TransitPulse
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News of Advanced Transit

ATRA is an organization of members who are encouraged to invite friends, neighbors and colleagues to join ATRA and may share a copy of TransitPulse on a one-time basis.

July/August 2013

INNOVATION'S SECOND ROUND

ATRA was well represented at a public sector innovation workshop convened by Aerospace Corporation at the behest of the City of San Jose. It was held at Aerospace headquarters in El Segundo, just south of Los Angeles International Airport. Seventy-five individuals representing a variety of agencies flew or drove in to discuss what needs to be done so that the public sector can begin to move toward automated transport in the possible form of automated transit networks (ATNs), a term that has evolved to encompass PRT, AGT, GRT and the like. The emphasis was less on technology, and more on processes and paradigm shifts needed in public infrastructure development as we approach a new age in public transit.

Aerospace conducted significant PRT research in the 1970s and is taking a second look. How appropriate to meet in a city whose Spanish name means second! Modal innovation has returned to the American agenda. This time around, it's called ATN.

Ed Anderson, author of the textbook *Transit Systems Theory*, holder of many PRT-related patents and founder of PRT International, traveled from Minnesota to accept an award in recognition of his achievements in PRT research and development. Stan Young and Matt Lesh made it out from the Washington Beltway. Sam Lott was over from Texas, and Peter Muller from Colorado. Christer Lindstrom added an international touch, in the context of the US-Swedish Memorandum of Cooperation. And of course, a large contingent from California – including Catie Burke and Will Ackel and representatives of Google, Lea+Elliott, Mountainview, Santa Cruz, San Diego and the Association of Bay Area Governments.

Rod Diridon emphasized the synergy with HSR now starting up for real in a segment that includes Fresno. He helped keep discussions focused on what needs to be done next. There was clear interest and commitment to action on leading urban infrastructure to more sustainable realms. Planning has begun to continue the dialog in October as part of the 7th Podcar City conference, October 23-25 in Arlington, Virginia at George Mason University.

IN THIS ISSUE

More roads? Or will the brainpower gathered at Aerospace headquarters last month generate a fundamental rethink of ground transport infrastructure?

MARTIN LOWSON: 1938-2013

Late last month as this edition of *Transit Pulse* was nearing completion, we received word that Martin Lowson, founder of Ultra PRT, passed away at the age of 75. Words of tribute and gratitude are pouring forth from many friends and colleagues – too many to include here as *Transit Pulse* goes to press. The next issue will feature comments and tributes from ATRA members for a powerful and popular intellect on both sides of the Atlantic. ATRA is compiling a tribute to Martin from member contributions. Please send your memories of Martin to *secretary@advancedtransit.org*.

The breakthrough PRT project at London Heathrow Airport was a highlight of Martin Lowson's notable career.

Martin was born in the UK in 1938, studied at Southampton University (Aeronautics and Astronautics) and earned a PhD in 1963. Martin Lowson was a rocket scientist and worked extensively with NASA. Martin worked on the Apollo Space Program's Saturn Rocket, where he led a team of over 50 staff. He was Chief Scientist of Westland Helicopters, generating the advanced rotor system (he holds the patent) now used on both Lynx and EH101 helicopters. This rotor set the absolute world speed record for helicopters. He collaborated with multiple NASA wind tunnels on studies of aerofoil noise, helicopter rotor noise, and rocket noise radiation. He was a Fellow of Royal Academy of Engineering, the Royal Aeronautical Society, and the American Institute of Aeronautics and Astronautics.

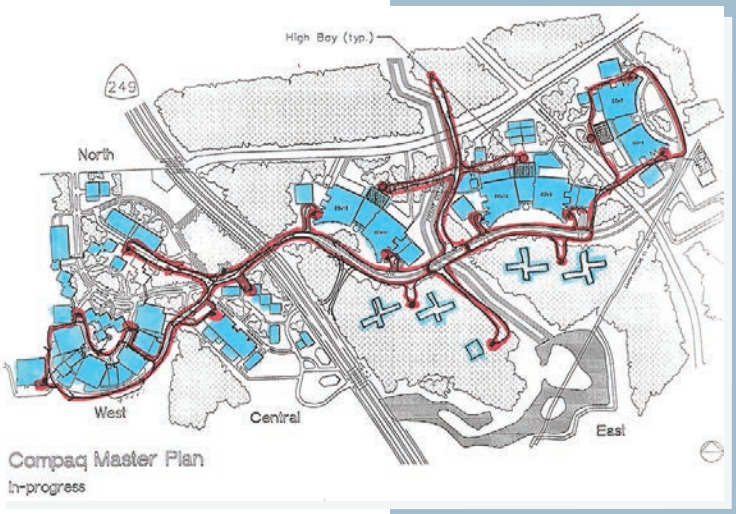
During the 1990s, his interest turned to ground transport, attempting to understand why so few people use public transport. He set up Ultra in 1995 and from 2000 onwards devoted his energy to promoting PRT, winning the first ever contract for a true personal rapid transit installation from BAA for Heathrow Airport. He became active in ATRA, elected Vice President. He then helped establish the ATRA Industry Group. He served on the ASCE APM Standards Committee, making many PRT-related contributions and presentations at APM conferences.

Martin is well remembered for his ability to communicate complex issues with clarity and rare foresight.

THE COMMERCIAL CONTEXT OF PRT

It is time to innovate as culture, life-style and political landscape shift.

The capabilities of modern communication and controls have transformed most aspects of urban life over the last several decades. The emergence of low-cost mobile devices, GPS, satellite-enabled calling and the Internet access makes events in any spot of the world almost immediately known globally. In many ways, 2013 is vastly different from 1963.



One might think that cheap, instant communications would reduce the tendency for people to live in large cities and suffer what economists call "agglomeration diseconomies". Life in big cities tends to be more expensive and polluted. Yet the opposite is happening. Worldwide more and more people are drawn to large cities and their social and cultural activities. At the turn of the century, half of the world's population was in large towns and major cities. Today it is

already estimated to be 60 percent. Mega-cities of more than ten million residents — exceptional in 1961 — are today commonplace.

Modern Urban Transport

Modern communication can help manage road and highway congestion. Drivers can inform themselves of traffic jams and parking availability in real time and find alternatives. Traffic signals can be set in real time according to current traffic conditions to facilitate flows. This helps squeeze extra capacity out of existing roads, highways and parking. Collision-avoidance technologies make driving safer.

Modern communication and control technology have also brought improvements to traditional forms of mass transit. Buses can benefit from current information on road conditions. Traffic signals can be programmed to give priority to buses. Priority ways can be given in street geometries. Apps inform passengers of when they will be able to board a bus, thereby reducing the well-documented unpleasantness of the wait.

Modern controls and communication have made the full automation of train movements not only feasible, but also safer and more regular. By removing the labor cost of each “run”, frequent service is more affordable. The very idea of automating train and other vehicular movements emerged in the 1960s. The full automation of rail transit has renewed interest in metros – now a booming field outside the US and the UK. Smaller APM versions in airports, hospitals and other specialized districts are now common.

State of the Industry

Today almost fifty airports around the world have APMs, representing almost a third of all automated transit projects operating today. Slightly over a third are owned and operated by mass transit authorities – as driverless metros such as in Singapore, Taiwan, Korea, Dubai and Europe, but also as local circulators in Japan, in three American downtowns, and as metro-feeders in Singapore. There were almost fifty additional projects in construction with a total value (excluding most civil work such as tunneling and guideways) of over US$12 billion.

The APM industry consists of about two dozen suppliers with an extensive array of component manufacturers and contractors and planning and engineering consultants. It is by nature very international and increasingly involved in public-private partnerships.

There is related commercial experience that parallels PRT/ATN product delivery in the industries that supply baggage handling systems, elevators/escalators/moving walks, and goods movement. This is the context in which the podcar industry is emerging.

SWEDEN’S SELF-PARKING CAR IN 2014

Volvo Car Group last month demonstrated autonomous parking. A prototype vehicle can find and park in a vacant space by itself with no driver inside. It also interacts safely and smoothly with other cars and pedestrians in the parking area. The driver can drop the vehicle off at the entrance of a park lot or structure, then later pick it up in the same or a different designated place.

In Volvo’s brave new parking world, there are transmitters in the parking area. The driver uses a mobile phone application to activate *Autonomous Parking*, then she

walks away from her car. The vehicle uses sensors to localize and navigate to a free space. The procedure is reversed when the driver comes back to pick up the car. Speed and braking are adapted for smooth integration in the parking environment.

Volvo's aim is to gain leadership in the field of autonomous driving by moving beyond concepts. The first features will be introduced in the all-new Volvo XC90 at the end of 2014. There are several parking system developments by others in this field.

Swedish design standards are world class, such as this rendering for Sodertalje.

Volvo was the only participating car manufacturer in the European *SARTRE* (Safe Road Trains for the Environment) project, which focused on technology for platooning traffic on conventional highways. Each platoon included a lead truck and four Volvos driven autonomously at speeds of up to 90 km/hr. Work continues on more advanced autonomous parking and platooning technologies.

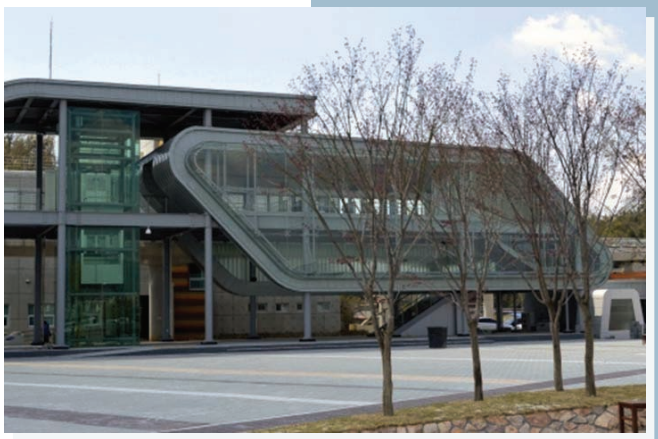
US-Swedish Collaboration

ATRA sees great significance in this and other smart car developments. “PRT is by definition a public project,” observes President Stan Young, who runs an ITS business as part of an incubator program at the University of Maryland. “We are seeing here the emergence of a type of advanced transit in the form of a consumer product. In the future, personally owned “crashless” cars will be capable of insertion into a smart guideway than powers it and gets it safely to any station in the network by itself.”

It is significant that *Autonmous Parking* comes from a Swedish company. ATRA Vice President Ingmar Andreasson, who once worked for Volvo, explains "The president of Volvo at that time stated that cars do not fit in large cities and we worked with public transport solutions. Now we see synergies in technology for PRT and cars." USDOT has a broad *Memorandum of Cooperation* with relevant Swedish Ministries. They and ATRA are cooperating with the International Institute for Sustainable Transportation (INIST) on the 7th *Podcar City* conference.

ASIAN PRT PROGRESSES

Attractive stations now serve passengers in Suncheon, South Korea, implemented by Vectus.



The 4.6km double-track Vectus PRT started trial runs last April, with two designer stations at a parking intercept and a nature preserve in Suncheon, South Korea. The first vehicle was commissioned in May, and rides for special guests began in late spring. Full public service is scheduled for the fall. Eventually there will be a fleet of forty vehicles that can run at 60km/hr and maybe future expensions. The costs of the project have not been made public. It is mostly financed by Vectus’s parent company Posco. The City of Suncheon is the owner. Daewo did most civil work.

In India, Sikh authorities have confirmed their support for Fairwood’s proposed PRT, presumably to be supplied by *Ultra*, now owned by the British Airports Authority. A network of 8km with seven stations has been tweaked to fit in the dense, historic city that houses the Sikh Golden Temple. Last fall the Punjab Infrastructure Development Board hired a consultant assess the proposed public-private partnership.

GEARING UP FOR PCC7

October 23-25
Washington DC
George Mason University in Arlington, Virginia

To see the provisional Program and to register, visit www.podcarcity.org

The Podcar City 7 in Washington DC is focusing on Innovations in Public Transit. This year has something very unique - the cooperation between US DOT and Swedish DOT, both together involved with the ATN community. These efforts are all under the Memorandum of Cooperation between Sweden and USA.

For Christer Lindstrom PCC7 Chairman it's an exciting environment to work in. We now operate under long term plans and alongside conventional transportation systems, and this is a big leap forward.As usual, the current year looks better than the last one in the ATN world. Since this year is so far a real success, what good things will follow in 2014?

Christer Lindstrom
PCC7 Chairman

SMALLER (and FLEXIBLE) IS BETTER

Copenhagen does bold things at affordable prices.

Engineers tend to like superlatives, especially for bigger and biggest. This sometimes gets in the way of practicality and eats up huge portions of budgets that are meant to serve many competing needs. If one projects takes $1 billion, there are fewer funds for ten $100 million projects, or for a hundred $10m efforts which in total may bring more benefits than that billion-dollar biggie.

Think of your city's street improvements program. Needs are prevalent, and funds are never commensurate to total needs, not even in the long run. If next year's budget is only so much, how do you best distribute it – across modes and across the urban (political) landscape?

Big projects just tend to be sexier. Last year a mainstream press article by journalist Stephen Smith ran over *bloomberg.com*. Smith lamented that rail transit consultants continue to develop hyper-expensive projects that "gouge" taxpayers. Examples include:

Manhattan's **Second Avenue Subway**: $2 billion for two miles (3km) for the starter of a project first proposed 75 years ago along a wide, straight arterial with no bridges or tunnels to cross, ultimately to cost over $17 billion for 8.5 miles (14 km).

Amtrak's **Northeast Corridor:** $151 billion serving the great Northeast – from Richmond to Boston or even farther if another $100 billion falls from heaven.

Time to Rethink Urban Transportation

Given this and our infrastructure "crisis", there is special interest in ATRA's mission to rethink transportation. Highway costs are staggering, squelching economic growth as funds go into the deep black hole of the oil-consuming highway system. Increasingly violent weather is waking up even climate change skeptics. There are urban life-style shifts as senior populations rise and alternative life styles go mainstream. Young people lust for the latest handheld device, not the hottest wheels like their parents and grandparents. Diverse neighborhood living with different lifestyles and mobility needs is flourishing.

As one of many scores of urban regions of a million residents, the capital of Texas - Austin is at a loss for ways to become more sustainable. How much can it get from a $500 million BRT system? How much more might be achieved with a 50-mile ATN? Will thousands of households eagerly buy into monthly subscriptions?

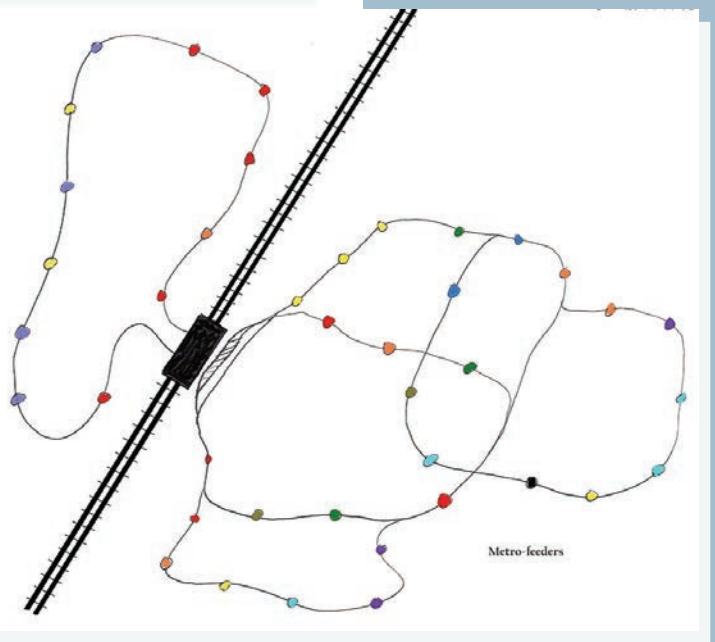
Albany and Albuquerque? Boise and Baltimore? MPO officials needs to reexamine urban infrastructure possibilities across these United States and beyond.

New Jersey? What ATN would unfold if a $1 billion were available to make it happen statewide? It alone would probably double rail ridership because it would do much easier to get around without owning a car.

UNCONGESTED MOBILITY FOR ALL: NJ's AREA-WIDE TAXI SYSTEM

By Alain Kornhauser, ATRA Chair

This year my students and I conducted a quantitative assessment of the mobility implications of the ultimate in Smart Driving Cars. The task was simple: how well could a truly safe fleet of self-driving cars serve the full spectrum of personal mobility needs?



ATNs can feed New Jersey's many existing rail stations, boosting ridership.

While the availability of such a fleet is more than a few years away, we assumed that the spatial and temporal aspects of children going to school, adults to work and the array of normal lifestyle activities would remain unchanged as they tend to occur on a typical weekday throughout New Jersey. We chose New Jersey, not only for local reasons, but also because, to the possible chagrin of some, New Jersey is actually a microcosm of the nation. It has an extremely rural south and northwest, sprawling suburbs in Central and Coastal and dense old and new urbanism in the northeast. It is served by an extensive commuter rail network yet the overwhelming majority of vehicular trips are currently served by the personal automobile. On a typical day, New Jersey

Transit serves 0.9 million of the 32m trips (2.8%) while walking and biking serve 2.3m (7.3%). The remaining 90% are by the personal automobile.

By "safe" we assumed a vehicle technology that is sufficiently reliable to yield at least the safety benefits touted for the Google car: 71% fewer accidents, 65% fewer injuries, 81% fewer fatalities. While very substantial, these safety enhancements are somewhat conservative, given the often repeated finding that "93% of automobile accidents involve human error" and the 2001 NHTSA report by Hendricks et al: "In 717 of the 723 crashes investigated (99%), a driver behavioral error caused or contributed to the crash. Of the 1284 drivers involved in these crashes, 732 drivers (57%) contributed in some way to the cause of their crash. …six causal factors…accounted for most of the problem behaviors: driver inattention 22.7%, vehicle speed 18.7%, alcohol impairment 18.2%, perceptual errors (looked, but didn't see) 15.1%, decision errors 10.1%, incapacitation (fell asleep) 6.4 %..." (p ii). Consequently, by adopting the Google values, we are implicitly assuming that Smart Driving Technology, while very good, is itself realistically not perfectly safe.

With respect to the operation of the fleet, assumed was that one or more fleet owner-operator(s) would emerge to provide the service. These owner-operators could be either public, not-for-profit or for-profit private operators. They would be responsible for the provision, operation and maintenance of the fleet of self-driving vehicles. A level-of-service would be offered that is comparable to conventional taxi services, except that no human driver would be involved in neither the passenger trip nor the repositioning of empty vehicles. Consequently, we've named the system an autonomous taxi (aTaxi) system.

Fare collection was put aside as irrelevant by the assumption that the level-of-service would be so compelling that essentially all "vehicular" trips would be served in some way by the aTaxi system. The enhanced mobility implications of the aTaxi system are assumed to dominate any negative utility implications of how the system is financed. This allowed us to sidestep the non-trivial mode choice issue and enabled us to address and ascertain the mobility implications of a very high-quality, full-blown aTaxi system.

To properly assess the aTaxi system's ability to serve essentially all trips, it is imperative to appropriately characterize each and every trip taken on a typical day. This was accomplished through the enhancement of an Individual Daily Trip Synthesizer (IDTS) recently by Princeton graduate and undergraduate students T. Mufti and J. Gao. IDTS begins with Census block data and builds a file representing each of the nearly 9 million New Jersey citizens characterized in the 2010 Census. Using the Journey-to-Work Census file, an additional 263,000 individuals are added to represent out-of-state residents that work in New Jersey. Each of these 9,054,821 individuals is assigned demographic characteristics such as age, gender, household size, family income, etc. that, when assembled, reflect the distribution of demographic characteristics reported in the Census data. The corresponding Census block centroid gives their home location to within a very short walk. To make the file a little more social, first and last names were assigned probabilistically to each individual from White Pages name-address files.

Based on an individual's demographic characteristics, a daily trip tour is assigned that begins and eventually ends at home. The very young, the very old, the sick and those incarcerated in prisons don't travel. The rest go to school, to work and/or to other demographic characteristics and school, employment and other activities, each with precise geographic location (geo-coded street address) and trip attraction characteristics such as employment levels, enrollments, and daily patrons. Each trip is assigned a departure time (in seconds from midnight) based on the trip type and the operational characteristics of the dominating trip end. For example, each school

and employer has a starting and ending “bell” time along with a parameter that characterizes the punctuality of the operation. Behavioral aspects, such as the fact that students tend to arrive early at school rather than late, are modeled in the non-symmetric probabilities used in assigning trip departure times.

The result of the trip synthesizing effort is the creation of a file containing the precise spatial and temporal values for each of more than 32 million trips. In total, these trips are representative of the desired mobility of all who travel in New Jersey on a typical weekday. Characteristics of one such realization of the trip synthesizer were reported by Gao.

The question becomes: how well does an aTaxi system serve such trips?

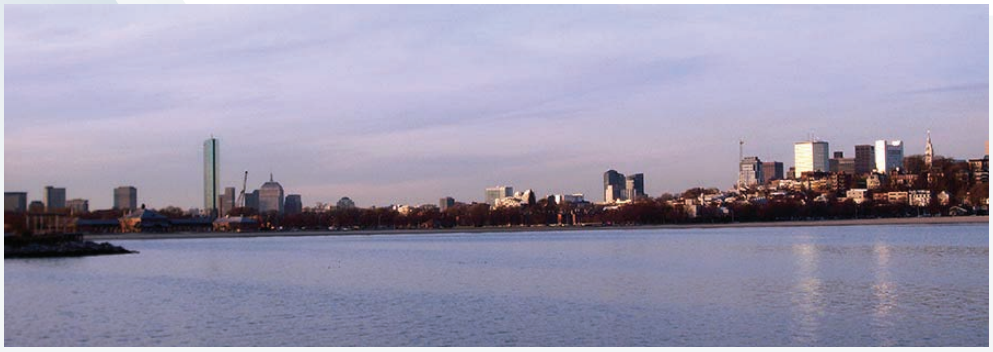
First, some trips are extremely short. Short trips, less than a mile in length (~7.3%), are taken by either walking or biking. Also, New Jersey has an excellent commuter rail system. Trips from/to New York City, Philadelphia and within a ¼ mile walk to a train station are assumed to use NJ Transit rail for at least a portion of the trip. Each of these trips takes NJ Transit to/from the other trip end’s nearest station with an aTaxi “multi-modal” segment completing the trip. The departure time of the non-NJ Transit segment is set to the appropriate train arrival, thus replicating the temporal bunching of onward trips following train arrivals.

In total, the analysis described above leaves almost 30 million trips that are to be served by the fleet of aTaxis on a typical day. The second part of this series will describe aTaxi service scenarios, similar to elevator services, which accommodate naturally occurring ride sharing opportunities. Taking advantage of these basically eliminates all congestion in New Jersey without the need for any infrastructure expansions. The third part of the series will describe the commensurate environmental and safety implications.

SEEDS PLANTED IN BOSTON

There are few friends of advanced transit in Massachusetts. For sure there are no vocal ones in positions of power with discretionary funds. This is true despite that fact that the father of the Morgantown PRT, a product of Harvard and Harvard Business School, was born in the Commonwealth of Massachusetts and still lives there! It is true despite – or maybe because of – Raytheon’s aborted PRT program. It is true despite great need for better urban transit.

In spite of this, four events took place last May catalyzed by Kjensmo Walker’s visit and presentation skills. These can help you in your city – but act fast before September. If you are willing to organize an event, contact her at *kjensmotwalker@gmail.com*.



Will Boston rethink its future mobility?

Several Small Events

At one briefing within the chambers of the Massachusetts State House, legislative staffers came to learn about potential benefits of superior transit. They were young and well aware that new urban citizens are more interested in devices and ridesharing than the hassles of owning a car. At another a Boston economist pointed out that many Boston neighbors already live without cars, making the dense neighborhoods where they live "ideal" candidates for smart networks of taxi-like transit service:

AREA	VEHICLES PER HOUSEHOLD
US	1.7
Massachusetts	1.6
City of Boston	0.9
Affluent downtown area	0.6

2010 US CENSUS

Environmental activist and professional planner Judeth van Hamm was instrumental in making these events take place. She organized a follow-up meeting with two suburban mayors – historic Quincy (as in John Quincy Adams) and nearby Weymouth. City councilors ("selectmen" in local parlance) also attended to learn about the potential of municipally developed mobility companies. Judeth will meet with several Boston neighborhood leaders as June closes. For info, email her at *one@hullportside.net*.

AMERICA NEEDS A SMART JOBS STRATEGY

Is it a good sign that American car makers are enjoying increased sales as "pent up demand" in the US gets satisfied? Obama won points for continued car production during his first term as he campaigned for re-election in 2008. Is his heart really not in urban Chicago, that needs better transit?

For a person or household to have and use a modest car requires an average of $5000 per year. According to Consumer Reports, the median cost of owning and operating a car is $9,100 – if your keep it five years — or $7,800 if you keep it eight years. For most Americans, a car is a necessity — not a luxury. Even an old vehicle eats up a quarter of a net income of $20,000.

Every year about ten million new vehicles are purchased in the US. In 2001 two-thirds were made by one of the Big Three – GM, Ford and Chrysler (many of the parts are imports). In 2008, the US share of the market was below 48%. US jobs in auto manufacturing fell below one million in 2007. By 2009 the figure dropped to 880,000, and in early 2012 it was down to 766,000. These are not happy times in the Auto Zone.

Transportation infrastructure creates many kinds of jobs.

ALBANY MPO BUZZ

Kjensmo Walker with Albany MPO Director Mike Franchini.

Last May, ATRA Secretary Kjensmo Walker and Event Organizer Larry Fabian visited the MPO serving Albany and the New York State capital region. The Capital District Transportation Committee (CDTC) planning staff's 13 members all attended the two-hour meeting.

The response was generally quite positive from these transit planners who were eager to learn more and investigate ATNs for their region. The possibilities of adding ATN in Albany's "airfront" strip – right along Wolf Road, where the meeting was held — attracted some attention. This was but one of several possible applications mentioned.

The planners were quick to point out the nature of Albany's transit planning process, which will take time to move on any new or different transit idea. It took the city of Albany a full decade to get the first line of a Bus Rapid Transit system in place, and the second is still years away. They pointed this out to illustrate that long process required to move forward with regional transit projects, including ATNs.

CDTC's Director Mike Franchini, who spent twelve years in disciplined military life after attending the US Coast Guard Academy and more than fifteen years in local government, saw great potential for ATN applications in this region of almost a million residents. "What are the barriers?" he asked. What benefits might come to SUNY (State University of NY, which has five campuses in this area)? What about state office buildings? Do robocars complement PRT, or is there a conflict?

Franchini is now starting an update of their long-range transportation plan, called New Visions. He said that ATN options will be explored during this process.

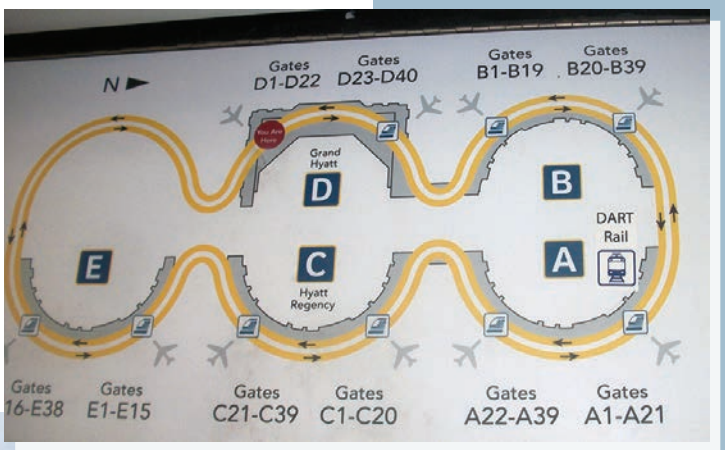
JUSTER WORK

Reuben Juster is one of a new crop of students whose forward-thinking curiosity with the potential benefits of advanced transit led him to study and write on some aspect of this broad topic. He recently received a Master of Science from the University of Maryland. His thesis is on A Trip Time Comparison of Automated Guideway Transit Systems. His advisor was Professor Paul Schonfeld of the Department of Civil and Environmental Engineering. Juster's work compares PRT to more conventional forms of APM using BeamED simulation software developed by Bengt Gustafsson of Sweden's Beamways. The thesis concludes that PRT is superior where trips are dispersed and performs well despite "biases" against it among transport practitioners.

Juster also worked with Professor Schonfeld on an internal circulation study in the Baltimore-Washington International Airport district for the Maryland Aviation Administration. This effort produced cost estimates of $120 million for a bus-retaining No Build scenario, $443m-$1,459m for various APM options and $183m-$491m for comparable PRT options. The build options resulted in significantly lower travel times and air emissions.

Both works are posted in their entirety on www.advancedtransit.org.

Dallas-Fort Worth, Texas: The upper-level airside (secured) *SkyLink* APM in 2005 replaced the earlier ground-level landside (unsecured) *Airtrans* which opened with difficulties and controversy in the 1970s. *SkyLink* dimensions are large like most things in Texas – 10 stations and 7.3km of two-way guideways. Today it carries about 38,000 transferring passengers on an average day running in opposite directions on the two tracks. In addition, there are an unknown number of workers and air passengers who seek shopping in the "showcase" Terminal D and its more elaborate retailing. Bombardier has about 100 staff on site to satisfy its



O&M obligations and another 20-25 airport staff are occupied with the APM. *SkyLink* was designed with room for two more stations to serve an additional Terminal F to be built in 5-10 years as international traffic grows. Next year a LRT from downtown Dallas will serve the airport with a walking link to the APM. In the long-run, a separate landside APM may connect to the car rental center and new airport administrative complex to be developed with a hotel, offices and retail. In addition and still in conceptual stages is a HSR line from Houston which might have its main Dallas station at DFW.

Dubai, United Arab Emirates: The economic setback of the global financial crisis of 2008 caused a halt in the strong growth experienced at the end of the 20th century and into the 21st. Given the oil and natural wealth of the region and political uncertainty in many neighboring countries, investment of Dubai as a safe haven has resumed. This is reflected in air traffic growth. Last April was 19% higher than in 2012. It is expected to reach 65m this year, making it that 3rd busiest international airport in the world. It is projected to reach 98m by 2020, and an APM underway will help accommodate this growth.

Oakland, California: An almost half-billion project to create a 5km APM underway between Oakland Airport and a station of the regional BART rail network is under-

way. Many complain of the high cost. One advanced transit developer in 2009 said it “unquestionably is a boondoogle” in the strange world of California politics. The project has faced extra challenges because of the unfamiliar tubular guideway. Because it is unknown to BART and Caltrans officials, the burden of proof has been put on the consortium of consultants and suppliers. It is scheduled to open next year with Doppelmayr *CableLiner* technology, which was implemented easily and cost-effectively at Toronto Airport and in Las Vegas casino complexes.

Stockholm, Sweden: There have been preliminary studies of a PRT system between Arlanda Airport and the nearby town of Sigtuna is the past. Now a more formal process is in place with involvement of stakeholders- the airport, the town, developers and others – with a modest budget of about $100,000.