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FEDERAL RESEARCH AND DEMONSTRATIONS IN NEW TRANSIT TECHNOLOGY: THE MORGANTOWN, WEST VIRGINIA PROJECT

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FEDERAL RESEARCH AND DEMONSTRATIONS IN NEW TRANSIT TECHNOLOGY: THE MORGANTOWN, WEST VIRGINIA PROJECT

I. INTRODUCTION

A major research and demonstration undertaking by the Urban Mass Transportation Administration (UMTA) of the U.S. Department of Transportation -- in its new systems research, development and demonstration program -- has been the demonstration of automated guideway transit technology in the system between the campuses of West Virginia University and downtown Morgantown, West Virginia. If compared in terms of continuous time spent on the project, money expended, pages of hearings testimony, scope and variety of problems encountered, and resulting controversy, the Morgantown demonstration easily rates as the major new systems research and demonstration project of UMTA since the agency was established.

Because of the substantial cost overruns beyond first estimates and the widely-publicized problems of project management and development of the systems technology involved, the Morgantown project has perhaps come to symbolize the problems of the entire Federal research and development effort in automated transit technology. Besides undermining enthusiasm for continued work in advanced technology and automated transit, the project has apparently produced so strong a desire in UMTA to avoid future Morgantowns and its perceived mistakes that future programs may be unduly constrained, or otherwise distorted, assuming that funds to support such

a research program continue to be appropriated.

This case study report summarizes the background development of the Morgantown project, and describes its present status. The cost history of the project and its immediate prospects are discussed, together with possible effects on other Federal research efforts. A general appraisal of the project and its political context is included.

This report is based mostly on published information except for some discussions with officials of West Virginia University, the City of Morgantown, the Boeing Company, and the Urban Mass Transportation Administration. Other recent reports on the Morgantown project, based on more detailed field investigations of records and accounts and on-site surveys, include an investigation of project contracting and accounting methods by the General Accounting Office.[1/] The Office of Technology Assessment is also preparing a technology assessment report on automated guideway transit technology generally, which may include a more detailed technical assessment of the Morgantown system.[2/]

A summary description of the Morgantown system is attached as Appendix A. Appendix B is a selected bibliography of materials relating to the project.

1/ U.S. General Accounting Office. Staff Study. The Personal Rapid Transit System; Morgantown, West Virginia. Washington, D.C., Apr. 1975.

2/ Office of Technology Assessment. Automated Guideway Transit: An Assessment of PRT and Other New Systems. Washington, D.C., 1975.

II. BACKGROUND OF THE MORGANTOWN DEMONSTRATION PROJECT

Terminology

A digression on terminology is necessary to avoid some confusion in reviewing the background of this project. One of the many obfuscations of concepts and objectives that permeate the Morgantown demonstration effort has to do with technical terminology. UMTA has referred to the Morgantown system as "PRT" or personal rapid transit, a term first coined in the 1968 report Tomorrow's Transportation: New Systems for the Urban Future,[1/] although the system proposed in Morgantown did not have some essential characteristics of PRT as originally defined, such as small one-to-six passenger vehicles, relatively high speed, a guideway network trip origin to destination capability, and very short operational headways between vehicles (less than 3 seconds). The system concept did include, however, automatically controlled operations, a fixed guideway, and off-line stations, all important characteristics of any true PRT system.

Others referred to the Morgantown system as a "peoplemover," in an attempt to distinguish between PRT and the actual Morgantown system. Lately terms like "GRT" or group rapid transit have come into use, indicating automated operations and off-line stations but larger, bus-like vehicles (those in Morgantown carry a total of 20 passengers, 8 seated and 12 standing, at about 15-second headways). A trend now is

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1/ Cole, Leon Monroe, ed. Tomorrow's Transportation: New Systems for the Urban Future. Washington, D.C. U.S. Department of Housing and Urban Development, 1968.

to group all automatically controlled off-line station systems under the more generic label of "AGT" or automated guideway transit.

UMTA now refers to "HCPRT," or high capacity personal rapid transit, i.e., small vehicles, a fixed guideway network, very short headways, off-line stations, and automatic operations as the "true PRT," returning to the original 1968 concept. Throughout the references to this report then, the Morgantown project is referred to as a PRT or peoplemover system, although it is more nearly the latter, according to the original and now recurrent definitions of the concepts.

Beginnings

The idea to build some kind of rapid transit system in Morgantown, West Virginia was first proposed in 1967 by Professor Samy E. G. Elias, now chairman of the Department of Industrial Engineering at West Virginia University (WVU) in Morgantown. Dr. Elias considered a rapid transit system on a separate guideway as a possible solution to the troublesome transportation problems created in the city by the separate locations of the three main campuses of WVU.[1/] Seventeen buses were then in operation by WVU transferring about 1,100 students in hour-long trips to and from the campuses, and adding to the already congested traffic problems caused by the city's narrow streets and steep grades.[2/]

1/ Luter, John. Dr. Elias and the Morgantown El. Aramco World Magazine, v. 24, Mar.-Apr. 1973: 26-32.

2/ Thorp, Bruce E. Transportation Report/Federal Funds for New Transit Systems Going up Despite Criticism of Present Technology, National Journal, v. 4, no. 48, Nov. 25, 1972: 1810.

Two seminars, funded by the 1966 amendments to the Urban Mass Transportation Act of 1964, were held at WVU in the summer of 1967 for management officials of rail and bus systems and transportation engineers. During these seminars, the topic of rapid transit systems for a small city was discussed. Based in part on those seminars, Dr. Elias drafted a proposal which was received at the Department of Housing and Urban Development (HUD), then administering the urban mass transportation program, on June 27, 1967.[1/] Compared with other prior and existing requests for urban transit assistance, the proposal was judged to have little merit, especially considering the small amount of transit assistance funds available to HUD at that time, and the application made no progress.

In July 1968, as part of the Johnson Administration's Reorganization Plan No. 2, most of the urban mass transportation program was transferred from HUD to the newly created Urban Mass Transportation Administration (UMTA) within the U.S. Department of Transportation (DOT).[2/]

Dr. Elias continued his efforts to interest State, university and local officials in the project. In early 1969, he wrote Dr. James G. Harlow, the newly appointed president of WVU, to acquaint him with the proposal and suggest that the appeal for Federal funding be

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1/ Memorandum supplied by the Morgantown/West Virginia University Personal Rapid Transit System Advisory Committee, May 9, 1974.

2/ U.S. Congress. Senate. Committee on Appropriations. Department of Transportation Appropriations for Fiscal Year 1970. Hearings, 91st Congress, 1st session on H.R. 14794. Washington, U.S. Govt. Print. Off., 1969. p. 82.

renewed. Dr. Harlow, brother of Bryce N. Harlow, then counsellor to the President of the United States, sought help as well from Representative Harley O. Staggers of West Virginia's second district, and Chairman of the Committee on Interstate and Foreign Commerce. Arrangements were made, through the efforts of Congressman Staggers and others, for a Morgantown delegation to meet with the then recently appointed Secretary of Transportation, John A. Volpe.[1/]

On June 20, 1969, shortly after the meeting with Transportation Secretary Volpe, the Morgantown study proposal was approved.[2/] A Federal grant in the amount of $100,900 authorizing a study "to determine the feasibility of demonstrating a new mass transportation technology for West Virginia University and the City of Morgantown. . ."[3/] was awarded by UMTA. The estimated total cost of the study was $133,500, including the University's contribution of $32,600.

The sudden transformation of the Morgantown project from a low-priority proposal to the major new system research and demonstration effort in UMTA, despite apparent uncertainties of the suitability of site terrain and location for such a complex and technically risky

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1/ Luter, op. cit., p. 30.

2/ U.S. Congress. Senate. Committee on Appropriations. Department of Transportation Appropriations for Fiscal Year 1970, p. 108.

3/ Urban Mass Transportation Demonstration Grant Contract between the West Virginia Board of Regents on behalf of West Virginia University and the United States of America, Contract No. DOT-UT-153, Oct. 6, 1969, p. 1.

project, has raised some questions about the objectivity, competence, and freedom of decision of the UMTA program management. With little doubt the Congressional district location of the project and its other political advantages, including potentially enhanced relationships with senior White House personnel, were attractive to the new Transportation Secretary. It should be noted also, that according to contemporary public pronouncements, Mr. Volpe was extremely eager to achieve tangible results for a research and development program whose lack of any perceptible accomplishments had created some increasingly sharp Congressional criticism. The Morgantown project proposal perhaps seemed simply to be a timely and fortuitous opportunity, at a relatively advanced stage of development, with potential program and political benefits to be realized in several ways simultaneously.

The following excerpts from hearings testimony are illustrative of the attitude of Mr. Volpe regarding research and demonstration at that time. On September 29, 1969, Mr. Carlos C. Villarreal, then UMTA Administrator, in response to a question from Congressman Edward P. Boland regarding an evaluation of UMTA, replied, "We have many things to do. The Secretary has placed the problem of urban transportation as the No. 1 priority of his Department."[1/]

1/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1970. Hearings, 91st Congress, 1st session. Part 2. Washington, U.S. Govt. Print. Off., 1969. p. 782.

The following day at Senate appropriations hearings, Mr. Villarreal stated, "We are attempting to redirect the public transportation program to make it action-oriented with discernible results that can be viewed by the Congress, the cities and the citizens of this country. . . I would like to assure you that the theme of Secretary Volpe, and myself, is action."[1/] In reply, former Senator Gordon Allott of Colorado commented, "The thing that leaves Members of Congress at a loss. . . is that all of these research programs are always stated in such general terms that we are very rarely able to identify results, definite, tangible results that come from research programs. And I would hope next year when you come up and in this year, the intervening year, you would keep your eye upon the research program with this in mind."[2/]

Mr. Villarreal's statements at the House appropriations hearings in April of the following year also stress the shift of emphasis within UMTA from research and study efforts to hardware demonstration projects,[3/] further reflecting the "action-oriented" policy of Secretary Volpe. It was this program management and political context into which the Morgantown proposal was reintroduced in 1969.

1/ U.S. Congress. Senate. Committee on Appropriations. Department of Transportation Appropriations for Fiscal Year 1970, p. 170.

2/ Ibid.

3/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1971. Hearings, 91st Congress, 2nd session. Part 3. Washington, U.S. Govt. Print. Off., 1970. pp. 10-11.
Hearings held on Urban Mass Transportation Administration Appropriations, Apr. 15, 1970, Washington, D.C.

An additional Federal grant of $20,000 awarded to WVU on March 13, 1970,[1/] financed further study of three proposed systems: the Alden Capsule Transit System, by Alden Self-Transit System Corporation, of Bedford, Massachusetts, the Varo Monocab System, by Varo, Inc., of Garland, Texas and the Dashaveyor System, by Dashaveyor Company, of Los Angeles.[2/]

WVU reviewed the systems studies submitted by the Varo, Dashaveyor, and Alden companies and selected the Alden system as most suitable. Based on data developed in the feasibility study, completed on August 5, 1970, the West Virginia Board of Regents on behalf of WVU submitted an application to UMTA for a capital grant, under section 3 of the Urban Mass Transportation Act of 1964, for design and construction of a 6-station, 3.6-mile guideway, 100-vehicle system. The total estimated cost was $18 million, with the Federal share to be $13.5 million. As stated in the application, the objectives of the WVU Board were to 1) demonstrate the feasibility of a new transportation concept for the immediate needs of a mid-sized urban community or major activity center; and 2) design, develop, test and introduce into passenger ser-

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1/ U.S. Congress. Senate. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for Fiscal Year 1971. Hearings, 91st Congress, 2nd session on H.R. 17755. Part 1. Washington, U.S. Govt. Print. Off., 1970. p. 854.
Hearings held on Urban Mass Transportation Administration Appropriations, Aug. 10, 1970, Washington, D.C.

2/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1971, p. 122.

vice a PRT system that would solve the university's and Morgantown's present and future transportation needs. WVU requested that the project be conducted under its own management.[1/] The university also recognized the uncertain and preliminary nature of the data on which the cost estimates were based, and stated that the figures would be reworked no later than 6 months after the grant was approved.[2/]

Expansion and Shift to UMTA Management

Soon after receipt of the WVU application, UMTA decided that "in order to achieve national relevance, tighter experimental design and development of reproducible equipment, facilities and methods [it would] retain management responsibility for the project."[3/] An agreement between UMTA and WVU was reached in which the university would make its own real estate available at no cost to the project and would acquire

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1/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1972. Hearings, 92nd Congress, 1st session. Part 3. Washington, U.S. Govt. Print. Off., 1971. p. 471.
Hearings held on Urban Mass Transportation Administration Appropriations May 18, 1971, Washington, D.C.

2/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1975. Hearings, 93rd Congress, 2nd session. Part 4. Washington, D.C., U.S. Govt. Print. Off., 1974. p. 725.
Hearings held on Urban Mass Transportation Administration Appropriations Apr. 24, 1974, Washington, D.C.

3/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1972, p. 471. UMTA statement for the record.

any additional properties required for right-of-way.[1] "In view of the community and university interest exhibited and of the groundwork already accomplished, UMTA found the conditions suitable for immediately starting the project activities."[2]

Upon assuming management responsibility of the project and shifting the funding arrangement from the capital grant program to the research and demonstration program budget, UMTA selected the Jet Propulsion Laboratory (JPL) of the California Institute of Technology to be systems manager for the entire demonstration project in September 1970. DOT officials also announced then that the project would be dedicated and operational by October, 1972. A contract with Alden Self-Transit Corporation, which had been working with WVU on the University's design and cost estimates, was canceled and system subcontracting work put open to competitive bidding.

JPL re-estimated the costs of the complete system and submitted an estimate of $37.4 million in March 1971. "This cost, although still based on incomplete engineering data, indicated that WVU had substantially underestimated the magnitude of the effort

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1/ Legally, the local party to the contract is the West Virginia Board of Regents, on behalf of the university.

2/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1972, p. 471. UMTA statement for the record.

required. . . the increase was primarily in the construction area."[1/]

In April 1971 Secretary Volpe announced that JPL had selected the Boeing Company of Seattle, Washington and the Bendix Company of Ann Arbor, Michigan as subcontractors, with contracts under negotiation in the amount of $4 million dollars. Boeing was to develop and construct prototypes of the vehicle system and the Bendix Company was to design and develop the automated control and communication system. A third firm, Frederic R. Harris, Inc. of Stamford, Connecticut was awarded the contract for architectural and engineering design work on the system's structures, guideways, and power distribution.[2/]

Change in Demonstration Contract Structure

Concerned with the greatly increased cost estimates for completion of the original scope of the project (6 stations and 100 vehicles) and thus the wholly untenable burden on the research and demonstration program budget, UMTA moved to separate the project into two contract phases, with only the first phase to be continued under the research and demonstration budget. Phase II would be supported by a much larger source of UMTA funds, the capital grant assistance program. "Recently we reviewed the costs and came to the conclusion that providing a full-

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1/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1975, p. 725. Statement for the record submitted by Mr. Frank C. Herringer, UMTA Administrator.

2/ Press Release. U.S. Department of Transportation, Urban Mass Transportation Administration, DOT--7571, Apr. 28, 1971.

scale service was more than we could tolerate, that our demonstration objectives could be achieved by less than a full-scale service. We therefore, in concert with the University, agreed to a reduction in scope. . . from 3.5 miles to 2 miles, from six stations, to three stations and from $37 million to $28.3 million."[1/]

To help support the separation, UMTA formally asserted that the reduced scope of Phase I would satisfy the major research and demonstration objectives of the project, and would "verify the PRT system concept."[2/] The JPL cost estimate for the reduced, 3-station, 5-vehicle system was originally $23.5 million, later raised to $28.5 million.[3/]

A limited demonstration of the partially completed Phase IA system and vehicle was conducted at the much-advertised dedication on October 24, 1972.[4/] Phase IA, "construction of a 3-station, 5-vehicle system with limited operational software and associated equipment to

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1/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1972, p. 472. Statement of Dr. Robert A. Hemmes, UMTA assistant administrator for program demonstrations.

2/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1973. Hearings, 92nd Congress, 2nd session. Part 2. Washington, U.S. Govt. Print. Off., 1972. p. 873. Mr. Bernard J.Vierling, Morgantown Project Director, statement submitted for the record.

3/ Ibid.

4/ Press Release. U.S. Department of Transportation, Urban Mass Transportation Administration, UMTA 72-92, Oct. 24, 1972.

test the feasibility of the system" was declared complete on June 30, 1973. Actual costs of Phase IA proved to be $40.4 million, instead of the $36.9 million revised estimate, and the $23.3 million initial Boeing estimate.[1/]

Phase IB of the contract procured 40 more vehicles, an expanded communication and control system, improved operational hardware, expanded maintenance facilities, guideway heating, tools, test equipment; spare parts, training, maintenance facilities, and demonstration and testing of the system in accordance with Phase IB specifications.[2/] The total fixed cost of Phase IB additions is $19.4 million.

1/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1975, p. 726.

2/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1974, p. 809.

Change in System Managers

JPL remained as systems manager until July 1971 when it withdrew, apparently because of several disagreements with UMTA, and was replaced in August 1971 by the Boeing Company.[1/] Some UMTA officials were quoted in a later news report as saying that since the supersonic transport contract had been killed by Congress in 1971, senior Administration officials had directed them to transfer management of the Morgantown project to "Seattle's Boeing Company, which had been developing the plane."[2/]

When the Boeing Company assumed responsibility as systems manager for the project, a new cost estimate of $27.4 million was issued, still based on incomplete design and system definition. As firm bids based on complete design were received the cost estimates, even for the reduced, 3-station system, again increased substantially. The Boeing Company estimate released on February 11, 1972 was $36.9 million for 3 stations, 2.2 miles of guideway, 5 prototype vehicles, the software system, test and evaluation work, and a 1-vehicle maintenance facility.

1/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1974. Hearings, 93rd Congress, 1st session. Part 1. Washington, U.S. Govt. Print. Off., 1973. p. 889.
Hearings on Urban Mass Transportation Administration Appropriations Mar. 27, 1973, Washington, D.C. Statement for record submitted by UMTA Administrator, Mr. Frank C. Herringer.

2/ Lindsey, Robert. U.S. May Raze Its $57 Million Showcase People-mover. New York Times, Apr. 13, 1974: 1 and 26.

By the time the systems manager change was in effect, Boeing had essentially a one-year deadline to have the system ready for an operational demonstration at the dedication in October 1972, three weeks before the Presidential election.[1/]

Current Project Status

Originally scheduled for completion in December 1974, Phase IB is now expected to be completed after June 1975. Upon completion of the acceptance testing under Phase IB of the contract, the Boeing Company will turn the system over to UMTA. Work on the 3-station, 2.2-mile guideway system is now nearly 100 percent complete. One week of formal acceptance testing of the entire system must be successfully completed to meet the terms of the Phase IB contract. The system must operate successfully in a quasi-revenue sense (no passengers) in both on-demand and scheduled modes of operation.

Currently 42 persons, employed by WVU, are being trained to operate and maintain the system after Boeing departs the scene, and operations manuals are being prepared. Boeing at present has no contract with WVU for any subsequent work on the system after completion of Phase IB, although Boeing will provide spare parts for the system to WVU for 6 months after contract completion.[2/]

1/ Wilson, Andrew. Morgantown's 'People Mover': A Little Engine that Couldn't. The Washington Post, June 3, 1974: C-3.

2/ Mr. Arthur E. Hitsman, Manager, Surface Transportation, The Boeing Company, in a discussion on January 20, 1975.

Problems Remaining

Major questions of the future of the Morgantown system and its ultimate cost remain unresolved. Even if the Phase I system operates successfully, WVU has not wanted to accept the Phase I system because, according to WVU officials, it does not meet the original intent of the demonstration project: a 6-station, approximately 100-vehicle, fully operational system. A central issue has been whether or not the Federal Government is committed to a 6-station system, the original system contemplated in 1970.[1/] As long as WVU does not accept the system, "the specter of having to remove the system hangs over the project."[2/]

WVU officials assert that the 3-station Phase I system would be of very limited value to the university, and since it does not serve the Medical Center and a sports coliseum, it will not serve the citizens of Morgantown. Costs to complete the project to the 6-station, 100-vehicle configuration, with an additional 1.5 miles of guideway, have been estimated by the Boeing Company to be over $53 million. In addition, WVU has requested that UMTA pay for operating and testing the system for one year before a final acceptance decision is made by WVU officials.[3/]

1/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1975, p. 479.

2/ Frank C. Herringer, UMTA Administrator, in testimony before the Transportation Subcommittee, House Committee on Appropriations, May 5, 1975.

3/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1975, p. 478.

The UMTA position has been that upon completion of Phase IB of the contract, the research and demonstration objectives will be essentially accomplished, perhaps after a period of operational testing with passengers, even though the 3-station system configuration will not serve completely student travel origins and destinations among the three WVU campuses and downtown Morgantown. UMTA awarded a contract to examine alternative methods to alleviate traffic congestion and student travel problems in Morgantown as possible candidates for capital grant assistance, in substitution for expanding the 3-station system to the originally contemplated 6-station, 100-vehicle system. UMTA has maintained the Phase I system can be made a part of a total campus transportation system adequate to WVU needs for considerably less than $50 million. Also, "there are virtually no research objectives to be satisfied by going to a 6-station system, assuming the 3-station system will carry passengers."[1/]

The demonstration grant contract, Phase I, between UMTA and WVU Board of Regents signed on September 4, 1971, provided, among other things, for three stations connected by approximately two miles of double track guideway, and a control and communications system "required for automatic operation of the total transit system, designed to accommodate further expansion up to 100 vehicles and six stations."[2/]

1/ Ibid., p. 484. Compare the statement in footnote 1/, page 36 of this report.

2/ Urban Mass Transportation Demonstration Grant Contract between West Virginia University, Morgantown, West Virginia and the United States of America, Contract #DOT-UT-546, Part I. Sept. 4, 1971, p. 2.

The contract further states: "UMTA will test and evaluate the system, and generate the necessary data to ensure the reproduceability [sic] and utility of the system in nation-wide locations that may have similar transportation needs. Successful completion of this Project will qualify this system concept for capital grant in appropriate locations." 1/

It is questionable whether that language alone is sufficient to indicate unambiguous intent on the part of UMTA to guarantee completion of a 6-station system in Morgantown.

WVU officials, however, wanted UMTA to guarantee a capital grant for $50 million to complete the 6-station system. Otherwise the 3-station system would not be acceptable to WVU, necessitating its removal by UMTA. This condition is in Section 3, Part I, page 3, the 1971 contract, which reads:

> "Possession of all Personal Rapid Transit System-connected facilities and equipment shall vest in the Public Body [the West Virginia Board of Regents] after completion of the UMTA Technical Evaluation of the system. The Public Body may request removal of the facilities, if the system does not meet the intent of the specifications described hereafter and cannot be brought up to minimum performance standards within one year. Under these circumstances UMTA will take the necessary steps to remove the facilities." 2/

This clause was inserted in the contract by Mr. Carlos Villarreal, former administrator of UMTA, according to WVU President James G. Harlow. 3/

1/ Ibid.

2/ Ibid., p. 3.

3/ Statement during a discussion on January 20, 1975.

Thus the possibility was contemplated that the Federal Government may have to dismantle the system at an estimated cost of $7 or more million dollars.[1/]

On April 24, 1974, UMTA Administrator Frank C. Herringer stated, "I have indicated to the university that if we decide that a $50 million extension is not reasonable and the university then says they won't accept the three-station system, then we will take it out. I do not want the university to feel that we are not willing to take it out under any circumstances and that they can essentially ask us for anything they want. I feel we have to draw the line somewhere and express our willingness to live up to the original contract and take it out. I would rather spend $7 million on taking it out than to spend $50 million on building a system that I can't justify to you."[2/]

In May 1975, however, a temporary solution to the stalemate outlined above was suggested by the UMTA Administrator, in four parts:

1) UMTA would assist WVU with "start-up costs" of the Phase I system, through capital grant and research and development funds; and

2) UMTA will fund, with a capital grant, the architectural

1/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1975, p. 485.

2/ Ibid., p. 479. This comment was later clarified to read "If the system cannot be justified, then I would rather. . ." See U.S. Congress. Senate. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations on H.R. 15405. Part 2. Washington, U.S. Govt. Print. Off., 1974. p. 1248.

and engineering design of a system expansion to five stations.

3) If the system operates properly, and if the costs of the expansion can be reduced significantly from first estimates through economic design and the elimination of one station, UMTA "would expect" to approve a capital grant for the limited expansion.

4) In return, WVU would agree to accept the present Phase I system, assuming that it meets agreed-upon performance standards after on-going acceptance tests are completed.[1/]

Estimated costs of this compromise solution are about $4.3 million, not including the $35 to $53 million capital costs of the system expansion.[2/]

While the ultimate destiny of the Morgantown system is still unsettled -- there are significant "ifs" and assumptions in the above agreement -- a demolition showdown has been postponed for at least one year. Final resolution of potential controversies concerning the system might well end in the courts.

1/ Frank C. Herringer, in testimony before the Transportation Subcommittee of the House Committee on Appropriations, May 5, 1975.

2/ UMTA estimates. The agreement was announced on May 20, 1975.

III. COST SUMMARY AND ANALYSIS

Summary of Major Cost Elements[1/]

In response to inquiries made at appropriations hearings for fiscal year 1975, of both the House and Senate transportation subcommittees, UMTA prepared a summary of the cost history of the Morgantown Project, as displayed in Table I. It can be determined from Table I that "all areas of the project were significantly underestimated. However, the greatest cost impact was due to the construction of the guideway, stations, and maintenance facility. Actual Phase IA construction costs were 131 percent above that estimated and accounts for 57 percent of the total Phase IA cost for system design, construction, installations, operation, and test."[2/] [sic]

Early in 1973, UMTA negotiated a contract with the Boeing Company establishing a not-to-be exceeded ceiling of $19.4 million for Phase IB of the project, or for a total $64.3 million ceiling cost for the 3-station, 45-vehicle system. According to the terms of the contract, Boeing must satisfactorily complete Phase IB at no more cost to the Government than the negotiated cost ceiling. If unavoidable delays in

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1/ For a more detailed exposition of the cost experiences and contract amendments of the Morgantown project, see the U.S. General Accounting Office Staff Study, op. cit., pp. 16-25.

2/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1975, pp. 725 and 726.

TABLE I: MORGANTOWN COST ESTIMATE HISTORY

($ millions)

DATE	ESTIMATES OF TOTAL COST	CONSTRUCTION	VEHICLE	COMMAND	PROG. MGMT. SYSTEM ENGINEERING I&CO & OTHER*	NOTES
8-15-70	13.5	10.0	1.8	1.3	0.4	6 stations, 3.7 guideway miles, 100 vehicles
3-19-71	37.4	21.1	6.4	6.0	4.0	
4-26-71	23.3	11.6	4.6	4.4	2.7	3 stations, 2.2 guideway miles, 5 prototype vehicles, R&D software, test and evaluation, one-vehicle maintenance facility
2-11-72	36.9	20.3	4.4	6.2	6.0	
Phase I-A actual cost (completed 6-30-73)	40.4	23.1	4.9	7.9	4.5	
Phase I-B additions	19.4	2.7	4.1	5.7	6.9	Guideway heating, revenue service equipment, maintenance facility, 45 vehicles, operational software, safety improvements, reliability improvements, acceptance testing and system demonstration

* Other includes safety and reliability engineering, training, spares, operational, maintenance, and test support equipment.

NOTE: JPL, WVU, TSC and other support costs in the amount of $4,500,000 constitute the remainder of the total $64,300,000 Morgantown PRT budget and are not shown here.

Source: U.S. Department of Transportation, Urban Mass Transportation Administration, April, 1974.

deliveries, or other delays occur, the contract schedule may be stretched, but no cost increases are allowed.[1/]

Analysis of Cost Escalations

Apparent cost overruns of about three and one-half times the original cost estimate of $18 million, to $64.3 million for about half of the original system,have generated much concern in Congress and elsewhere. An analysis of the reasons for the errors in cost estimates was prepared by UMTA for the fiscal year 1975 appropriations hearings. According to UMTA, it is difficult to determine all the causes for the cost escalation, but some specific reasons are known, and can be grouped as follows:

1. Government, industry and university participants failed to recognize the complexity of an automated transit system which had to safely and reliably accomplish functions without the intervention of a human operator. The system was viewed as the bringing together of existing automotive and electronic components representing State-of-the Art technology and thus requiring a minimum R&D effort. It was not recognized that significant R&D advances were required at the system level to accomplish design objectives. The fact that the system was a first-of-a-kind with the usual attendant complexity of such an effort was simply not appreciated.

2. The initial system definition and subsequent cost estimates were based on a feasibility study rather than a system specification with established requirements for maintainability, reliability, and safety. This was the first major new system demonstration and acceptance of the initial cost estimates reflect an overeagerness on the part of all to begin the project.

1/ U.S. Congress. House. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for 1975, p. 722.

3. Similarly in 1970, a 2-year schedule was accepted as realistic, in spite of the warnings of experienced personnel that it was unrealistically tight.

4. There developed some confusion between the subtleties of two different objectives, namely:

    a. To develop a specific system for the WVU needs at Morgantown.

    b. To develop a generic, general purpose system which could be deployed in any city of the Nation.

    The impact of these objectives was significant on the design. For example, environmental requirements of locations other than Morgantown had to be considered, adjustments in vehicle size and performance were needed to provide for broader application, and the software design objective was changed so that the developed system could be expanded to support a growing passenger demand. The impact of these changes was felt in each subsystem; however, the changes were necessary to assure potential application in other locations. Once studies of these changes were made and a design cost established, some compromise of the more ambitious objectives had to be made.

5. The initial intent was to develop a "Demonstration System" (including revenue type service demonstration); however, as more realistic, refined cost estimates were obtained and exceeded the available funding, the scope of the program was materially reduced, including a temporary compromise for Phase IA away from "Demonstration" to system R&D.

6. As this process of unclear and redefined objectives accumulated costly project time was wasted, resulting in insufficient time to do the initial R&D phase adequately under Phase IA.

7. The schedule precluded the usual testing and evaluation of subsystems and components prior to hardware fabrication. As a result, significant design problems were encountered at Morgantown which required excessive field testing to identify design deficiencies and numerous modifications were necessary to make the custom designed units function properly.

8. The BART[1] safety problem in 1972 triggered an intensive and costly safety review and analysis which resulted in further design changes that substantially increased project costs.

9. Significant cost increases were incurred in the construction of the guideway and station due to the accelerated construction approach and extensive overtime to support the established schedule. Construction, in general, has experienced significant escalation nationwide during the past few years, but additional specific problems were encountered in Morgantown due to unique terrain and a shortage of construction tradesman in the area. 2/

1/ The Bay Area Rapid Transit system in the San Francisco area.

2/ U.S. Congress. Senate. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for Fiscal Year 1975, pp. 1255 and 1256.

Capital and Operating Cost Projections

When asked by UMTA in September 1973 to prepare an application for a capital grant to support Phase II of the contract, WVU in turn requested the Boeing Company to prepare a cost estimate to complete the 6-station, 3.6-mile guideway system. The estimate submitted by Boeing amounted to about $50 million, compared to the $25 or $30 million anticipated by UMTA.[1/]

Operating and maintenance costs for the 3-station, 45-vehicle system are estimated by Boeing to amount to $850,000 per year (in 1972 dollars, using WVU wage rates).[2/] The operational and maintenance cost estimates are based on aggregates of 40 percent for labor costs, 40 percent for parts and machinery, and 20 percent for power.

The full 6-station, 100-vehicle system would carry operational and maintenance costs of about $1.1 million per year as a 10-year average, according to WVU officials, again using 1972 dollars.[3/] The annual operating budget of WVU is about $120 million and to help defray the anticipated burden of system operation and maintenance, WVU plans to assess students $50 per year each for use of the automated system. Currently students pay $9 per year each to support the existing

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1/ Ibid., pp. 1228-39.

2/ Mr. Arthur E. Hitsman, Manager, Surface Transportation, The Boeing Company, in a discussion on January 20, 1975.

3/ Dr. James G. Harlow, President, West Virginia University, in a discussion on January 20, 1975.

bus system.[1/]

Finally, statements of costs to demolish the 3-station system have ranged from $6 to $18 million, but apparently no detailed cost estimates have been made.[2/]

Project Costs in Perspective

Since fiscal year 1971, budget allocations for the Morgantown demonstration project have ranged from 30 to nearly 70 percent each year of total budget allocations for the new systems research and development subactivity in UMTA. The largest percentage share for the Morgantown project was recorded in fiscal year 1972. Overall the Morgantown project has been allocated approximately 20 percent of the total UMTA research, development and demonstration budget since fiscal year 1971.

Much has been made by critics of the presumed profligate waste and immense cost overruns in the Morgantown project. Some general comparisons of Federal research and development expenditures in other civilian programs may help to place the $64.3 million research and development total current cost of the Morgantown project in a more useful perspective.

Direct Federal obligations for another high-technology, hardware development program, the supersonic transport aircraft, amounted to

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1/ Mr. Earle T. Andrews, Member, West Virginia Board of Regents, in a discussion on January 20, 1975.

2/ See for example U.S. Congress. Senate. Committee on Appropriations. Department of Transportation and Related Agencies Appropriations for Fiscal Year 1975, pp. 1238 and 1417.

nearly $1 billion in the 1965 to 1975 decade, excluding related research conducted by the National Aeronautics and Space Administration (NASA). Obligations for conduct of research and development in aeronautical technology by NASA amount to an estimated $166 million in fiscal year 1975 alone.

In another hardware-development program, high speed ground transportation research and development, obligations since fiscal year 1971 amount to more than $146 million. Research and planning grants obligations under the Federal Highway Administration have amounted to more than $300 million since fiscal year 1971. In fiscal year 1975 alone, total Federal obligations for the conduct of civilian (other than space) research and development will be an estimated $18.0 billion.[1/]

1/ Special Analyses, Budget of the U.S. Government for Fiscal Year 1976, p. 252.

IV. OBJECTIVES AND PERFORMANCE

To critics the evolution of the Morgantown demonstration project has seemed like a case of incompetents struggling to meet confused objectives and arbitrary deadlines, and proceeding cost-ineffectively. An objective appraisal, however, should consider the technical and political contexts in which the project was initiated and developed, and the multiplicity of concurrent objectives which were and are being sought. Stated objectives for the project appear to have shifted and to have been redefined through time as realities have intruded upon aspirations, both of UMTA and WVU. It appears as well that internal political purposes also importantly affected the course of development of the project.

For example, it is difficult not to conclude from the record and materials that the main original intent of the university in submitting an application for capital grant assistance was to seek relief for a local transit and student commuting problem. In a statement in January 1975, however, WVU President Harlow asserted that such expenditures of Federal and university funds, even at the original $13.5 million estimated Federal share, could never be justified for that purpose alone. Establishing WVU as a "national transportation laboratory" of benefit to the nation was always the prime purpose of the WVU

involvement,[1] with relief of student commuting problems only secondary, according to President Harlow.[2] UMTA also has redefined the published scope and purposes of the project and of its commitment to the project, and has reorganized the project management structure and personnel several times as costs escalated.

In order to appraise the Morgantown project systematically within the limits of this report, the demonstrated or probable performance of the operational system can be compared to the major objectives of the project, those publically stated, and the presumed internal political objectives as well. Publicly-stated general objectives of the Morgantown project can be categorized as : the "national research and demonstration" objective, and the "local traffic relief" objective.

National Research and Development Objective

Under the "national research and demonstration effort" rationale, these questions among others, can be raised: How applicable are the engineering and technical concepts developed at Morgantown to construction of similar systems elsewhere? How valid is the cost history of Morgantown for estimating costs of other system developments? How

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1/ The West Virginia Board of Regents grant application in 1970 did list as a third objective the attainment of a transportation research facility at WVU. Expenditures of capital grant funds for such a university purpose were not authorized under the Urban Mass Transportation Act of 1964, however, a limitation perhaps not known to WVU officials.

2/ Dr. James G. Harlow, President, West Virginia University, at a luncheon January 20, 1975.

valid is the concept of Morgantown and WVU as a life-size laboratory to investigate the socio-economic behavior of users of advanced, automated transit systems? These questions are examined below with respect to engineering and technical performance of the Morgantown system, and its usefulness as a laboratory for testing user behavior and economics of operation.

Engineering and technical performance: Without much question, the final vehicle and control system technology and engineering, when finally tested and accepted will be of high quality and the most technically advanced in revenue operation anywhere in the world. With regard to detailed technical and engineering competence of the Morgantown system, about the same kind of technical quality and competence evident in Boeing commercial aircraft will doubtless be evident in the Morgantown vehicles, within the limitations of the overall systems engineering.

Because of systems design limitations, however, the local terrain and climactic conditions peculiar to Morgantown, and the guideway design, some technologists estimate that very little of the specific Morgantown system hardware, and less than one-third of the control systems technology will be directly transferable to other system demonstrations. Nor can much reliance, in planning other demonstrations, be placed on the cost history of the Morgantown experience because of the confused objectives and project management, the unexpected costs of external events like poor weather, and arbitrary time requirements pressed on the demonstration project.

A most significant finding of the demonstration, however, of potentially great use elsewhere, is that automated guideway transit systems are by the nature of their technical and operational requirements much more costly than originally assumed. When the "New Systems Study," the genesis of most of the subsequent activity in application of high technology systems and components to public transit operations, was being conducted by the U.S. Department of Housing and Urban Development in 1967 and 1968, an assumption then held generally was that high technology systems like PRT would cost out roughly the same per vehicle-pound as automotive industry technology, then about one dollar per pound. (For comparison, transit buses cost about $4 per pound, rail transit cars about $7 per pound, the Boeing 747 jet aircraft technology costs about $65 per pound, spacecraft technology about $1,000 to $2,000 per pound.)

From the Morgantown experience, even discounting any excess cost or waste because of the special conditions of that demonstration, it is rather abundantly clear that the early assumption was in error, and that a per pound cost of perhaps $10 to $13 is more realistic for high-technology transit systems. Under the operating and safety requirements required by an automatically-controlled system, commercial television technology in electronic circuity and standard automotive technology in mechanical components simply are not adequate. Hence, the greater cost.

Another original argument in support of automated systems was the cost savings to be realized because of reduction in labor needed to operate the system. While it is true that the need for vehicle operators is essentially nil in an AGT system, maintenance costs, because of the necessary higher standards of maintenance required, may be much higher than for conventional transit systems. It is still unwise to presume too much about operational maintenance costs on automated systems, however, in view of their extremely short or non-existent history in revenue service.

Aside from vehicle and control technology and costs, it should be noted that the concrete and steel guideway for the Morgantown system represents about 40 percent of the total cost of the project. There has been considerable criticism of the engineering and design of the guideway, and of its aesthetic impact. With regard to design, the guideway did win a 1972 award of the National Society of Professional Engineers as one of the nation's ten outstanding engineering achievements of that year, and the "guideway across Monongahela Boulevard was cited as one of the 18 most beautiful new steel bridges to be built."[1/]

Critics of the guideway say it is grossly overdesigned, mainly to meet unreasonably small tolerances for deflection of the guideway

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1/ Personal Rapid Transit, a brochure published by the West Virginia Board of Regents, 1316 Charleston National Plaza, Charleston, West Virginia, n.d., n.p.

beams. Defenders of the engineering design firm, Frederic R. Harris, Inc. of Stamford, Connecticut, say that the design parameters were set by "over-cautious, inexperienced theoreticians at Cal Tech and JPL. . . and added 20 percent to the cost of construction."[1/] Another cost inflator of the total system, critics assert, was the bad engineering management at UMTA. One example cited was the decision to go to "concurrent" planning or engineering as a result of politically imposed deadlines.[2/] Thus, by the time the Boeing Company entered into the vehicle design work, the guideway design was fixed and largely in concrete. Many subsequent vehicle and control systems engineering decisions were importantly affected by fixed guideway configurations.

Laboratory for Testing User Behavior: An argument that the Morgantown demonstration was justified as a national research and development effort in order to gain insight into the behavior patterns of users of AGT systems raises some questions, other than the obvious one of research benefits measured against project costs. The City of Morgantown has a population of some 30,000 persons, 17,000 of which are WVU students, another 6,000 university employees. That this relatively remote and pleasant college town provides a representative socio-economic and demo-

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1/ Mr. Earle T. Andrews, Member, West Virginia Board of Regents, in a discussion on January 20, 1975.

2/ "Concurrent" design and development is a systems management euphemism for trying to do everything at once to meet a tight deadline.

graphic profile of urban communities in the United States, suitable for extrapolation of social research findings to other urban locales, seems improbable. Nonetheless, this research continues to be a professed objective for continuing Federal expenditures on the project.[1/]

"Local Traffic Relief" Objective

WVU officials feel that the highly publicized cost overruns and technical problems of the project has reflected unjustly and unfavorably upon their own management and stewardship of WVU interests in their attempt to resolve campus traffic problems. They assert that all of the cost and technical problems are the sole responsibilities of UMTA, and that WVU was mostly on the sidelines after UMTA assumed management of the project. The actual capital cost to the university to date, however, has been relatively modest, about $1 million for additional land for right-of-way, and a small amount of training funds.[2/]

Although some WVU officials now explain that local and student traffic and congestion relief was never a primary purpose of the application for assistance and the pursuit of the demonstration, the published material about the project indicates otherwise. Supposing that

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1/ "The dramatic payoff is still to come [from Morgantown] from research on how people will interact with automated systems. These questions still need to be studied." Statement by UMTA Administrator Frank C. Herringer, in testimony before the Senate Appropriations Subcommittee on Transportation, May 20, 1975.

2/ Dr. James G. Harlow, President, West Virginia University, at a luncheon January 20, 1975.

such an objective was in fact important, if not primary, can the Morgantown project be considered an efficient alternative?

The problems of commuting time at large, multi-campus universities is not uncommon, and many alternative solutions not involving massive spending for high-technology systems are of course possible. A more distributed schedule of classes is an obvious approach, both by day and through the week. For example, students could spend an entire day at one campus location, another day at another campus. Relocation of university schools and colleges and other activities within existing structures and campuses could be feasible to support such schedules. Considering the estimated total cost of $120 million or more for the complete 6-station AGT system, or $112 million for a 5-station system, the alternative of simply moving the present downtown campus in toto to the new campus location arises. Although asset value figures were not provided by WVU, the assessed value of university property in Morgantown for 1974 was $85 million according to the Morgantown City Manager, or an actual market value of $170 million.[1/]

Assuming these figures are even approximately correct, it is easy to agree with the statement of President Harlow that the Morgantown project as an "effort to satisfy transportation needs in Morgantown"

1/ Mr. James A. Ashborn, City Manager, City of Morgantown West Virginia, September 12, 1974.

rather than a "significant test of an innovative transit system of national importance" is "total nonsense."[1/]

"Political" Objectives

It is common among critics of the Morgantown project to suggest that most mistakes in estimates, and designs, and errors in judgement were caused by the time pressures generated by a tight political deadline: the system had to be demonstrated in October of 1972, before the Presidential election of that year. That deadline was set and pursued at the energetic behest of then Secretary Volpe, whose guiding philosophy at the time, as he often stated, was one of action and results, not of more studies and research. Mr. Volpe also seemed understandably desirous of making a mark in the new Administration, and of establishing close rapport with an influential Congressional committee chairman and with senior White House staff. In another's words, the former Transportation Secretary "wanted to put an apple on teacher's desk."[2/]

1/ Dr. James G. Harlow, President, West Virginia University, at a luncheon January 20, 1975.

2/ Ibid.

Effects of Political Deadlines: The arbitrary and politically inspired deadlines, the desires for the most "sophisticated" technology, and terrain and climatic problems (steep grades and snow-covered guideways), combined with the vast ignorance of the depth and detail of technical problems, so the argument goes, led to the enormous cost-overruns and inefficient research and development. Assertions or implications usually follow that if political motives had not interfered, the demonstration would have almost surely been less costly and certainly more tidy.

While it is true that there are technological development imperatives and time scales which are perturbed only at risk of escalating costs and increasing management confusion, (concurrent design is such a perturbation), it is also true that political imperatives and technology development have been mingled and mixed with success in the past, sometimes with spectacular success.

Engineers, managers and technicians, like other skilled people, like to be let alone to think and tinker with problems and generally proceed at their own deliberate speed. If pushed into a more frenetic pace and things go wrong, it is not surprising to hear the technician's lament: "The politicians made us do it." Apparently no senior technical professionals, however, either within UMTA or employed by the project contractors, were sufficiently disturbed by the political deadlines to refuse to participate in the project unless more realistic technical deadlines were established.

Suppose, though, that former Secretary Volpe had not pushed and shoved and forced the Morgantown demonstration project into tight political deadlines. Would the national purpose of high-technology transit research and development have been better served?

The answer is not perfectly clear, at least not yet. It certainly is possible that the same amount of money could have been expended elsewhere, in smaller contract amounts and at a more leisurely pace, yet the residual knowledge gained would perhaps not be as useful as the fallout from Morgantown.

With little doubt, more judicious management and realistic scheduling could have saved some money in the Morgantown project; perhaps not as much as often generally assumed.[1/] But without the great, if artificial, urgency imposed by political deadlines, the lack of momentum and "critical mass" of the research and demonstration efforts may not have been sufficient to accomplish even as much as the Morgantown project has. Certainly there is little evidence of any greater success in other, less forced, components of the UMTA advanced technology research program.[2/]

1/ A savings of perhaps $10 million of the total $64.3 million is a reasonable estimate if every aspect of the design, manufacturing and construction contracts blended perfectly, with no unforeseen problems, according to some observers.

2/ See Cole, Leon M. Summary Review of Federal RD&D Programs in Urban Mass Transportation, The Library of Congress, Congressional Research Service, July 25, 1973.

V. CONCLUSIONS AND PROSPECTS

Summary

In sum, it seems that the high-technology system for transporting people between downtown Morgantown and WVU campuses began, as other projects have, as a technological solution in search of a problem, or an excuse for development. To be sure, both the cost and the level of technology of the system as finally realized has proved to be much higher than originally anticipated by anyone. In the "new systems" enthusiasm of the beginning years of the Morgantown project, however, the stress was on high-technology innovation, both in professional interest, and in the interest of Federal officials awarding grants and contracts at that time. Some early participants in the project have said that simpler, and cheaper, system concepts and technology alternatives were rejected as not being sufficiently "sophisticated." Combine those enthusiasms with widespread ignorance and erroneous assumptions about the costs and minimum quality of technology required, and the Morgantown experience may have been inevitable, if not at Morgantown, certainly somewhere else.

Aside from the prospective results internal to the project itself, what effects of the project are in prospect concerning future Federal transit technology research and development programs?

Effects on High-technology Research and Development

An unfortunate cost or result of the Morgantown project may be the negative effect of encouraging supercaution. In order to avoid more Morgantowns, the UMTA research and development program may strive to so turn in on itself, systems analyzing and cross-checking everything, that the technicians may again become isolated from real-world problems, a seemingly common tendency, even in the best of research situations.

The tensions between political and technological imperatives are ever present in any program of government research and development, and especially in civilian hardware research. When these tensions are combined advantageously and supported with sufficient budgets, the results sometimes can be of substantial public benefit. The trick is to keep the political objectives guiding, supporting and driving the technical research and development, not interfering or impeding. The obverse trick is to keep the technicians and technological development not only cost-effective, but responsible to the public and their political representatives. A third and concurrent trick is to somehow insulate complex technical demonstrations from becoming political and public relations side-shows.

Since the 1966 amendments to the Urban Mass Transportation Act of 1964, the performance of the Federal Government, and UMTA, in conducting high-technology research applied to civilian problems in transportation has been mostly disappointing.[1/] The various incumbents of

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1/ See Cole, Leon M. Summary Review of Federal RD&D Programs in Urban Mass Transportation, The Library of Congress, Congressional Research Service, July 25, 1973.

senior politically-appointed and professional positions of responsibility in these programs must bear a large measure of the burden of faulty judgment and non-accomplishment. But the paucity of useful results may be caused by more fundamental structural flaws in the Federal research and development programs as well.

Based on the history of the Morgantown project, if the promise and potential benefits of advanced technology applied to public transit and other civil systems are to be realized, a complete restructuring of the Federal research and development programs, their relationship to industry, the procedures they follow, and the method of their funding may be in order. To continue pretty much as in the past, considering the few useful accomplishments so far achieved, does not seem promising from a broad public interest standpoint.

Redirections of Federal Technology Development Programs

If implementation of advanced technology systems and their apparent potential contributions to improving urban area transportation problems are to be realized, it appears that several lines of development must be pursued systematically. If unit costs of automated guideway transit are ever to be more competitive with more conventional technology, substantial economies of scale in manufacture and fabrication must be achieved. Instead of handcrafting vehicles in lots of a few hundred for custom-designed installations, mass manufacture of relatively standard configurations must become the norm, according to some observers. It might then be possible to reduce vehicle costs per unit from between $100,000 to $500,000 down to a unit cost level more nearly comparable to present conventional transit vehicles.

Stability in design and quantities of production cannot be realized without some relatively large-scale market aggregation for automated guideway transit (AGT) systems, yet no such systematic effort of market aggregation has been pursued by the Government, or by industry. The market studies for AGT systems undertaken by private firms are heavily dependent on estimates of future annual Federal budgets, and the estimated risk-taking capacity of local governments, both highly uncertain areas. Most of these studies necessarily deal also with

relatively small, special-purpose installations such as airports and urban activity centers, and the like.

The complex problems of moving to large-scale systems and their presumed unit cost advantages from prototype systems like the Morgantown project apparently are not being addressed officially in any significant way. Instead, incremental hardware development for near-term, small-scale application appears to be the present Federal research and demonstration posture.

In brief, presuming that future development of AGT systems is worth an effort that can provide genuine opportunities for success at the scale these systems seem to require, two things at least must be accomplished: 1) aggregation of sufficient markets for implementation in urban areas, and 2) aggregation of sufficient production capacity, for both vehicle and guideway units, to drive down unit costs. A third necessary if not sufficient condition to support the first two is the need to stabilize funding for the development of such systems over a time period adequate to enable thorough technological development and testing to take place.

In conclusion, it appears that a reformulation of Federal research and demonstration programs in urban transportation could benefit by reestablishing the public-at-large as the direct and primary target recipient of the benefits of program efforts. That is, projects should be pursued not simply for their intrinsic technical interest, or

for the benefit of high-technology suppliers, or to keep Government employees occupied, or to support personal or institutional political ends. Throughout the record of the Morgantown project, an impression is that the parties involved in the project almost uniformly perceived their own personal or institutional interests as paramount. The interests of the general public, whose tax monies supported and continue to support the project, were formally acknowledged occasionally, as legally required. In the main, however, the general public interest in improved travel service and in reasonable return to the public on tax dollars expended seems to have been a relatively minor consideration of the principal parties involved in the Morgantown project.

APPENDIX A

"MORGANTOWN (W. VA.) PERSONAL RAPID TRANSIT SYSTEM"

Basic Fact Sheet, Phase I System

SYSTEM

Guideway: Elevated and on-grade concrete guideway with power and steering rails contained along sides of guideway. Length: 2.2 miles.

Stations: Three off-line stations with multiple boarding slots: Walnut Street (central business district), Beechurst (downtown university campus), and Engineering (Evansdale campus).

Operations: Scheduled or demand mode at option of system operator to satisfy traffic requirements. Features include passenger-operated destination selection equipment which activates in-station graphic displays to indicate vehicle availability and boarding instructions. In demand mode, passenger selects destination by pushing button.

VEHICLE

Description: 15 feet, 6 inches long; 6 feet, 8 inches wide; weighs 8,750 lbs. empty. Made of fiberglass, with panoramic, tinted windows. Capacity: 21 (8 seated and 13 standing). Rubber-tired; four-wheel steering.

Propulsion: 70 horsepower DC electric motor fed by power collector from guideway rail. Speed: 30 miles per hour cruise. Practically noise-and air-pollution free.

Control: Vehicle commanded by central computer and station computers. Fail-safe collision avoidance and emergency braking, system monitoring and vehicle direction, speed, stops and starts controlled by computer. Vehicle control can be overriden by operator in control center in poor weather, emergency or other abnormal conditions.

PROJECT

Funding: The project is funded by the U.S. Department of Transportation's Urban Mass Transportation Administration.

Purpose: To determine durability, reliability, safety, operating and maintenance costs of Personal Rapid Transit system operating under automated control.

Objective: To demonstrate the feasibility of a new system concept in public transportation and determine, through operational experience, the potential applicability of this concept to a variety of urban transportation requirements.

Completion: System and subsystem components developmental testing completed mid-1973. Second phase, with system fully proved and ready for revenue service, scheduled for completion spring, 1975.

Source: The Boeing Aerospace Company, Seattle, Washington

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