2000 ,

Table 4
A comparison between Skytrain and LRT operating on the Skytrain corridor

LINE	EXISTING AGT SKYTRAIN	EXISTING LRT IN PORTLAND	"CONVERSION FACTOR"	SIMULATED LRT ON SKYTRAIN
Length (km)	24.7	24.3		21.4
Stations	17	28		17
P.H. Trains on line	28 x 4 cars	11 x 2 cars		19 x 3 cars'
P.H. Trains per hour	24 x 4 cars	8 x 2 cars		15 x 3 cars
P.H. Headway	2.5 minutes	7.5 minutes		4 minutes
P.H. Capacity	7,200	2,656		7,470
Base Trains on line	14 x 4 cars	8 x 2 cars		15 x 2 cars'
Base Trains per hour	12 x 4 cars	4 x 2 cars		12 x 2 cars
Base Headway	5 minutes	15 minutes		5 minutes
Cars Required	130 AGT	26 (LRV)		66 (LRV)
Boarding Passengers (million/year)	33	7.5		33
Passengers/km (million/year)	408	91		408
Staff				
Operations				
Administration	4	3		6
Control/Supervisors	24	11	P.H. Trains	1
Operators	-	36	P.H. Trains	62
Feld Operations	76	-		18'
Maintenance				
Administration/Finance	44	14	Cars	36
Vehicles	67	33	Cars	83
Power	14	4	Length	4
Signals	11	5	Signalled Length	10
Trackway	21	9	Length x Trains	16
Stations	Contracted	4	Pass. x Stations	11
Lins/Fare Machines	Contracted	6	Passengers	26
Fare Inspection	Included	10	Passengers	44
Security	12	1	Passengers x 2	9
Contingency***	N/A	N/A		34 (10%)
Total Staff (Excludes Contract Staff)	326	136		378
1991 Budget in $ millions"	27.6	7.7	Total Staff	21.4
Passenger/km/Employee million	1.25	.67		1.08
Cost/Passenger-km cents	6.8	8.5		5.2

- Assumes 6 key stations have an anendant part time.
- Assumes average trip length is half line length.

***Contingency provides additional staff to cover extra non-peak service, and supervision, maintenance, etc. thereof.
LRT includes extra train to allow operator layover time.
" Includes cost of contracted work.

In some comparative studies, the capital cost difference has been reduced by loading the cost of the LRT option. For instance in Vancouver it was insisted that the LRT option would need to be grade separated because there was heavy cross traffic at a few crossings. A recent study in Rennes [4], claimed that the LRT would cause "havoc" in the pedestrianized historic center, and so 3 km of subway was assumed in a 9.3 km corridor, for both the LRT and AGT options. Presumably this subway can be constructed without causing havoc in the central area!

A particular problem with a proprietary mode is matching equipment in future years. As technology develops, old systems become obsolete, and hard to match. Orders may be small, and there may be only one source of supply. A recent order for 16 Skytrain cars cost almost $2 million each, about the same as a light rail car having more than twice the capacity.

7.2 Operating Costs

The nature of any fixed transit requires the presence of staff on trains or on platforms to deal with the service disruptions and delays that inevitably occur in the real world. Technical malfunctions, stuck doors, real, false,

or malicious alarms, passenger emergencies, and accidents occur frequently. Most systems cannot wait while personnel are sent out by road to every incident, particularly if close headways are operated. On LRT systems, these problems are handled by the operator. On AGT systems, line personnel are required to compensate for the absence of operators.

On AGT systems, the increased complexity of the cars, trackway, and supporting equipment requires larger maintenance crews, and more, and more expensive maintenance parts. The location of AGT stations away from public streets tends to increase surveillance requirements. It appears to be for these reasons that the frequent claim that automatic operation saves operating costs is not supported by data from the systems built so far.

7.3 Reliability

Reliability is a key attribute of a transit system, and essential to attract discretionary riders. Almost all transit systems claim high reliability, and it is sometimes difficult to penetrate beyond the public relations to obtain real-life reliability data. What is the real consequence to passengers of 99.9% vs 99.2% availability (actual rates achieved by VAL.)

Typically AGT systems are highly dependent on centralized control and from that dependence comes vulnerability for a local problem to become systemwide. The safety policies and equipment needed to allow unmanned operation also create numerous opportunities for false actuation, and require cumbersome procedures to restart operations. When an AGT system shuts down, each activity, such as evacuating passengers, getting to the problem, providing a "bus bridge", and even restarting trains is attended by great complexity.

By contrast LRT vehicles operate with a high degree of autonomy, and have great versatility to respond to localized problems. System shutdowns are extremely rare. A well designed LRT will include procedures to continue operations in the event of the failure of almost every element of the system.

Comprehensive records are not available for Skytrain. However a report in the local press on October 9th 1991 describes 2 failures in 2 days, and goes on to list four other major failures in the past year. The following day, the Mayor of Vancouver is quoted as questioning the wisdom of building extensions to the Skytrain system. The Skytrain operation in Toronto recently shut down for several weeks for modifications.

On the VAL system, a March 1990 report in the local press describes four shutdowns in one week, one of them caused by a cat on the track. In 1990 VAL is reported to have shut down 8 times, twice for more than 6 hours. In 1988 the entire VAL system was shut down for 36 days to modify the control system. Hopefully the recently opened VAL line to Orly Airport will prove more reliable.

The reliability of Docklands has been worse. Currently the system is supported by a back-up parallel bus service, and is shut down completely on evenings and week-ends. It was recently closed completely for several weeks for modifications.
LRT systems are designed on the assumption that things will sometimes go wrong, and that when they do, service must be maintained. Sidings, cross-over tracks, and alternative operating procedures are provided as a response to "how does it work when it doesn't work".

In Portland, any train operating more than two minutes off schedule must report the delay, which is recorded in the daily log. A review of the log for the Portland LRT for 1990/91 reveals months of almost eventless operations. Individual trains are delayed a few minutes by vehicles in the trackway, minor accidents, bridge openings, or by large numbers of wheelchair boardings. The procedure for emergency single track operation can be implemented instantly by radio, and adds only about 12 minutes to travel time. During the year 1990/91 there were three delays to trains of more than half an hour, each affecting a single train. None of these exceeded one hour. In addition, in January 1991, a severe ice storm resulted in the overhead power line burning through in 3 places. The system was shut down for the first time in 5 years, for 7 hours, and bus service substituted. A new Standard Operating Procedure (SOP) has been issued to prevent a reoccurrence.

Similar levels of reliability are reported from Sacramento. Systemwide shutdowns are unknown, but about once a year a major problem, such as damage to the overhead requires the line to operate in two pieces, with a