APPENDIX B

ABSTRACTS OF PANEL REPORTS

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ABSTRACT OF THE REPORT OF THE PANEL ON CURRENT DEVELOPMENTS IN THE UNITED STATES

This report describes the development and current status of Automated Guideway Transit (AGT) systems in the U.S. It is based on information from a wide variety of sources, including the major suppliers of equipment for the 17 AGT systems now being built or in operation in this country and public agencies which are considering future systems.

The anel examined seven questiom+ as follows:

(1) #hy *AGT?* This section is a recitation of the arguments which proponents of AGT systems put forward.

(2) *What distinguishes three AGT system types from one another?* Shuttle-Loop Transit (SLT), Group Rapid Transit (GRT), and Personal Rapid Transit (PRT), are described in terms of their use and particular attributes.

(3) *Who owns AGT?* The 17 existing systems are described in detail. Fifteen of them are SLT systems, representing private investment of $75 million. The other two are GRT systems, representing private investment of about $46 million and federal investment of about $72 million. Of the 17 systems, 10 are in service, one is idle, and six are in advanced stages of construction.

The systems, in general, have operated very safely. There has been one injurious accident in about 150 million passenger trips. The ability of these systems to provide continuous service varies a great deal, depending on the reliability of component hardware and on system layout and vulnerability to complete shut down as a consequence of a single failure.

(4) *Who warks AGT?* This section examines data from studies of possible AGT application in 36 localities. The studies represent perhaps one-third to one-half the planning that has been done on potential deployment of AGT. Four of the studies are for metropolitan networks at a cost of $6.7 billion. Two are for corridor systems in urban areas at a cost of about $250 million. The remaining 30 plans are for business districts, airports, and other major activity centers at costs totaling about $1 billion.

Most of the studies are on simple SLT systems but some include low technology GRT features. Several studies for large, metropolitan systems have considered high technology GRT or PRT systems and then rejected them because of uncertainty about whether certain technical features are sufficiently developed for everyday use, Prospective buyers appear to be more interested in proven systems which could be quickly installed rather than in more sophisticated systems which may require R & D. Thus, prospective buyers seem to have little interest in systems more sophisticated than the low technology GRT level.

(5) *Who supplzes AGTand what are their probknzs?* Six firms in the AGT business have supplied all but one of the 17 AGT systems. A larger number of companies are prepared to sell systems if they can find a market. Reliable estimates su gest that these firms have invested $100 million corporate funds in develo ing GT capability. However, the market has become increasingly uncertain.Jome firms have already discontinued their AGT programs and others are considering similar action.

(6) *What has UMZ'A done?* Federal agencies, mainly the Urban Mass Transportation Administration, have spent more than $100 million on AGT installations and development programs. The two GRT systems—AIRTRANS at the Dallas/Ft. Worth Airport and the Morgantown project—received about 70Y0 of the federal funds. All other A GT efforts, including $10 million spent on demonstration of four systems at Transpo '72, absorbed the remaining $30Y_0$.

(7) *What actions would encourage greater exploitation of AGT?* The panel sought the views of suppliers on this question and found their responses varied. Recommendations ranged from minimal government involvement to extensive government involvement both in financial support and product control.

The suppliers agreed that UMTA must clarify the level of funding which will be available for capital grants for AGT and the conditions that a supplier must meet to qualify his product for capital funds.

Suppliers also said a clearer definition of the part the federal government intends to play in research and development is needed.

Finally, they asked that the federal government specify what financial aid or assurance of markets it can provide industry in order to encourage investments which, the suppliers say, me necessary to get technically advanced systems into production.

From the information before it, the panel on current developments in the U.S. concludes that UMTA has the authority to establish conditions for the qualification of new products for capital grants and needs only to act, if it chooses to do so. Likewise, the role of UMTA in developing and selecting hardware-systems, subsystems and components—could be redefined by administrative action, backed by the necessary appropriation **of funds.**

ABSTRACT OF THE REPORT OF THE PANEL ON INTERNATIONAL DEVELOPMENTS

This report discusses recent international developments in Automated Guideway Transit systems. The research and development efforts underway in Germany, France and Japan on PRT and the institutional arrangements for developing and deploying new systems are highlighted.

The stimulus for automated systems in foreign cities is that these cities adapt poorly to large numbers of automobiles. Some older urban areas have suffered physical, environmental and aesthetic damage from excessive automobile use. As a result, many foreign governments are taking steps to arrest further automobile intrusions.

The remedies include preservation and improvement of traditional transit service including tram and bus lines. In addition, the cities are considering AGT systems where transit service is insufficient or nonexistent. In some cities, these remedies are coupled with the creation of auto-free zones. Only walking and transit are permitted in these zones. Sheffield, England, and Grenoble, France serve as examples.

Lower technology AGT systems have not proliferated in Europe and Japan as fast as they have in the United States. One SLT system is in operation in Paris and one in Japan. Also in Japan, three GRT systems are under construction.

Despite lower levels of application than in the U. S., foreign technical research and development is more ambitious. PRT systems are in prototype testing in Japan, Germany and France. If present plans are followed, they will have surpassed United States technological developments in this field in two to four years.

If PRT systems are of interest to United States cities, this country has three options:

- To begin a catch-up program of research and development.
- To attempt to negotiate cooperative development and licensing agreements with foreign governments or companies.
- To import the technology when it becomes available.

Foreign AGT system development, in general, is proceeding relatively faster than it is domestically, in part, because of official attitudes. In the first place, the purpose of AGT installations overseas is primarily to solve urban transportation problems; not to perform limited, special tasks, as it is in the U.S. In addition, uncertainty about the economics of a system (particularly the high technology **systems) is not considered serious enough to halt research and development.**

With these attitudes have come institutional advantages to the developers of foreign systems that are not available to U.S. manufacturers:

France.—A **supplier is selected early in the planning process, He details his design and engineering work for the specific installation, instead of universalizing the product for general sale. He concentrates his efforts, with the cost of competition eliminated. Developers are also advanced "front-end" funds which are paid back from the resulting commercial installations; thus the government also has an incentivre in seeing that the eventual revenue operation is successful.**

Germany.-Suppliers arc funded up to 80% of project costs by the Ministry of Research and Technology. The Ministry finances only those projects which industry considers most viable. The 20% industry share is an inducement to build a profitable system, The developer may retain all patents, rights to data and rights for commercial exploitation.

Japan.—As **in other areas, Japanese transportation development involves cooperative government-industry cartels. Development of the CVS has involved eight industries, partially funded through the Japan Society for the Promotion of**

Machine Industry. CVS is managed by a team from the Ministry of International Trade and Industry and the University of Tokyo. The Japanese Dual-Mode BUS Program involves a consortium of 17 industrial parties.

One particular interesting institutional arrangement is the Urban Transportation Development Corporation in Ontario, Canada. The corporation encourages the participation of other provinces and the federal government in its research and development efforts, thereby aggregating a large enough market to undertake large-scale development, license imported technology, and market the various systems. Sales royalties are used to offset costs of the operation.

In conclusion, a review of foreign programs suggests that there are many institutional arrangements which the U.S. might consider in developing and deploying AGT systems. Foreign installations are not as extensive as those in the U. S., but development programs are more ambitious. The status of technology is comparable, at present, but if present plans are successfully completed overseas, foreign technology will surpass that in the U.S. in two to four years.

ABSTRACT OF THE REPORT OF THE PANEL ON ECONOMICS

This panel examines the reasons for the scanty AGT market that now exists' briefly discusses the probable economics of AGT compared with other transit modes, and recommends an accelerated UMTA research and development program to assess the utility of AGT systems in urban environments.

Properly timed research and development of AGT systems can be expected to yield two results: improved hardware systems and an understanding of the potential of AGT for competing with auto transportation in cities. To the extent that the need for urban arterial highways is reduced, there will be a direct return on the research and development investment. A savings in energy cost over rapid rail will occur if AGT system technology can produce a reduction m the weight of vehicles per passenger. At present AGT hardware is not an improvement over rapid rail with respect to energy cost.

One indication of the size of potential economies of AGT systems lies in the fact that AGT capital costs are projected by UMTA at half the cost of rail transit systems, if both are constructed above ground. More research is needed to test whether the potential AGT cost can be achieved in practice. Research is also needed on the technical and social implications of deploying AGT in already developed areas.

No form of existing transit meets the random access needs of the millions of suburban residents as efficiently as the personal automobile. Once the consumer owns an automobile, use of that auto versus use of mass transit is determined by perceived cost, even though the social costs of urban auto use are undoubtedly much higher.

Therefore, a shift to mass transit could best be achieved by raising the cost of driving a car in congestion-prone areas. Several reputable studies indicate that raising the out-of-pocket costs of auto trips is a more effective method than doing the reverse, that is, lowering transit fares. Political and public opposition, however, have so far made raising auto costs impractical.

The remaining option is to subsidize competing transit modes as heavily as the automobile is being subsidized.

Because of their economic situations, states and localities will not be inclined in the near future to make heavy, additional expenditures for new transit services. If a community or metropolitan area perceives the level of federal transit assistance to be low, the demand for building or improving mass transit will also be slight; the more federal money available, the greater will be the public demand for transit.

The panel finds that the potential benefits nationwide of AGT technology are great enough to justify the high risk investment which AGT research and development will require.

The panel recommends that Federal research and develoment should remain at least as high as five percent of the mass transit budget. In the decade 1963–73, R & D was about seven percent of the total UMTA program; in 1974 the level was about five percent, and in 1975 and 1976 it dropped to about two percent.

R & D programs should include demonstrations of systems in actual USC. Such systems should be built in incremental stages, beginning with small applications of promising technologies and, if these are successful, continuing with progressively larger applications,

The panel recommends that research and development of AGT systems be accclerated so that it does not fall behind in the general UMTA mass transit program and so that the technology can be applied during the period of urban growth expected to end circa 1995.

A critical question is the manpower savings that can be achieved by automation. Depending on the levels of wages and interest rates, the amount that can be economically spent on automation may range up from $100,000 per job saved. However automated systems have yet to demonstrate significant manpower savings in practice. Any savings in operating personnel are largely offset by increased maintenance manpower requirements.

The current UMTA program lacks long-term objectives for AGT. It also lacks hardware specifications and criteria for evaluating AGT systems.

The panel has four major concerns on the current federal AGT research and development program:

- **With regard to the "HPPRT" project, selection of one of three quite different technologies before each is demonstrated could result in selection of a less than optimal technology and prevent development of alternatives.**
- **With regard to the "HPPRT" project, selection of a single company to build the prototype AGT project could reduce future competition** in the transit supply field, because of the enormous competitive advantage of the chosen firm.
- Conduct of research and development without application tends to make R & D a dead-end exercise.
- Use of research and development projects for corporate or government public relations purposes tends to destroy much that could be learned from the projects.

ABSTRACT OF THE REPORT OF THE PANEL ON SOCIAL ACCEPTABILITY

This report examines potential attitudes of a spectrum of interest groups re garding whether or not to introduce an AGT system in a metropolitan com munity.

The panel found five areas of significant public concern, summarized as follows:

Quality of service.—The acceptability of transit service is clearly dependent on quality. The level of availability, area coverage, safety and dependability that are proposed for public AGT systems determine, to a large extent, the social acceptability of the systems.

Relationship to Automobile Use.—Whether AGT is Derceived as an alternative form of transportation for specialized trips, or perceived as a general transportation system will influence acceptability. The manner in which the relationship between AGT and automobile use either evolves naturally, or is regulated, is of public concern.

Cost.—Present knowledge of cost is inadequate. Construction, operation and maintenance costs for AGT are often generalized and Preliminary. First system **implementation costs and capital and 'operational financing arraangements have received little analysis, though financing will directly affect public acceptance.**

Aesthetic and Land Value Impact. The total physical impact of AGT systems, both the appearance and the effect on land values m both business and residential districts, is poorly understood.

Effect on *Development Patterns.* Undoubtedly fixed transit guideways and the travel patterns they create will influence development patterns. However, the extent of influence and the benefits and liabilities which might accompany poorly defined patterns are even less well understood than the four effects already discussed.

The panel makes four recommendations about federal R & D activities:

- Re-evaluate the concept of deriving system performance criteria for PRT directly from the automobile. The current presumption that automated transit must copy the good features of the automobile in order to attract people from their cars may be mistaken. This presumption requires that AGT research and development progress toward pure PRT forms. Instead, the federal government should develop national goals for AGT that match its service characteristics with services not being adequately performed by automobiles. Commuting in critical corridors and access to and circulation within major activity centers are examples.
- initiate a major research effort into the social, political, financial and operational effects of installing AGT systems which are matched with specific, existing transportation needs.
- Establish measures of the benefits and liabilities of AGT to a community so that the value of the system can be weighed by the public during planning stages.

- Develop guidelines for superimposing fixed guideway systems on urban master plans, just as guidelines are developed for adopting major thoroughfare plans or urban development plans and superimposing them on the master plan.

The panel concluded that the general public will support improved transit, particularly as the cost of private transportation rises. The majority of non-transit users, however, are not likely to 'convert to transit without special incentives. If installation of automated transit is accompanied by economic penalties or disincentives to drivers of automobiles, the rising costs could cause this tax-paying majority to balk at transit expenditures, particularly if transit is viewed as "welfare" program. A national commitment to mass transit, the panel concludes, must be accompanied by guarantees of federal financial aid sufficiently large to reassure the local taxpayer that the commitment will be met. Otherwise the taxpayer, who pays added sales tax or whose home is being assessed for the local share of transit projects, will object to the increased taxation.

In conclusion, the panel urges that Federal R & d policy include a program to put several SLT and less sophisticated GRT systems into operation in cities. The panel rejects the contention that SLT and medium- to large-vehicle GRT is ready for use whereVer needed. It is the opinion of the panel that UMTA's present approach neglects the near term need of local communities, and that concentrating solely on the small vehicle GRT type commonly called "HPPRT' will unnecessarily delay putting automated systems into use.

ABSTRACT OF THE REPORT OF THE PANEL ON OPERATIONS AND TECHNOLOGY

This report describes the technological advances necessary to improve upon present installations or to develop more sophisticated types of Automated Guideway Transit systems. The panel began by identifying potential system applications and then developed technological requirements.

The four unanimous findings of the Panel were as follows:

. The moderate headway Group Rapid Transit concept (headways of 15 seconds or more and \'chicle capacities of 15 passengers or more) can provide a technologically feasible and useful transit service at a capacity between that provided by buses and rail rapid transit. GRT line-haul and collection/distribution services combined with other modes are feasible. The present need is to develop the concept to a fully automated operational status, to improve reliability and performance, and to reduce cost and weight of the vehicles and guideway. A small scale urban installation of an improved system is essential to establish design and performance standards, cost data, and the size of the potential market.

. The development of a technological baseline for the Group Rapid Transit concept should be pursued along with the initial staging of a federally owned test facility. The baseline can be used to: 1) provide data on performance, cost, reliability, and safety; 2) formulate specifications for deployable systems; 3) examine performance and cost trade-offs; and 4) examine options in operational mode. The proposed UMTA "HPPRT" program, with reorientation, could provide this development to support and permit expansion of initial simple deployments of group rapid transit technology. The "HPPRT" test facility can also be employed for continued development and testing of various automated transit systems and their components.

. The case for or against the Personal Rapid Transit system concept has not been adequately established. The panel is skeptical regarding the eventual deployment of these systems because of the long-term development requirements, possible lack of economic viability, and the intrusive nature of the fine-grid network of guideways. How-ever, limited funding is justified to clarify the advantages and disadvantages of the PRT concept.

. Because the requirements for development of new technology are dependent on the application, the federal government should interact more strongly with transit authorities in urban areas to consolidate and to define the public transit needs of these areas and the relationship of automated vehicle transit systems to those needs. This interaction is necessary to identify which AGT systems combined with which other modes will most economically meet transportation needs.

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The panel concluded that certain development requirements are common to all Automated Guideway Transit systems, regardless of type. These include:

Automation.— Improvements to performance and reliability of certain critical subsystems such as wayside and vehicle control systems and wayside-to-vehicle communications; development of software techniques to manage vehicle fleets; and development of methods to accommodate failures.

Short headway operation will require improvement in vehicle detection, faster responding equipment, increased accuracy in speed and position control, and development of controlled deceleration profile emergency braking.

Reliability.— Improved definition of reliability goals, improvement in reliability of critical subsystems and components, and development of techniques to minimize the time to restore service in the event of failure. Establishment of a reliability data bank is recommended.

Guideway Cost and lntrusion.-Guideways represent about one-half the system capital cost which warrants effort to develop procedures, designs, and erection techniques to reduce cost. Improved ride quality standards are also required,

System Integration.—Integration of subsystems is necessary to insure that design objectives are achieved. This process requires computer simulation of systems and testing of subsystems and components.

The panel concluded that certain technological development requirements are specific to the different classes of automated systems, as follows:

Shuttle-Loop Transit.—The technology for this class is essentially developed and available for limited operation in urban areas. Systems still require product improvement and production engineering, especially in reliability.

Moderate-Headway Group Rapid Transit (greater than 15 seconds) .—The feasibility of this concept has been demonstrated. Improvement is required in reliability, software development for system management, cost and weight reduction of vehicles and guideway. Vehicle suspension technology trade-offs need to be examined to determine effects on guideway size, cost, foul weather operation, and lateral guidance and switching.

Short-Headway Group Rapid Transit (three to 15 seconds).—This class requires a test facility for integrated system prototype testing with specific attention to improving the responsiveness and accuracy of longitudinal control systems and to the development of a controlled deceleration profile emergency braking system. The potential application of this concept including safety and economic features, needs to be clarified.

Personal Rapid Transit.—Development requirements for PRT include such initial steps as establishing the basic system goals: performance, cost, reliability, service level and development objectives.