SOMEWHERE IN TIME – A HISTORY OF AUTOMATED PEOPLE MOVERS

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Abstract

The history of automated people movers is a fascinating story of innovation by governments, companies, entrepreneurs, transportation interest groups, researchers, and individuals. Some believe that the initial work began when the auto manufacturers were conducting in-house research on automated highways and other companies were developing systems using driverless vehicles on separate guideways. However the impetus for the development of these systems in the United States was provided by amendments to the Urban Mass Transportation Act of 1964. The amendments required that a project be undertaken to study and prepare a program of research, development, and demonstration of new systems of transportation. Extensive research studies were undertaken in the late 1960s and 1970s. Several manufacturers developed prototypes and early applications included installations at Tampa and Dallas-Fort Worth International Airports and in Morgantown, West Virginia. The Downtown People Mover studies generated considerable interest in the late 1970s. Research and development work was also underway in Canada, Europe, and Japan. Today there are over 130 installations of various types and configurations throughout the world and many more are under construction or are being considered. This paper travels somewhere in time to review some of the events in the development of this new transit technology.

Introduction

When one looks back in history, one is overwhelmed by the terminology, acronyms, and technologies that have evolved over the years. As a starting point, it is probably appropriate to define an Automated People Mover (APM). An automated people mover is a guided transit mode with fully automated operation in which driverless vehicles operate on fixed guideways in exclusive rights-of-way. The vehicles come in a variety of designs and they can rubber-tired, steel-wheeled, magnetically levitated, suspended or drawn by cables. The guideway structure can be constructed below grade in tunnels, at grade, or on elevated alignments. The specific design details will

depend on the system but generally the guideway consists of steel or reinforced concrete sections.

The Early Years

Some believe that the initial work on automated transit technology began in the 1950s when General Motors was doing in-house research on automated highways and other companies were developing ideas on systems using driverless vehicles on separate guideways. In the late 1950s, the New York City Transit Authority experimented with automated operation for rapid transit in a project called the "Shuttle Automatic Motorman" (SAM). The system operated for about two years in the early 1960s on the 42nd Shuttle between Times Square and Grand Central Terminal.

In 1958, Alan Hewes of Cape May, New Jersey formed Universal Design Limited to develop a straddle beam monorail. His system was installed in ten amusement parks, fairgrounds and zoos before being acquired by the Westinghouse Air Brake Company (WABCO). In the late 1960s, WABCO engineers developed a fully automated version which was installed at the Houston Airport in 1972.

During the same period, Charles Paine formed the American Crane Hoist Company and one of the objectives of his company was to develop a suspended monorail system for the Los Angeles Fairgrounds in 1962 and the 1964-65 New York World's Fair. Out of his experience came the Braniff Airlines' Jetrail system. It was a fully automated suspended monorail system at Dallas Love Field Airport that connected a remote parking lot with the terminal building.

Meanwhile across the Atlantic, Habegger Limited, a small family owned Swiss firm was independently developing a "straddle beam monorail" for the 1964 Swiss National Exhibition in Lausanne. Numerous applications followed around the world and the system was first automated for Expo'67 – the world exposition in Montreal, Canada. The design proved durable and popular and was the genesis of monorails that are now offered by several companies.

These pioneering efforts initiated by small entrepreneurial firms were all low-speed systems marketed primarily for special purpose applications at expositions, fairgrounds, and zoos. Early attempts to use these simple system technologies for serious urban transit application were unsuccessful. The story might have ended had not the U.S. federal government got involved. The U.S. government began supporting automated transit systems by providing a grant to Westinghouse in the early 1960s to assist in the construction of a test facility in South Park, near Pittsburgh, for a system known as "Skybus" or "Transit Expressway". The system featured the first automated rubber-tired vehicles capable of operation at 60-second headways. The vehicles had a capacity of approximated 100 passengers and a top speed of 50 mph (80 km/hr.).

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The Role of the U.S. Government

Significant impetus for the development of automated transit systems in the United States was provided in 1966 by the Reuss-Tydings Amendments to the Urban Mass Transportation Act of 1964. These amendments required that the Secretary of Housing and Urban Development to:

"undertake a project to study and prepare a program of research, development, and demonstration of new systems of urban transportation that will carry people and goods within the metropolitan area speedily, safety, without polluting the air, and in a manner that will contribute to sound city planning. The program shall concern itself with all aspects of new systems of urban transportation for metropolitan areas of various sizes, including technological, financial, economic, governmental, and social aspects; take into account the most advanced available technologies and materials; and provide national leadership to efforts of states, localities, private industry, universities, and foundations."

The resulting 1968 report to Congress, "Tomorrow's Transportation: New Systems for the Urban Future" set the tone for UMTA's (Urban Mass Transportation Administration, U.S. Department of Transportation) research and development program for the next ten years. The study, which became known as the *New Systems Study Project* also popularized such terms as "major activity centers", "dial-a-bus", "dual mode", and Automated Guideway Transit (AGT). The use of the term Automated People Mover (APM) came later.

AGT concepts were identified to move people and goods in major activity centers such as airports, shopping centers, industrial parks, central business districts, and universities. New terms were introduced to describe these systems:

Shuttle-Loop Transit (SLT) – This is the simplest type of AGT system in which vehicles would move along fixed paths with few or no switches. The vehicles simply shuttle back and forth on a single guideway, the horizontal equivalent of an automatic elevator. They may or may not make intermediate stops. Vehicles in a loop system move around a closed path stopping at any number of stations. In both shuttle and loop systems, the vehicles may vary considerably in size and may travel singularly or coupled in trains depending on the system manufacturer.

Group Rapid Transit (GRT) – This category would have more extensive use of switching. Stations may be located on sidings off the main guideway permitting trough traffic to bypass and service could be provided on several routes.

Personal Rapid Transit (PRT) – A system that could carry one person or a group of up to six persons in vehicles that operate with short headways. Operation would be

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fully automated to provide an optimum route over a network of guideways from origin to destination without intermediate stops. Small, unobtrusive guideways would form a gird throughout the service area, and stations would be off-line to allow through service.

Downtown People Movers (DPM) – A category related to the application of an automated system operating in the central business district.

In 1969, UMTA initiated the Morgantown project to develop an AGT system and demonstrate a system in revenue service. The system would operate on the West Virginia University campus in Morgantown. The objectives of the project were to demonstrate the feasibility of a fully automated urban transportation system, determine the potential application of such a system, and qualify the system as a candidate for use in other locations. The system incorporated features of the GRT category. Boeing Aerospace was selected as the system manufacturer. Project authorization was given in 1970, ground breaking was held in fall 1971, and the system went into revenue service in October 1975. The system was expanded in the late 1970s and it still operates on campus today.

Another federal initiative was the Transpo'72 Exposition at the Washington Dulles Airport in which four systems (the Bendix Dashaveyor, the Ford ACT, the Otis Hovair, and the Rohr Monocab) were demonstrated in limited configurations. Although the Morgantown system received some negative press during construction and in its early years of operation, these programs helped in changing the low-reliability park technologies to proven transit systems.

At about the same time, an innovative terminal design was being proposed for Tampa International Airport. To reduce walking distances, an airside-landside concept placed aircraft gates in satellite terminals that would be located on the apron and separated from a central terminal building. A key component of the concept was the need for a reliable transit system that would shuttle passengers between the satellite terminals and the central terminal building. The Westinghouse Transit Expressway was selected for the project and it went into service when the new terminal opened in 1971. A Westinghouse system was also used to link two satellite terminals to the main terminal in an expansion project at the Seattle-Tacoma International Airport in 1973. Both applications were very successful and airports quickly became, and continue to be, an important market for AGT.

Another airport project that incorporated an automated transit system in its development was the new Dallas-Fort Worth International Airport. The AirTrans system began in 1970 when an UMTA grant was made to the Dallas-Fort Worth Airport Board to finance studies and test tracks to evaluate two systems being

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considered for the new airport. A 1972 capital grant helped finance installation of the "AirTrans" system. An extensive network of overlapping linking four terminal buildings, a hotel, and remote parking went into service in 1974. The AirTrans system was manufactured by the Vought Corporation.

In 1974, the Transportation Subcommittee of the U.S. Senate Committee on Appropriations requested an assessment of PRT and other new systems. The work was undertaken by the Office of Technology Assessment and five areas were examined – current developments in the United States, international developments, operations and technology, social acceptability, and economic considerations. The final report, "Automated Guideway Transit: An Assessment of Personal Rapid Transit (PRT) and Other New Systems", was released in 1975. One of the report recommendations was to support an AGT demonstration project in a city to ascertain feasibility. Congress agreed and the Downtown People Mover (DPM) program was one of the results.

In 1976, UMTA solicited proposals nationwide for DPM projects. Although 68 cities responded with letters of interest, only 38 were able to submit proposals. Four cities were selected as DPM demonstration sites – Cleveland, Houston, Los Angeles, and St. Paul. Three other cities – Baltimore, Miami, and Detroit – were advised that they could divert funds from existing transit funding commitments for their proposed DPM systems. In 1977, Congress directed UMTA to consider funding for Jacksonville, St. Louis, Baltimore, and Indianapolis. Three DPM projects were eventually built in Miami, Detroit, and Jacksonville in the 1980s.

While technological development continued, the severe operational problems encountered by the deployed systems in early revenue service eroded the confidence of these systems in solving urban transportation problems. It was felt that government sponsorship of research on the critical problems of automated transit systems and an assessment of existing AGT designs was required. In response, UNTA initiated the Automated Guideway Transit Supporting technology program in 1975. The program included numerous projects aimed at specific problem areas including systems operation, safety and passenger security, vehicle longitudinal control and reliability, vehicle lateral control and switching, and guideway and station technology.

Concurrent with the DPM demonstration program, UMTA also funded the development of a new AGT technology known as Advanced Group Rapid Transit (AGRT). This program examined several advances in technology including magnetic levitation, high speed switching, and new command and control capabilities to permit short-headway operations in complex networks. As a result of substantial cost increases in the program, a review of the project's feasibility as well as its relationship to the overall goals of the Department's mass transportation program was

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undertaken in 1978. Among the findings in the 1980 final report was that the federal programs underestimated the complex institutional, economic, and technical barriers to innovation. Neither transit operations nor local public officials were anxious to volunteer their communities as laboratories for transit experiments unless the federal government was prepared to underwrite the financial risks. Potential transit system suppliers found it difficult to justify major investments in transit innovation given a history of uncertain federal support, tight development timetables, complex institutional barriers, and the lack of stable markets.

Activities Without U.S. Government Support

In 1981, the U.S. federal government decided to reduce its role in the research, development, and support of AGT systems. Committed DPM projects were completed in Miami (Metromover, 1986), Detroit (Detroit People Mover, 1987), and Jacksonville (Automated Skyway Express, 1989), but much of the new AGT activity in the United States shifted to applications in major activity centers. Although the specific origin is not known, it was about this time that the term Automated People Movers (APM) started to appear in the literature.

Airports continued to be a major application for AGT and today, there are over 40 airports with AGT systems and they have become a standard component of large airports. Systems have been used in amusement parks, zoos, expositions, museums, universities, hospitals, shopping centers, hotels, resorts, and casinos. Other papers presented at this conference will describe many of these systems and the planning for future installations.

One of the exciting concepts presented in the 1968 New Systems Study Project was Personal Rapid Transit (PRT). Although it was defined and research was undertaken, no systems have been built. In the early 1990s, the Raytheon Corporation and Northeastern Illinois Regional Transportation Authority (RTA) announced plans to develop a system called PRT 2000. A test track was completed and extensive research and development work was undertaken, and exciting plans were prepared for a system that would operate in Rosemount, Illinois, adjacent to the Chicago O'Hare International Airport. The program was abandoned in the late 1990s but there are several in the United States that continue to do research and examine potential PRT opportunities. One group that has been a strong promoter of PRT is the Advanced Transit Association (ATRA). The ATRA (www.advancedtransit.org) is a professional organization has been a leader in the investigation and development of advanced transit technologies and applications.

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International Activities

Research and development work was also being done in Canada, Europe, and Japan. Although the initial impetus for the development of AGT systems in the United States was a desire to develop less labor intensive and innovative solutions for urban transit, most of the applications have been in major activity centers. However in other countries automated operation has been used for mass transit systems.

In Canada, the Ontario Ministry of Transportation initiated a program in the early 1970s to support the application of AGT systems. Following a review of systems, the German maglev system (Transurban) manufactured by Krauss Maffei was selected for a Toronto demonstration project. However the project was cancelled when the German government withdrew their support for the system. Another part of the Ontario transit initiative was the formation of the Ontario Transportation Development Corporation (UTDC) Limited with the task of developing new transit technologies. In an extensive research and development program, the UTDC identified the need for an intermediate capacity transit system (ICTS) to fill a void between high capacity rail and lower capacity buses and streetcars. A system was developed to serve urban transit requirements and to serve as a people mover system for airports and other major activity centers. Plans were developed for extensive systems in Toronto, Ottawa, and Hamilton, but none of the projects came to fruition. In 1981, Vancouver, British Columbia, took a bold step by selecting the ICTS technology over a conventional light rail system for an urban rapid transit line to serve the region and support the transportation theme for the 1986 World's Fair in Vancouver. The system consisted of automated trains operating in line haul service on an exclusive right-of-way. The original Vancouver Skytrain opened in 1986 with 13 miles (21.4 km) of guideway and 15 stations. Several extensions have been added to the system. In Toronto, a light rail extension was being planned between the main east-west subway line and the community of Scarborough, but in 1982 these plans were changed and the decision was made to use the ICTS technology as a manned AGT system on the Scarborough RT line. Service began in 1985. The ICTS technology was also selected for the Detroit DPM system which opened in 1987. The UTDC is now part of the Bombardier organization.

During the planning of a new town in France, it was decided that a rapid transit service was needed to link the new town of Villeneuve d'Ascq and Lille. As a result, Lille proposed that a fully automated transit line be built. Matra proposed a new system called VAL and it was selected. Revenue service began in 1983 with 13.2 km of guideway and 18 stations and the system has been expanded. The Lille system was the first automated system in line haul service. Similar systems are now operating in Toulousse and Rennes. Automated driveless trains have been introduced on rail

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transit lines in Europe and these will be discussed in the conference paper and presentation, *Urban Mass Transit Goes Driveless* by Mr. Gerard Yelloz.

In Japan an interest in APMs by government and industrial organizations began in the early 70s when Vought Aerospace licensed its technology to Niigata Engineering. Niigata made several improvements and the Japanese government adopted this technology as its standard and other suppliers entered the APM business. Japanese companies have become major competitors in the worldwide APM marketplace. The Japanese have also been leaders in the application of monorail systems in urban applications and they have used automated people movers as feeder systems to link new development areas with regional rail networks. Examples can be found in Kobe, Komaki, Omiya, Osaka, Sakara, Tokyo, and Yokohama.

There is also heighted interest in PRT in Europe and several papers that are being presented at this conference describe exciting projects. One example is the ULTra PRT prototype supplied by Advanced Transport Systems that is being implemented at London's Heathrow International Airport. A PRT with automated four-passenger vehicles will link automobile parking lots with the terminals. On-demand, non-stop service will be provided. A second example of PRT development activities is underway in Sweden where test tracks for SkyCab and Vectus technologies have been built in Hofors and Uppala respectively, and several planning studies are underway.

ASCE Conferences

As automated transit systems evolved, the American Society of Civil assumed a leadership role in organizing APM conferences. Murthy Bondada and Edward Neumann were the first chairs of the ASCE Automated People Movers Committee and they provided the initiative and organizational skills for the first ASCE conference on automated people movers in 1985 in Miami, Florida. This year marks the seventh conference that has been organized and sponsored by ASCE in the United States.

1985 – Miami, Florida
1989 – Miami, Florida
1993 – Irving (Las Colinas), Texas
1997 – Las Vegas, Nevada
2001 – San Francisco, California
2005 – Orlando, Florida
2009 – Atlanta, Georgia

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Through the efforts of members of the ASCE Automated People Movers Committee, international conferences have been held in between the U.S. conferences. ASCE has been a cooperating agency, and members have assisted national engineering societies to organize these APM conferences.

1991 – Yokohama, Japan
1996 – Paris, France
1999 – Copenhagen, Denmark
2003 – Singapore
2007 – Vienna, Austria

APM Standards

The American Society of Civil Engineers has also taken an important role in the development of standards. Under the initial leadership of Tom McGean, the ASCE Automated People Mover Standards Committee has established safety and performance standards for an APM system. All standards are developed by a consensus process managed by ASCE that includes balloting of the standards committee and ASCE members, and balloting by the public. The first standards were released in 1997 and since then revisions and a re-balloting process has been completed, so today there are four parts.

Automated People Mover Standards – Part 1, ASCE Standard No. 21-05, American Society of Civil Engineers, Reston, VA, 2006 – minimum requirements for safety and performance of APM systems (a comprehensive revision of ASCE Standard 21-96)

Automated People Mover Standards – Part 2, ANSI/ASCE/TD&I Standard No. 21.2-08, American Society of Civil Engineers, Reston, VA, 2008 – vehicles, propulsion, and braking systems

Automated People Mover Standards – Part 3, ANSI/ASCE/TD&I Standard No. 21.3-08, American Society of Civil Engineers, Reston, VA, 2008 – electric equipment, stations, and guideways

Automated People Mover Standards – Part 4, ANSI/ASCE/TD&I Standard No. 21.4-08, American Society of Civil Engineers, Reston, VA, 2006 – security, emergency preparedness, system verification and demonstration, operations, maintenance and training, and operational monitoring

The web site for APM standards activities is www.apmstandards.org.

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APM Guidebooks

Airports have been an important application for APMs. In 2003, the Airport Cooperative Research Program (ACRP) began to fund various airport research activities that have not been addressed in other programs. ACRP is sponsored by the FAA and managed through the Transportation Research Board. Two research projects have focused on airport automated people movers and final reports are expected to be published in summer 2009. One is a guidebook for planning and implementing automated people mover systems at airports and the second is a guidebook for measuring the performance of people mover systems at airports. These reports will be invaluable for future work. A third project is examining a variety of other conveyance systems, like moving walkways and escalators, in airport applications.

Guidebook for Planning and Implementing Automated People Mover Systems at Airports, ACRP Project 03-06, expected release – summer 2009

A Guidebook for Measuring Performance of People Mover Systems at Airports, ACRP Project 03-07, expected release - summer 2009

Airport Passenger Conveyance System Usage/Throughput, ACRP Project 03-14, expected release – fall 2009

Conclusion

Although APMs were initially envisioned as new urban transportation systems, they have found very special and unique applications in major activity centers in the United States while the original vision of automated systems for urban transit has occurred in other countries. Today, there are over 130 installations of various types and configurations operating throughout the world, and many more are under construction or are being planned. As one looks back who could have predicted the development of automated people movers as they are today.

Historic AGT Reports

Tomorrow's Transportation: New Systems for the Urban Future, a report from President Johnson to the United States Congress, Washington, DC. May 1968

Automated Guideway Transit – An Assessment of PRT and Other New Systems, United States Congress, Office of Technology Assessment, Washington, DC, June 1975

Impact of Advanced Group Rapid Transit Technology, United States Congress, Office of Technology Assessment, Washington, DC, January 1980

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