with system design and analysis, technology forecasting, transportation planning, financial studies and economic analyses for urban transit systems. Mr. Ross was a founder of Transportation Technology Incorporated in 1968, and prior to that was at Stanford Research Institute.