Kansas Department of Transportation: Exploratory Concepts in Automated Small-Vehicle Transportation

Research Project

Mobility and Land Use Enhancements Enabled by Automated Small-Vehicle Transport Technologies

SUMMARY

Kansas State University in cooperation with PRT Consulting, the University of Maryland Center for Advanced Transportation Technology, and Kansas University has embarked on a third phase of automated small vehicle transit (ASVT) research to investigate the potential of ASVT to solve transportation and mobility issues in a specific environment. The study environment is the commercial development encompassing the retail and entertainment area commonly known as the Legends on the western edge of the Kansas City, KS metropolitan area. This area is located north of the intersection of Interstates 70 and 435. Existing development in this quadrant includes the Kansas Speedway and the Legends at Village West, a retail and entertainment environment as well as the Woodlands Race Track and the Providence Medical Center. Planned development includes a casino. Despite the number of attractions, the dominant use of developed land however, is parking lots and roads to serve these attractions. This study will investigate the ability of an ASVT system to improve the inter-accessibility of the existing and planned facilities, to serve as a feeder to any existing and planned transit systems, to reduce the quantity of land dedicated to roads and parking lots freeing up land for additional development or open areas, reducing carbon, and, most importantly, improving the quality of mobility for residents and patrons of the area. The analysis will include not only the impact of an ASVT system to serve the existing development, but also how development may have been designed differently had it incorporated ASVT from the beginning.

BACKGROUND

Automation is vital to solving many problems associated with the current petroleum-based vehicle-highway system. One of the key original ITS focus areas was a vision for a completely “Automated Highways System” – however, ITS interests have since been refocused on methods to enhance the safety of vehicles, rather than leverage the benefits of full automation. A major breakthrough in vehicle automation has occurred in Europe over the past six years and is about to debut in full commercial deployment in 2008. A fleet of completely automated, small, four-passenger vehicles is being harnessed to provide connectivity between parking facilities and airport terminals as part of major improvements planned by BAA at numerous airports starting with Heathrow in 2008.

Although innocuous at first appearance, this technology may hold the key to major strides forward in terms of safety, service, sustainability and general quality of movement and life. Patterned off a US demonstration project in the 1970s in Morgantown, WV, the system is poised to deliver automated mobility at price points previously unheard of for travel (either private or mass-transit). The Morgantown PRT system (1), often maligned for cost-overruns and poor construction management, has quietly been operating under full automation for over 30 years providing key mobility services for a university environment. Although mostly overlooked in the US, it has sparked new developments in campus mobility concepts in Europe, the United Arab Emirates and Asia where multiple privately- and publicly-financed developments are underway to capture similar system operation concepts using modern cost-effective automation and infrastructure technologies. Despite several mishaps during development, and its relatively large and awkward stations and guideway, the New York Times recently characterized the Morgantown PRT system as a white elephant turned into a transit workhorse [11]. This serves as evidence that modern implementations of ASVT could be a significant solution to current transit problems.

At the same time, Kansas State University (KSU) has been the leading research institution in the area of automated small vehicle transportation (ASVT) since 2000. Through the support of the Kansas Department of Transportation, KSU has performed the first of its kind research in assessing the mobility impact of an ASVT system on a university campus (6). The mobility impact study combined with the follow-on efforts related to architectural impact, safety and security, and constructability analysis has positioned KSU to lead in the implementation of modern personal rapid transit (PRT) and ASVT concepts.

The intent of this project is to research ASVT as a means to solve transportation, accessibility and land use issues. The ASVT concept uses a fleet of fully-automated vehicles operating on dedicated guideways to provide on-demand service to shuttle small groups of people non-stop from origin to destination. ASVT is anticipated to be most viable in situations subject to numerous relatively short trips, situations where a collector/distributor system could enhance transit use and situations where numerous fairly closely-spaced parking lots serve different facilities with different peak times.

Kansas City (KC) recently passed a bond issue for the pursuit of light rail. Cities such as KC, with large suburbs and few natural obstructions to development typically do not possess the density or corridors of development that allow light rail and other forms of transit to operate effectively. Augmenting the transit stations with ASVT concepts to connect light rail or other forms of metro service to business and retail districts could greatly enhance the effectiveness of centralized transit options. Furthermore, interconnecting such activity centers with ASVT could relieve parking, pedestrian, and vehicle congestion by removing the need to circulate private vehicles within the development in search of adequate parking. The project scope includes the use of ASVT to provide a central point of connection for some type of major future transit system such as rail, subway, light rail, etc.

Research Goals and Potential Benefits

The goal of the research will be to determine the ability of an ASVT system to solve the transportation/mobility issues faced by the study area and contrast this with conventional solutions. These issues include the reduction and elimination of congestion, enhanced safety, and the creation of a sustainable transportation infrastructure minimizing environmental impacts. In pursuing this research a secondary benefit will be to raise the level of awareness regarding ASVT in each partner community and, if ASVT is viable, accelerate the adoption of such technology and its associated benefits.

Potential Benefits of ASVT include:

- Enhanced accessibility in dense developments
- Relief of parking, pedestrian, and vehicle congestion in developed areas
- Reduced terrorist threat potential to campuses, shopping centers and business parks by eliminating the potential for vehicle borne explosives
- More secure facilities by enabling screening on the periphery of facilities such as in airports, and other commercial campuses
- Increased quality mobility options for those not capable of operating automobiles
- Reduced greenhouse gases, and reduction in oil dependence (ASVT is run off the central electrical grid)
- Economic development opportunities resulting from land use changes such as reduction in needed parking, linking of peripheral and shared parking areas, and land use consequences
- Improved safety resulting from automation and reduction of vehicle use (and associated vehicle casualties and injuries.)
- Enhanced efficiency of mass transit

While ASVT is rapidly gaining momentum overseas and particularly in Europe, the United States has been slow to accept fully-automated solutions with the notable exception of airport people movers. ASVT and its underlying concepts break the mold of conventional linear transit. It can be somewhat difficult to understand and public agencies thus have difficulty forming the consensus needed to dedicate funds to an ASVT project. For this reason this program affords an important opportunity to investigate the potential benefits of ASVT as well as ownership and governance issues and thus to help accelerate the development and adoption of this technology in the United States.

Technology

ASVT uses a fleet of vehicles with capacities between 2 and 12 people to deliver fully-automated, on-demand, non-stop transportation service. ASVT technology has been in operation for over thirty years in Morgantown, West Virginia. This system has completed over 140 million injury-free passenger miles (conventional transit would have injured over one hundred) (5) and has proven that all of the major ASVT technical operating characteristics are feasible including the safe operation of small automated vehicles at short (15 second) headways, and the ability for vehicles to merge and diverge and thus bypass stations providing direct, non-stop and on-demand revenue passenger service.

The ASVT concept was originally encapsulated in what was termed ‘Personal Rapid Transit’ back in the 1970’s. The concepts have matured in the intervening years, and with lessons learned from the Morgantown experience, there are now at least three viable vendors of modern ASVT systems.

Methodology

A steering committee comprised of members from the KDOT ITS Committee, Advanced Transit Association (ATRA), representatives from the study area, and experts in automated transit systems will be formed to set the overall direction of the research and to monitor and review the project at key milestones. The Project Team (described later) will accomplish the bulk of the work with the cooperation of Wyandotte County Division of Planning. The proposed research is described below on a task-by-task basis:

Kickoff Meeting

This meeting will involve all of the key participants and stakeholders. The purpose will be to inform about the ASVT concept, gather any existing pertinent data, discuss the research to be undertaken, discuss risks and benefits for all stakeholders, and share the expected timetable. This kickoff meeting will also serve as a discovery phase of issues, and the relative importance of various aspects of the proposed study. The full scope of the study will be finalized upon completion of the kickoff meeting.

Deliverables: More knowledgeable participants and stakeholders. A finalized scope of work and meeting minutes.

ASVT Literature Review

A review of ASVT literature will be undertaken to discover any previous pertinent work. The review will help avoid duplication of effort while allowing this project to build on work by others.

Deliverables: A compilation of previous literature that may influence this work and may be referenced to support decisions and conclusions made. A brief summary of the pertinent aspects of each relevant article/paper/book will be provided.

Data Collection

The data collection effort will commence during the kickoff meeting where each participant will be asked to share their knowledge as to where pertinent data may be obtained. The types of existing data being sought will include topographic mapping, zoning and land use plans, traffic and travel data as well as emissions, energy use and other pertinent environmental data. Future expansion plans will also provide useful information for the project.

Deliverables: As much existing pertinent data as can reasonably be obtained.

Conceptual Design

The conceptual design process will be iterative with considerations of guideway and station layout, land use and ridership interacting with each other until preferred solutions emerge. The process will commence with an examination of the existing layout, land use and traffic as well as consideration of any expansion plans that are available. Public workshops will be held to determine system acceptability and help develop system requirements. At least three alternative land use plans will be developed illustrating how ASVT could allow improved land use such as buildings and/or green space in place of parking lots. Guideway and station layouts will be conceptually developed based on the land use alternatives and rough ridership estimates will be made. Much of the above work will be accomplished in a full day work session. At the end of the work session the preferred alternative will be chosen. A map will be prepared depicting the preferred alternative and showing existing and proposed land uses, guideways and stations. Using the ridership estimates from the following task, the proposed ASVT system will be simulated to determine wait and travel times as well as the number of vehicles needed and to ensure each portion of guideway has adequate capacity.

Deliverables: Conceptual Design Map. Simulation results.

Ridership Estimates

ASVT ridership will be estimated based on models developed in previous research undertaken at KSU. These models will be adjusted as necessary to fit the operating parameters agreed upon for this project at the kickoff meeting and input obtained from public workshops. For example, if it is agreed that close-in parking supply should be very limited and/or expensive, this will increase ASVT system ridership. If the ASVT system is just to provide an alternative means of transportation within the development, ridership will likely be lower.

Deliverables: Expected ASVT system ridership including peak period volumes on links between stations.

Code Compliance Issues

ASVT is a new mode of transportation for the State of Kansas. In addition, some types of ASVT are rail-like and have a powered third rail while others are battery powered and travel on open guideways with little or no exposed power supply. This task will attempt to clarify which agencies will have jurisdiction over an ASVT system and what their requirements are likely to be in terms of structural codes, passenger and public safety as well as environmental impacts.

Deliverables: Technical memoranda addressing likely compliance requirements.

Cost Estimates

A complete capital cost estimate will be prepared for the preferred alternative taking into account the length of guideway (elevated or at grade), the number and type of stations, the anticipated ridership and compliance requirements. Capital and operating costs will be based on estimates from ASVT vendors such as ULTra, Vectus, 2getthere, Austrans, CyberTran and Skyweb Express. Capital costs will be amortized over the likely system life and added to anticipated operating costs to develop total estimated costs per passenger.

An estimate of revenue will also be made. This will take into account such sources as fares per ride, parking fees and any other passenger-related revenue as well as potential cost savings or revenues from improved land uses enabled by the ASVT system.

Deliverables: Capital and operating costs and revenues.

Ownership and Financing

This section will investigate different ownership options for the ASVT system and different ways in which it could be financed. Ownership option ranges include the county, the ASVT vendor/supplier and a utility specifically formed to own and operate the system. Financing options include public bonding and private financing based on guaranteed revenue per trip.

Deliverables: Technical memorandum addressing the pros and cons of various ownership and financing alternatives.

Benefit/Cost Evaluation

Drawing on all of the above work, this task will compare the anticipated benefits and costs, both tangible and intangible. Primary benefits are anticipated to be related to accessibility, mobility, symbiotic transportation systems, safety, security, land use and environmental impacts. Primary costs include visual impacts of overhead guideways and capital costs. While this section will be focused on comparing the preferred alternative with or without ASVT, consideration will also be given to how the preferred alternative could have been improved had it not been constrained by existing development.

Deliverables: Technical memorandum addressing benefits and costs.

Implementation Plan

An implementation plan will be prepared addressing such issues as risk mitigation, hurdles to be overcome, technology assessment, system ownership and procurement options, financing and schedule. It will conclude with a specific action plan.

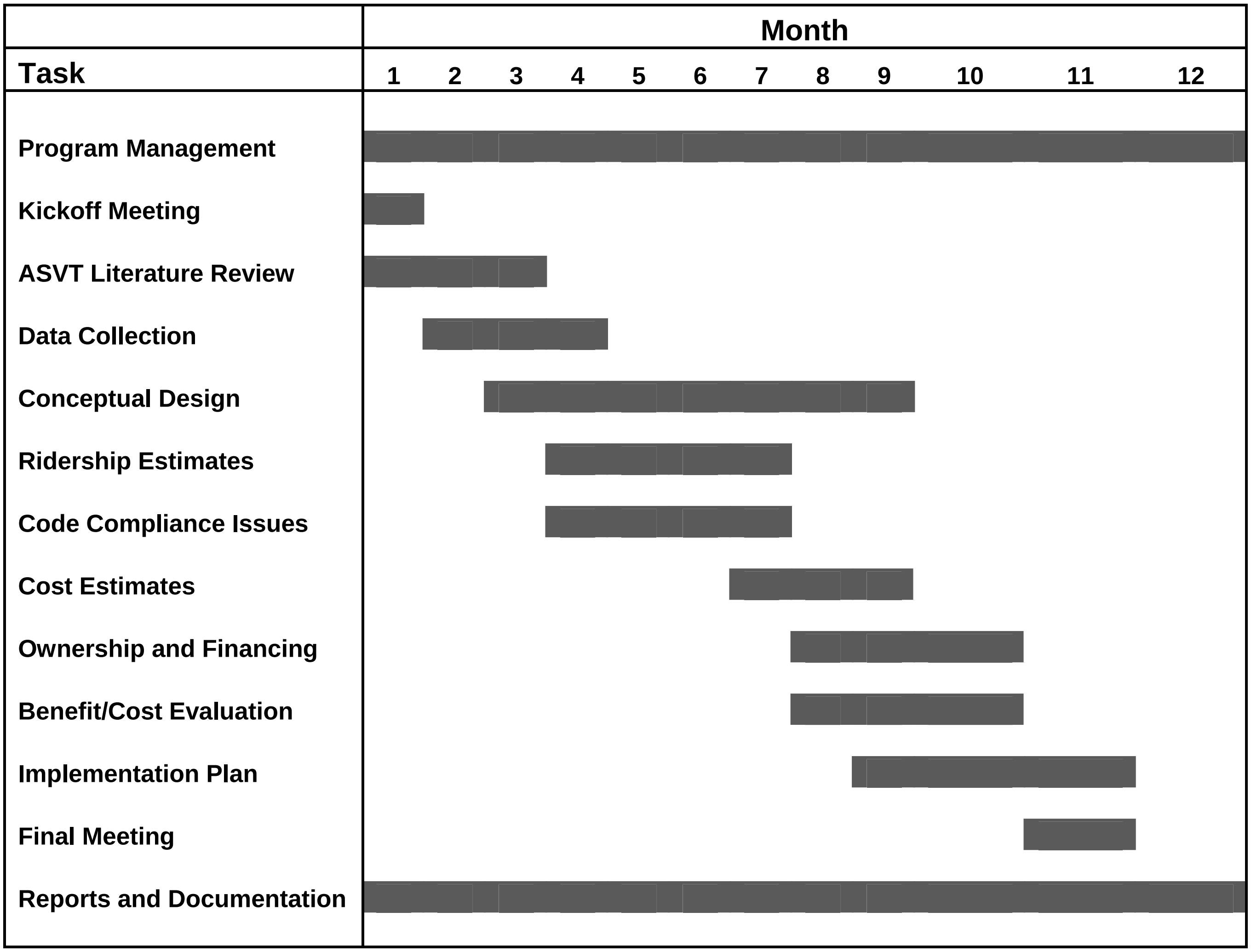
Deliverables: Implementation Plan

Final Meeting

A final meeting will be held to present the results of the project to all of the key participants and stakeholders. Their input will be obtained regarding any adjustments that should be made in the final report.

Deliverables: Feedback for final report and meeting minutes.

Milestone Schedule



Evaluation Metrics

The evaluation metrics to be used in this project include trip time (wait plus travel), accessibility, reliability, safety and security, reduction in congestion, reduced dependence on automobiles (and thus the need for roads and parking lots), reduction in accidents, throughput, responsiveness, environmental and land use benefits, and a cost/benefit ratio.

Project Team

The project team members and their roles are described below. This proposal has been developed by KSU in conjunction with PRT Consulting (PRTC), the Kansas Department of Transportation, the University of Maryland Center for Advanced Transportation Technology (CATT) and the Advanced Transit Association (ATRA).

Since 2000, KSU has been the leading institution in researching ASVT concepts. Sponsored by the KDOT, research (1), (5), (6), (7), (8), (9), (10) assessing the mobility impacts of ASVT on university campuses has been presented and published through TRB. This project is intended to build on and further that research.

Dr. Stanley E. Young, P.E., research engineer at the Maryland Center for Advanced Transit Technology, KSU adjunct faculty, and former advanced technology research engineer at KDOT will serve as the primary academic investigator. Dr. Young was on staff in the research department of KDOT and oversaw all of the KSU ASVT research.

PRT Consulting Inc. (PRTC) is an independent planning and engineering consultancy specializing in the research, planning, design and implementation of ASVT. They will provide the project manager (Peter J. Muller, P.E.) and will undertake the bulk of the work including running meetings, undertaking research and writing reports.

Patti Banks Associates is a landscape architecture firm based in Kansas City that has land use planning experience in the project area. Patti Banks and Lisa Lassman Briscoe will undertake land use analyses comparing existing land uses and plans with possible alternative land uses enabled by ASVT.

Additional professional support will be drawn from Dr. Moni El-Aasar and Dean Landman, both former researchers in the KSU ASVT work, KU Transportation Center, and other noted professionals experienced in ASVT concepts as needed.

ATRA is an international organization that promotes better communities through advances in transportation. They will play an advisory role.

CONTACT

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