REASONS WHY PEOPLE MOVERS ARE UNDERUTILIZED IN SOLVING TRAFFIC PROBLEMS

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ABSTRACT

This paper presents constraints which have prevented People Movers from securing a noticeable place in the marketplace and offers some recipes for a broad introduction of People Mover systems to the worldwide transit market. Several issues are raised, and they include the following:

- AGT Market Growth and Share;
- AGT Technology Suppliers;
- PRT Quest - An Inventor Syndrome;
- Misperception of Technology Capabilities;
- Misperception of Technology Costs;
- Proven in Operation Dilemma;
- Destructive Role of Consultants in Technology Progress;
- AGT Procurement and Specification Science;
- The Under-appreciated Guideways;
- Others.

This paper also goes into the topics of how, from over 200 technologies developed to date, only a few have remained in the market, how People Mover suppliers have been driven out of business, and how a 1960's product has dominated the worldwide AGT market. In addition, this paper discusses the overwhelming ratio of consultants to suppliers and feasibility studies versus installations, specification impact on innovation and cost, and reversed trends in procurement methods. Further, it discusses the inability of decision-makers and funding paradox, and summarizes the status of AGT industry in the beginning of this new millennium.

AGT MARKET GROWTH AND SHARE

In the last 20 years, the Automated Guideway Transit (AGT) market size has quadrupled, despite a sharp decline in the middle of the 1990's, which gave way to a noticeable recovery. At its peak in 1990, the market size surged to approximately $8.8 billion. Then, in 2002, it stabilized to $7.2 billion. Figure 1 illustrates market trends since 1983.

It is difficult to precisely determine what is included in cost figures and what is not. As a general "rule of thumb", civil work outside of a "turnkey" contract (if applicable) is excluded from this amount. The percentage of the large system segment has been quite stable, but with very few projects. Medium and small system project quantities fluctuate extensively; however, they will increase dramatically in the next two to three years, as illustrated in Jakes Associates, Inc.'s "Upcoming Automated Guideway Transit Project" bi-annual database, which is available to the industry on a subscription basis. The medium size segment has more than quadrupled in the last five years, reaching nearly the $2 billion level. Similarly, the small system market segment has doubled in the last five years, reaching the $800 million level with its peak level of $900 million in 1990.

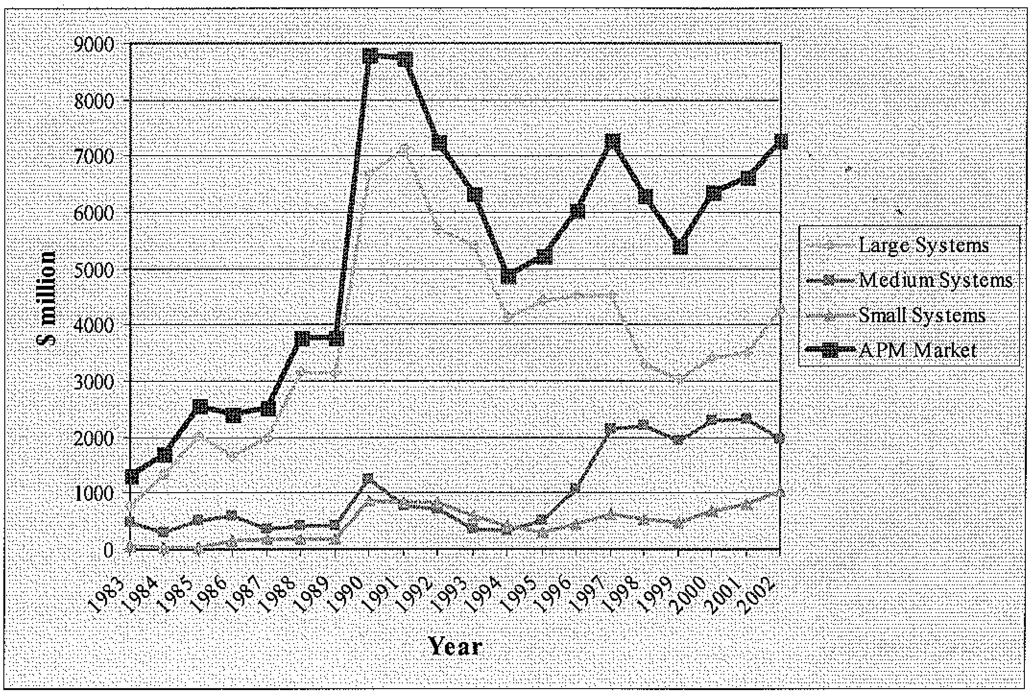

Figure 1. Worldwide AGT Market Growth.

The definition adopted to distinguish between large, medium, and small AGT categories is somewhat flexible and not necessarily dependent upon the level of cost for a given project, although the large system group consists primarily of metropolitan scale systems, and many of them reach cost levels of hundreds of millions of dollars. Examples include the Vancouver (Canada) Skytrain, Lille (France) VAL System, and Yokohama (Japan) Seaside Line.

The medium size group typically includes many institutional size systems with a variety of cost levels, having a size range over $50 million (civil work excluded). Examples include both Miami and Detroit Downtown People Movers. The remaining systems have been grouped under the small size category. Examples include the Getty Museum (California) and Mystic Center (Massachusetts) shuttle installations. This analysis serves purely to establish the total dollar value of the People Mover market and its fluctuations over the coming years.

Approximately 60% of these installations have been for public clients (including approximately 20% for airports). Over 50% of these installations have occurred in North America, with Europe and Asia being in the twenty percent range. Large/medium AGT types of installations amount to 50% (with Bombardier CX-100 being the most typical example of AGT), monorails 35%, and rope/belt-propelled shuttles 15%.

AGT TECHNOLOGY SUPPLIERS

Tables 1 to 3 summarize the wealth of technological effort and achievement in the last forty years. Most of the technologies, although technically feasible, are no longer available in the market. The list is not exhaustive. Rather, it simply illustrates enormous intellectual and financial capital, which has not been taken advantage of by the transit market. The reason why these technologies are no longer available, besides the fact that many of their promoters have gone out of business, is very straight forward. The only market segment that has consistently performed to provide a flow of projects is the large airport market. As most airport installations are based on the same technology, the result has been that other suppliers were not able to sustain their activities with occasional projects and aggressive competition.

PRT QUEST – AN INVENTOR SYNDROME

As Personal Rapid Transit (PRT) technologies dominate the research and developmental efforts as shown in the tables below, PRT deserves a dedicated discussion. With Raytheon's withdrawal from development of Personal Rapid Transit (Raytheon PRT 2000 technology), the introduction of PRT is destined for a multi-year setback, in spite of significant amounts of media publicity. PRT programs have always been historically ill-balanced, and their destiny has not changed since the 1960's, despite the broad availability of advanced technologies.

PRT technology is primarily dedicated to communities typically with low density and highly localized activities, such as SeaTac (outside of Seattle, Washington), where the implementation of PRT has been analyzed for years. At the estimated cost of $260 million, it is unthinkable that any community of SeaTac's size would be able to afford PRT without funding assistance from the federal government. Since thousands of communities like this exist in the U.S., it is unlikely that the federal government would enter into a program in which hundreds of applications would be submitted annually. The private franchise option, which was explored by Raytheon, cannot work in such communities, since no tangible revenue stream of a necessary magnitude can be identified either from the projected ridership or related developments and activities.

As Raytheon was unable to reduce their costs (which can only be accomplished by an economy of scale, since the technology is inherently expensive), PRT will remain on various test tracks and may soon be temporarily forgotten. The political momentum, which has been created as a result of PRT publicity (including the APTA strategic report), may keep the idea alive, as no other high technology alternative exists at the present time. However, this may only generate additional studies, with no eventual opportunities for implementation (lost with Raytheon's deal for the first demonstration in Rosemont, outside of Chicago, Illinois).

MISPERCEPTION OF TECHNOLOGY CAPABILITIES

Since the early 1970's, when The N.D. Lea Transportation Research Corporation (a non-profit organization) ceased publishing *The Lea Transit Compendium*, meaningful classification of transit technologies has been absent, particularly from the point of view of the promise they hold for solving urban congestion and pollution in a substantial way.

A limited number of technology review reports (developed in the last thirty years) are typically quite confusing, as they have focused on gathering engineering details (frequently outdated and misleading) rather than on interpretation of technological value for specific types of applications. Typically, a technology assessment is treated as a task in feasibility studies, where a bias towards a specific technology already exists prior to the study implementation. As a result, many unsuccessful transit projects have been implemented with a negative return-on-investment and extremely disappointing ridership.

Table 1. Automated People Mover Technologies.

Status	Type	Supplier	Description
Currently Available	Straddle	Aerobus International	
		Aeromovel Global	Aeromovel
		Alstom Transport	
		AnsaldoBreda	
		Bombardier Transportation	CX-100, C-45, ALRT, Wedway, M-Bahn
		Cybertran	
		Futrex	
		HSST	
		IHI/Niigata Transys	New Tram (NTS)
		Kawasaki Heavy Industries	Portliner
		Leitner	
		Maglev 2000	
		MegaRail Transportation	MegaRail
		Nippon Sharyo	Vona
		Otis/Nippon Otis	LIM System
		Poma-Otis Transportation	Shuttle
		ROTEM	
		Samsung	
		SDI	
		SNC-Lavalin	
		STS	VAL
		Sumitomo/Mitsubishi Heavy	Crystal Mover
	Suspended	STS	SIPEM (H-Bahn)
No Longer Available	Straddle	Actrams	
		Airtrans	
		Alden	Starrcar
		American Maglev	
		Bendix	
		Bertin & Cie	Tridim Aerotrain
		BN/ACEC	TAU
		Bourassa	Metromatic
		Briway	
		D.K. Paul	EITO
		Dashaveyor	
		Deleuw, Cather	Comprehensive Transit
		Ford	MiniTram
		GEC	
		Harmathy	Relay Race
		Hawker Siddeley	MiniTram
		Hitachi	Paratran
		Knolle Magnetrans	
		Kobe Steel	KRT
		Krauss-Maffei	Transurban
		Linear Air Motors	Insta-Glide
		Mitsubishi	Mat
		Mono Tri-Rails	Mono Tri-Rails
		Schindler	Sky Rabbit
		Transville	
		Uniflo Systems	Uniflo
		UTDC	LCTS
		Vought	ACT
	Suspended	AAI	SLRV
		American Guideway Corp.	SLRV
		Piasecki Aircraft	SLRV
		Rohr	Monocab
		Transyt Canada	SLRV

Table 2. Personal Rapid Transit and Group Rapid Transit Technologies.

Status	Type	Supplier	Description
Currently Available	Bottom-Supported	Aerovision	People Pod
		Austrans	
		Axar	
		Axar Transport	
		Bishop Austrans Ltd.	Austrans
		Bristol PRT	
		Cimmaron	
		Computer-Taxi Guideway System	
		CyberTran International Inc.	CyberTran
		Hoffman Transit	
		Intamin	PRT
		Kor's Solo	
		Megarail Transportation Systems	Microrail
		Mitchell	
		Nettrans	Cybertcab
		Otis	Network
		RUF International	
		Sa Turn	
		Systel	
		Taxi 2000	Taxi 2000 System
		Topway	
		Turn	
		Ultra-Wave Guided PRT	
		UPRT	
		Urbanaut	
	Suspended	Higherway Transit Research	The Baz, The Owl, Other
		Intamin	PRT
		Mitchell Transit Systems, Inc.	
		Pathfinder	Pathfinder
		Personal Mass Transit	
		PRT Advanced-Maglev Systems	
		Skycab	Skycab
		Skyparade	
		Stig Aby's Netcab	Flyway
		Swedetrack System, AB	Swedetrack
		Titan PRT Systems	
		WGH Ltd.	
No Longer Available	Bottom-Supported	Aerospace Corp	Advanced PRT
		ATS	Alpha
		Bendix	
		Boeing	
		Cabintaxi Corp.	Cabintaxi
		Engins - Matra	Aramis
		Fried. Krupp	Kompaktbahn
		Kawasaki Heavy Industries	KCV
		Mitsubishi	Transcab
		PRT Corp.	
		Pullman	Aerial Transit "Palomino"
		Raytheon	PRT 2000
		Toyo Kogyo/Mitsubishi	CVC
		Transport & Rd Research	Cabtrack, Autotaxi
		UMTA	High Performance PRT
		Woo-bo	
	Suspended	Cabintaxi Corp.	Cabin Lift, C-Lift
		PRT Systems	
		SIG	

Table 3. Monorail Technologies.

Status	Type	Supplier	Description
Currently Available	Straddle	Bombardier Transportation	M-VI, UM, VR Type
		Eurotren Monoviga	
		Intamin	People Porter
		Mitsui/Hitachi	
		Severn Lamb	
		Urbanaut	
	Suspended	Aerorail	
		Arrow Dynamics	
		Holland	
		Intamin	
		Mitsubishi Heavy	Townliner, Skyrail
		Siemens	Sipem/H-Bahn
		Titan PRT Systems	Jetrail, Astroglide
	Side Guided	Futrex	System 21
		Owen Transit Systems	
No Longer Available	Straddle	Alweg	
		Bendix	
		CPM	
		Dashawyeor	Minimonorail
		Rohr	
		Schwarzkopf	
		Tokyo Shibaura	
		Universal Design	
		Universal Mobility	Unimobil
		Wabco	
	Suspended	American Crane & Hoist	Skyway
		AMF	
		Compagnie d'Energetigue	Urba 30
		Monorail	Gyroglide
		Northrop Norair	
		Safege	
		St. Louis Car Co	
		The N. Amer. Monorail	

Considering the limited reference sources and their questionable quality, there is a need for a customized methodology that would emphasize the practical aspect of technology implementation rather than a scientific and detailed engineering approach, which often confuses decision-makers. There have been many names assigned to technology groups over the years, such as Group Rapid Transit (GRT) or Shuttle-Loop Transit (SLT). Multiple names have been used to describe the same type of systems, such as Automated Guideway Transit (AGT) and Automated People Movers (APM).

Consultants should be careful in classifying technologies according to their capacity, cost, headways, dimensions, radii, and other factors. These types of characteristics can be very misleading. For example, the Narita International Airport (Tokyo, Japan) cable-driven shuttle, with only two trains, carries 12,000 passengers per hour per direction, whereas the Santa Clara Valley (California) light rail system, with 50 trains of similar size, carries only approximately 14,000 passengers per day per direction, due to the underutilization of the technology.

In general, system performance and capacities can be tailored to match expected loads to meet the functional requirements for various applications. Vehicle size can be expanded or reduced. Seats can be added or removed from vehicles. Various grades and curves can be accommodated by altering guideway design and speeds. The grades are often limited by passenger comfort and safety rather than technology limitations. This is true for most AGT technologies.

System classification becomes further complicated by emerging trends. Conventional Rapid Transit Systems are heading towards automation (for example, Paris Metro). This trend will accelerate, thus eliminating the fine line between manually driven systems (such as the Washington Metro, U.S.) and automated, advanced systems (such as the Vancouver Skytrain, Canada and the New Tokyo Waterfront System, Japan). As a result, classifications may require revision to keep pace with the evolution of technology.

To summarize, technology classification should be structured in a practical way to assist potential buyers in providing for an increase in urban mobility through the application of appropriate and sufficiently proven transit technologies. The emphasis should be on answering the fundamental question of "How can a transit system be implemented in such way that high efficiency at peak hours and low cost at off-peak hours are ensured?"

MISPERCEPTION OF TECHNOLOGY COSTS

There are widespread misconceptions regarding the actual cost of People Movers. The general perception is that People Movers are more expensive than they really are. This perception further hinders the consideration of People Movers for a larger range of applications. It is an unfortunate characteristic of the People Mover industry that there is no reliable source of cost information available in the market. As organizations, such as American Public Transit Association (APTA), conduct numerous studies on the cost of conventional transit (particularly light rail transit), their data source documents for People Movers are virtually non-existent and list only large, public AGT systems on the top level of detail.

Based upon poor understanding of the People Mover system cost structure, it is not unusual for most consultants to inflate their cost estimates for People Mover systems in their feasibility studies. There is no steadfast cost estimating guideline, and the whole process remains a mystery to a large portion of consultants who strictly rely on supplier inputs, which are becoming increasingly difficult to obtain. Furthermore, it is not unusual for suppliers to inflate their numbers out of their lack of commitment to specific market segments.

In a recent market survey (which targeted transit officials, consultants, and various decision-makers), the high cost of transit systems was rated as the number one implementation constraining factor (among many other important factors). In fact, the need for improved cost effectiveness ranked first among 43% of respondents as being the primary problem in the transportation industry. This clearly presents the overwhelming need for systems requiring lower capital cost investment and increased cost effectiveness.

Private real estate developers appear only to be willing to invest three to five percent of the total development cost for an internal transportation system, which typically translates into only a few million dollars. This level of investment is insufficient to implement a typical APM technology system, although it is quite substantial if one considers the collective number of potential applications (a mass market approach).

For example, the total cost for the privately funded Indianapolis People Mover system in a very complex urban environment (extensive 100-year old underground utilities, historic districts, and others) was approximately $42 million. It consists of a 2.5-km guideway and three elevated, fully enclosed stations with overhead air-conditioned walkways, linking the stations to adjacent buildings. Based on an exhaustive comparison of its features with typical airport technical specification requirements (which are the most established in the industry), this fully automated technology has everything to offer in comparison with any of the existing airport People Mover installations, except the fully-proven switch (which can be rapidly demonstrated). The Mandalay Bay Express system in Las Vegas, Nevada, was built in nine months for $17.9 million (stations excluded). Since its opening in April 1999, it has carried millions of satisfied passengers without a single incident in a similar fashion as any other airport installation.

In contrast, a similar People Mover system for the Oakland International Airport has been estimated by consultants to be in excess of $270 million, whereas the cost estimate from

Schwager Davis Inc. (SDI), a design/build contractor based in San Jose, California, was below $100 million. Why spend $270 million when one can accomplish the same task for $100 million? As another example, consultants have estimated a similar system for the San Jose International Airport in the $80 million range (depending on the option); however, the system could be built easily for half of this cost, particularly that it is substantially shorter and has a capacity of only 600 pphpd (depending on the ridership estimate revision). Historically, it has been a practice to use engineer's cost estimate as basis for the bidding process and simply spend the money. Therefore, it is important not to inflate budgets just in case, as they are always being spent regardless of the actual financial needs of the project.

PROVEN IN OPERATION DILEMMA

Proven in operation, requirements by public buyers and their consultants hinder technological progress. Few public authorities have ever considered a demonstration project based on emerging transit system technology. On the other hand, several prototype systems have been rapidly demonstrated in Las Vegas and, more recently, in Indianapolis without any problems, with over 200 million satisfied passengers just in the last couple of years. The Las Vegas experience is proof that advanced transit technology is an undisputed solution for affordability and popularity of transit. It just needs to be recognized by the planners and decision-makers.

DESTRUCTIVE ROLE OF CONSULTANTS IN TECHNOLOGY PROGRESS

The recent best-selling books, *Dangerous Company* and *Consulting Demos*, have finally dared to expose the rapidly increasing role of consultants in worldwide business. Similar books could be easily written from the impact of consultants on the transit business, particularly in the last ten to twenty years. The destructive role of transit consultants is especially evident in the advancement of People Mover technologies and their introduction into mainstream transit business. The existing 'army' of consultants has been expanding exponentially, whereas the number of transit suppliers has been shrinking. In addition, the best talents from suppliers have been absorbed by consulting firms over the years. However, these individuals actually represent only a fraction of the current consulting force, which consists primarily of individuals with limited hands-on design and implementation experiences.

There are numerous market barriers to People Mover implementation (perception, non-proven in urban applications, conventional transit lobbying, consultant bias, conservative government policies, political structure obstacles, and others). Among all constraints, the most overwhelming is consultant bias, since most consultant revenues are derived from conventional transit projects. Big consulting firms are too entrenched in market mechanisms and are becoming very powerful. There are numerous transportation consulting firms thriving on the frequent inability of transit decision-makers to make decisions (the "Has the consultant studied it yet?" type of approach). Transit consultants tend to behave like therapists; they like multiple sessions to prolong the good feeling that frequently evaporates when real world implementation comes into play.

In addition to the aforementioned comments on the misrepresented costs of People Movers by consultants, the actions of many consultants further contribute to unnecessary cost escalation. Particularly, the established trend to separate the guideway portion of the scope of work from the system portion is a perfect example of eliminating engineering creativity and driving the overall system cost out of perspective by designing and building generic guideways. As most of the cost of People Mover systems is in their infrastructure, selecting the conceivably most expensive guideway eliminates all possibilities for cost savings.

There is no need to go as far as a recent issue of *Business Week* magazine, which boldly suggests, "First, Let's Kill All the Consultants." Instead of "killing" them, let's educate them. However, the question is "Who is going to do that?", as there are probably a few hundred consultants for every People Mover designer. With no one to educate the consultants, it is no wonder that there is nobody out there to educate the decision-makers. Subsequently, overall market perceptions about People Mover capabilities and costs have become highly distorted. Such education is very important, as many feasibility studies 'cranked out' by well-known consulting firms mislead the decision-makers and very often do not make much sense.

The results of this "consultant conundrum" are readily apparent and are devastating to the People Mover industry, resulting in transit system cost escalation, reduced technical innovation, more of the same type of work, prolonged schedules, enormous paper work, and thousands of reports written annually with very few actual installations.

AGT PROCUREMENT AND SPECIFICATION SCIENCE

There are many elements necessary for project success, with the selection of procurement methodology being the key, which encompasses a variety of aspects. Keeping the procurement process open to as many companies and technologies as possible is a good way to keep prices down. Even if one technology or company is preferred or expected to win the job, a competition is likely to result in a more competitive price than a "sole-source" procurement. The procurement should be structured to make the competition attractive to potential bidders based upon the custom nature and complexity of the project.

Another important element is clever scoping (and enforcing) of preliminary engineering objectives (as an element of the procurement process), whose outcome will have an enormous impact on project costs. Alignment complexity, in combination with the lack of understanding of technological constraints and impacts, may result in final alignments that are certainly feasible by selected technologies, but expensive in implementation and detrimental in performance. Intermediate station locations also play an important role. Typically, consulting firms rely on design and cost inputs from candidate suppliers and add 'heavy' mark-ups 'just in case'. One may say that marking up may not be that bad since these types of projects often go beyond budget. However, this approach would result in a more costly final product, but not necessarily better.

Redesigning the wheel is a common practice in this market. Performance specifications, not detailed design guidebooks as for recent airport projects, are needed. The newly adopted Automated People Mover standards and codes specify most of the requirements in detail. What is the point of rephrasing them if the codes supersede it anyway? While specifications are absolutely necessary for an airport project success, these documents should not be judged by the number of pages, but by their "smart" contents.

To meet system cost objectives, it is also important that the system be designed appropriately. Providing excess capacity or speed beyond what is necessary will increase costs, with no increase in the utility of the system. Similarly, specifying unrealistic system availability might discourage qualified bidders or result in price escalations to the point of beyond the project budget. It is important to avoid specifying performance levels beyond those that are actually required. With an evolutionary technology, improvements may be made to the technology midway through the contract period of performance. Allowing the supplier to include such changes may reduce system price, improve performance, or even both. Prohibiting such changes due to a rigid procurement structure would be ineffective. Similarly, onerous terms and conditions are likely to cause bidders to increase their prices to cover risks or uncertainties on their part, or even withdraw from the competition.

THE UNDER-APPRECIATED GUIDEWAYS

Guideways or tunnels typically amount to over 60% of the People Mover project cost. Therefore, there is a strong incentive to reduce the cost of infrastructure. The trend has been to separate guideways and stations from the overall People Mover contracts into separate Request for Proposals packages, requiring expensive and complex system integration in the course of the project. The trend has been to design and build generic concrete guideways to suit all candidate technologies. But in practice, the CX-100 technology and its competitors have different guideway designs, hence forcing candidate suppliers to modify their technology in order to be allowed to compete. The guideway for the CX-100 technology was conceived during the oil price crisis when federal grants were generously floating around, and all emphasis was on technology, not infrastructure. By preventing cost effective guideway concepts, the People Mover buyers set themselves up for high costs, often totally prohibitive.

CONCLUSIONS

There is really no simple recipe for broad and rapid introduction of People Mover systems to the worldwide transit market. It will occur when the needs of the market start to accelerate due to prohibitive congestion. In the meantime, there is an urgent need to educate the People Mover buyers, as they are often subjected to a number of misconceptions, which can be summarized as follows:

- Do not be intimidated by the procurement and specification "science". It is likely that your specification is nearly a copy of the previous specification for somebody else. The newly adopted ASCE APM standards and codes define it all.
- Integrate guideways, stations, and technology into one design-build package and save millions. Consider different guideway designs, including steel guideways, if cost beneficial.
- Separate People Mover consulting contracts from larger terminal architectural and engineering packages. Never award sole source contracts to consultants without checking your options and opportunities. Do not be blinded with the "more of the same" approach. Balance your risks with enormous opportunity for cost savings. The risks can be easily mitigated.
- Initiate direct contact with candidate suppliers and listen to them without a consultant's presence to develop your own opinion. Educate yourself rather than merely allowing your consultant to educate you. After all, in the transit industry, there are probably a hundred consulting firms per supplier (hopefully, they won't be extinct). Consultants can be "Dangerous Company".
- Always seek a second (or third) opinion in the case of large, complex projects. Do not underestimate the importance of peer review. Bringing a seasoned individual consultant as opposed to a firm, even from overseas for a few days, may result in multi-million dollar savings.
- Keep balance between proven and unproven technologies, but recognize proven technologies in similar applications. With additional guarantees, it may be sufficient for what is needed (if proven in operation would apply to all aspects of our lives, the human race would have been extinct by now).
- Consider cargo movement in addition to passenger movement to boost profitability.
- Think "out of the box"; make People Movers affordable without compromising, or simply continue to overpay.

The future People Mover market is hindered rather than accelerated by its past. The last century, especially the last thirty years, has been technology driven. Transportation technologies, contrary to other fields, have stood still on a system level, with some innovation on a subsystem and component level. The primary question we need to pose is: How will the People Mover market look ten or fifteen years from now? Will we have more of the same, or experience a breakthrough in demonstrations and result in market expansion?

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