portation mode in an area; it must be one part of a family of modes that serves an urban area.

It was observed that there is no simple solution to the problem of modal transfer. The facility design, for example, depends on whether the transfer point serves a distribution or collection function. The size of the passenger volume involved is equally important.

Two schools of thought were identified in regard to the layout and functions of transit systems in metropolitan areas. One holds that there is only need for services that run point to point (a radial system) without transfers. The other holds that, in a comprehensive service (a grid system) for a metropolitan area, there are too many trips that have too little volume to permit all-day point-to-point service and that, therefore, some transferring is essential. Further discussion of this issue centered on two points. First, in the United States a transfer has a negative consumer connotation because in recent years the use of transfers has not been well executed; there are a few cities in Canada in which they have been handled well. Second, pricing is very important in making transfers acceptable. In addition to financial disincentives, it was also felt that inclement weather and the fear of crime deterred the use of transfers.

The idea of time as a factor in choosing whether or not to take advantage of a transfer was also discussed. This is important in facility design in terms of providing a dispersal function for two modes that have different headway characteristics; i.e., if one mode is delayed, the transfer is missed, and the transfer ride is lost. The particular circumstances in local situations should be the factor that dictates the facility requirements. How quickly people can be moved from one mode to another may determine the success of the design. If a large volume of people must be moved through a transfer point, grade separation may become a major means of making transfers workable and attractive to riders. However, in other settings it may not be needed at all. It depends entirely on the make-up and match of the headways involved. Reliability is seen as critical.

It was observed that in Europe one mode is selected to serve one particular travel desire and other modes are coordinated with it. In the United States, United Kingdom, and Canada, bus and rail usually compete, but this depends on local circumstances. One participant stated that in Boston, for example, the commuter bus competes with the commuter rail because of their bases in historic services. Before the Massachusetts Bay Transportation Authority (MBTA) owned both, they competed; now that MBTA owns both, they still compete. In Cleveland, before the rapid transit system was established, the buses operated several express services directly into the central business district (CBD). Now that the buses turn back at the rapid transit stations, many patrons were lost and have still to be regained. In the case of Toronto, there were never large express surface services into the CBD. Participants stated that many communities are beginning to realize the utility of having two services.

It was felt that damaging competition was the result of organizational in-fighting and that the United States has not been very sophisticated in terms of finding ways of constructing incentives within the marketplace for coordination and cooperation between competing operators. The growth of federal programs that subsidize operations should permit the development of ideas that support cooperation. Furthermore, there has been a tendency in the last 10 years to believe the solution to this problem lies in the acquisition of the competing operators and their consolidation into a larger and larger operation under public ownership. It was felt that this creates larger and more difficult management problems. It is more difficult to promote coordination in operations that cover a large area with thousands of buses but have a very narrow range of management control. More attention should be given to finding ways of creating incentives for the operators and looking for new markets.

Sophistication and Complexity Versus Economy: The Problem of Gold-Plating

Tom E. Parkinson, Transit Services Division, British Columbia Ministry of Municipal Affairs and Housing, workshop moderator

All aspects of overdesign were considered in this workshop session. Overdesign is not necessarily bad if it attempts to increase reliability, extend component life, or reduce maintenance; it can also improve public acceptability, reduce energy consumption, and lower noise levels. The problem is to distinguish between good design that advances the state of the art in a cost-effective way and unnecessary overdesign.

In view of the limited experience with new light-rail transit (LRT) systems in North America, how can one define overdesign? It was proposed that the experience in heavy-rail transit over the last 15 years could in part be extrapolated to LRT. Furthermore, overdesign is often introduced early in the planning stages when system designs for civil engineering, railroad or rapid transit power supply, signaling, and fare collection are being selected; e.g., LRT in Buffalo was burdened with inefficient fare collection, and subway standards were applied to signaling and power supplies on Toronto's Scarborough line. It was stated in rebuttal that the Urban Mass Transportation Administration (UMTA) applied sufficient monitoring and safeguards to avoid blatant modal bias in alternatives analysis. In Toronto, the extra costs of applying subway standards are only a small proportion of the estimated total cost and represent the engineer's desire to be conservative and to ensure that the system can be built within estimates. The objection was raised that others, seeing the high quotes for Toronto's signaling and power supply systems, would be suspicious of the lower estimates in their own studies, despite the fact that actual costs in Edmonton, for example, are less than half Toronto's for power supply

and one-third for a functionally similar signaling system. The discussion ended with statements of the need for planners, engineers, and economists to work together more closely in the design stages of an LRT system.

A vigorous discussion that centered on signaling referred to Burgin's paper in this Report recommending against any move away from relay logic. A supplier stated that proven, cost-effective solid-state signaling components are available and should be used. Several participants contradicted this; they noted that what a supplier regards as proven and cost-effective on the test bench often turns out to be a technical and economic disaster in the extremely adverse environment of urban rail transit. This led to comments on the unfortunate process in a small industry whereby much of the learning curve for innovations takes place in revenue service, where problems directly affect the quality and reliability of daily service. Despite the best intentions and the availability of such testing facilities as those at Pueblo, constraints of time and money dictate a situation in which components can often never by truly tested except in the rigors of daily revenue service. The need for any signaling at all was addressed by comments that Chicago had a better safety record when the rapid transit system was mainly under visual control than it does now with a full signal and communication system. The moderator pointed out that this was not a fair comparison since it is no longer possible in the 1970s to select, train, supervise, and discipline operators in the way that was possible in previous generations.

The signaling discussion ended with the suggestion that we will soon be able to compare actual systems. Next year Edmonton opens its LRT line with a low-cost relay logic system that uses European rather than Association of American Railroads (AAR) standard components and signal-light aspects, while the San Francisco Municipal Railway (Muni) will start operating a cab-signal system that will have hybrid components (i.e., some solid-state devices). In the near future, the approved and funded Calgary LRT proposes to build some sections of line that have no signaling at all, while Toronto's funded Scarborough LRT line proposes to use AAR subway signaling standards.

The discussion on gold-plating began with its definition as spending more than is needed to do the job and went on to explore UMTA's, consultants', and operators' attitudes toward gold-plating. UMTA was defended as rightly wanting to advance the state of the art, but workshop participants felt that UMTA also had a desire for high technology for its own sake. Some regarded consultants as having a vested interest in increasing the civil engineering costs, since their fees may be set on a percentage basis; others defended consultants since they often only follow their clients' wishes. Operators may have no financial investment in a system that has 20 percent local and 80 percent federal funding. The decision makers within the operator's management may not consult with those who would operate and maintain the overdesigned system. However, UMTA was regarded as having effective control over most such abuses. It is understandable that the consultant and his client have preference for the easiest rather than the cheapest solution to certain design questions. For example, it is easier to build a grade separation than to negotiate with traffic engineers and public utility commissions for a controlled grade crossing at which LRT is not impeded by severe speed restrictions or the fear of having even the smallest negative impact on automobile flow.

Overdesign was discussed with respect to portions of Muni, the Washington Metro, and Los Angeles' perennial proposals for rapid transit in which only the best would do. Comments were made that a city would hardly accept LRT with grade crossings if it thought there was a chance of getting a fully grade-separated rapid transit system.

Chopper control was discussed at length. In summary, it was felt that UMTA had mandated chopper controls in the standard light-rail vehicle but that claims for energy and maintenance savings with choppers had been overstated. It was agreed that well-maintained resistive controls are as smooth as chopper control except on trolley coaches and that starting-power losses were lower than expected; in many cases, this loss can be used to heat the car interior during the colder months. The more skeptical, conservative European approach was discussed and several participants speculated that in the next decade alternating-current motors with suitable power conversion would supersede both resistive and chopper control.

A discussion on the merits of power collection by means of pantographs or trolley poles failed to reach any conclusion. Each has several advantages and disadvantages, and the workshop was split into two camps.

In summary, it was apparent that the participants were aware of many mistakes during the past decade in LRT and rapid transit planning and design that can be attributed to gold-plating. They were uncertain who was in charge to ensure that the lesson had been learned and that the mistakes would not be repeated. The concept of LRT as an application of proven technology does not mean that advances are not desirable. The problem was in determining in the long run which advances are necessary or desirable and are cost-effective.