

would be provided by applying signal preemption to isolated intersections. There appears to be a "compounding" of benefits along arterials that are so controlled.

In summary, analytic and simulation modeling of transit operations controlled by a bus-signal-preemption policy indicates that under well-defined conditions significant benefits may accrue in terms of reduced travel time without disrupting general traffic. The particular conditions and factors that promote these incremental benefits have been identified.

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Transportation for the 1980 Winter Olympics: A Retrospective Look

RICHARD D. ALBERTIN, GERALD S. COHEN, AND ROBERT G. KNIGHTON

A review of transportation planning for the 1980 Winter Olympics in Lake Placid, New York, and the implementation of the plan is presented. The many events that led up to the Olympics, such as the purchase of land for parking lots, the planning of the bus system, and the reconstruction of highway facilities, are described briefly. The operation of the bus system during the Olympics is examined closely. Both newspaper accounts and first-hand knowledge are used to ensure an accurate representation of events. The roles of and relations between the New York State Department of Transportation and the Lake Placid Olympic Organizing Committee are examined.

When Lake Placid, New York, was selected as the site of the 1980 Winter Olympics, the world wondered if a small town could run them successfully. Several critical problems were immediately realized. One of the greatest areas of concern was the problem of moving an estimated 50 000 people within an area that usually had 3000 residents. Limited housing made this issue even tougher, since 20 000-30 000 people would have to arrive and leave every day.

The Lake Placid Olympic Organizing Committee (LPOOC), a private corporation made up mostly of local Lake Placid citizens, turned to the New York State Department of Transportation (NYSDOT) for answers to the transportation questions. NYSDOT was asked to design a feasible plan to transport visitors. The plan, after review by LPOOC, was to be implemented by the organizing committee. The Olympic Transportation Plan (1) met the various environmental constraints, minimized the impact to local residents and spectators, and yet allowed tens of thousands of people to witness the 1980 Winter Olympics.

The plan's five basic elements were (a) restriction of automobile access into the area, (b) parking

in peripheral parking lots for spectators arriving by automobile, (c) provision of transportation in the Olympic area by means of a shuttle-bus system, (d) enforcement of speed traffic controls, and (e) sale of 50 percent of all event tickets available to the public only as part of a charter bus, train, or air package.

NYSDOT and transportation consultants hired by LPOOC thoroughly tested and reviewed the plan by means of a series of computer programs. Assuming that all of the above basic elements would be conscientiously implemented, these professionals were confident that, except for possibly a few peak hours at the largest events, delays would be minimal and travel in the area possible.

PLANNING THROUGH 1976

The LPOOC planning efforts were endorsed by a local referendum in 1973, by a joint resolution of the New York State Legislature in 1974, by a concurrent resolution of the U.S. Congress in 1975, and by actions of Presidents Nixon, Ford, and Carter and New York State Governors Wilson and Carey. LPOOC requested NYSDOT to examine existing facilities and determine what actions were required. One of the state's first steps was to inventory the transportation facilities as well as other areas that would affect transportation (2). A series of program information reports (PIRs) was issued. These reports included inventories of highways, lodgings, and restaurants.

Highway access to the Lake Placid area consisted of three 2-lane rural facilities, a winding and mountainous route with roads that approach from the south, west, and north. Two rail facilities serve

the general area but would prove to have minimal impact. The closest airport capable of serving large planes and providing reasonably frequent service was 65 miles from Lake Placid in Clinton County. Closer airports could serve only general aviation or had limited ground storage for planes.

Existing bus service included daily intercity service along each of the highways (usually three to four buses per day). There is no local public bus transportation in this area.

The system had to be able to work even if the weather was poor. In 1979, for example, in the second week in February temperatures were as low as -30°F at night and the daytime temperature never got above zero. Furthermore, 24-in snowfalls are not uncommon in the area.

Preliminary analysis confirmed suspicions that unrestricted travel into the area would result in massive traffic tie-ups. There was simply not enough capacity to accommodate an unrestricted influx of spectators. The transportation system into the area, and within it, would impose limitations that must affect every aspect of the Olympic planning process. Related functions such as ticket sales, housing, and scheduling had to be flexible enough to meet the constraints imposed by the transportation system.

Beyond meeting the LPOOC's 1975 request for technical assistance, there was a strong commitment by the state that any planning effort must maximize public safety. This concern culminated in the passing of a law mandating that any transportation and security plan allow for public and government review.

An Environmental Impact Statement (EIS) provided an environmental framework that included the following constraints:

1. Be sensitive to the environment--The area is in the largest state-controlled wilderness and park area in the nation and is regulated by the Adirondack Park Agency, which oversees any development in the area.
2. Plan no major highway construction--This was in keeping with the desires of local officials and environmentally concerned agencies.
3. Use known technologies--The Olympics were too important to test untried techniques.
4. Look to post-Olympics use--The capital projects had to be in keeping with post-Olympics use.

A series of three reports (3-5) outlined the basic assumptions and developed a base plan around them. This transportation plan proposed a large internal bus circulation system and restricted automobile access into the area. Spectators were to park in a series of peripheral lots and be transported within the area during their visit by a shuttle-bus system. A preliminary estimate was made that 450 buses might be sufficient. The early analysis of the transportation system is summarized elsewhere (6). Although this system appeared workable, the strategy needed further testing and more refinement before the obviously expensive system was to be implemented by a financially constrained LPOOC.

PLANNING AND IMPLEMENTATION: 1977-1979

With the aid of a transportation consultant, NYSDOT developed a testing strategy that was as accurate as the existing data would allow but also flexible enough to adjust easily and accommodate changes in data or assumptions. The first step in this process was to use existing inventories, supplemented by field surveys, to identify all highway characteristics within the area and along entry routes. These

data were used as input to computer simulation programs.

The event schedule was analyzed to select several peak hours of travel. Each peak hour was then broken down into its various components (officials, spectators, residents, etc.). By using available data on each group's travel patterns, the travel between internal locations was estimated, including the forecasting of origin-destination (O-D) pair volumes. The volumes were then assigned over the available routes. A computer program assisted in this effort by providing a description of the impact on each intersection from the accumulated needs.

These results were then analyzed on a system basis. Problem areas were identified and solutions were proposed. This process was repeated for several strategies until a workable solution for these peak hours was found. These peak hours were largely dependent on the event schedule, and a solution for one peak hour did not ensure that the same system would solve the problems found at another site for a different peak hour. To solve the problems, several peak hours were tested. Initial results of these efforts were summarized in the December 20, 1977, draft transportation plan (7). This report was then used as the basis for several informational meetings. Comments received from these meetings were incorporated into the plan.

This plan was submitted to LPOOC for review. LPOOC hired a transportation consultant to review NYSDOT efforts and coordinate implementation. Because there was concern that the cost of this transportation system (which called for 450 buses) would be prohibitive, the consultant was also directed to look for ways to reduce the costs (but maintain revenue).

The result of these efforts was the Olympic Transportation Plan of July 1979 (1). The basic elements of this plan were identical with those of the earlier plan, but it also included the following:

1. Snow and ice removal within the Olympic area that would attempt to reach bare pavement (thereby maximizing capacity);
2. Control of all private vehicles within the area to maximize highway capacity;
3. A 24-h transit system of 300 buses (peak hour) supported by a system of peripheral lots along each travel corridor for spectators arriving by automobile;
4. Pooling of official vehicles to minimize their impact while meeting the needs of athletes, officials, news media, and LPOOC family;
5. Assurance that 50 percent of all public ticket sales would require transportation to be included (this would minimize highway impact and reduce system cost); and
6. Enforcement of internal traffic regulations within the Olympic area to again maximize capacity (these included a one-way loop and restriction of parking at event sites to buses and official vehicles).

NYSDOT Role

Within this transportation plan, the state took responsibility for two general areas: highway-related and airport operations. During the Olympics, the state ran the Lake Placid heliport and Saranac's Lake Clear Airport (with the help of Pan-American Airlines).

In addition to snow and ice control, the highway responsibilities included

1. Signing--There was a need for thousands of

square feet of temporary signing leading to and into the Olympic area;

2. Highway reconstruction--Using an accelerated construction schedule, NYSDOT did general improvement work on several key inroads and internal highways;

3. Towing--The critical importance of keeping the highways open was also addressed through a towing contract that provided 24-h service along all critical highways;

4. Vehicle permit plan--The strategy to restrict access into the Olympic area was designed and implemented by NYSDOT and State Police forces; and

5. Coordination of existing intercity transportation services.

The state also provided expertise in transportation by offering LPOOC assistance in key activities that were falling behind schedule, monitoring LPOOC's progress in its areas of responsibility, and, when requested, assisting the consultants or LPOOC staff in related transportation issues.

The activities that fell behind schedule included the acquisition of the peripheral parking lots and the meeting of environmental regulations. NYSDOT testified in environmental hearings on Olympic and post-Olympic use of the peripheral lots. In addition, NYSDOT developed preliminary plans for each site and, when a negotiated agreement failed, New York State acquired the sites and leased them to LPOOC. NYSDOT also filed air quality permits and kept state and federal agencies informed of progress and decisions.

NYSDOT's mandate to monitor gave it the right to advise but not to control; its legislative mandate could not force LPOOC to react in a timely fashion, nor could there be a takeover of the contracts or operations of LPOOC (a private company) unless public safety was jeopardized. This could only occur during the actual operation. NYSDOT did have the right to report on problems to the Governor if the schedule of tasks was not progressing satisfactorily but, at least early in the process, reliance was placed on the assurances of experienced LPOOC officials that early difficulties were characteristic of large operations and that all problems would be resolved.

As an outside agency, NYSDOT was frequently not privy (nor should it have been) to contract negotiations. During the Olympics, the monitoring was expanded to include an entire NYSDOT task force whose members were located on-site wherever appropriate. The group was originally designed only to perform the NYSDOT highway and aviation responsibilities and to monitor LPOOC's transit responsibilities; it was this group of monitors, however, who early identified the problems, alerted the NYSDOT Commissioner, and, because it was necessary, actually began operating facilities. Because of their expertise, the NYSDOT monitors were able to assume a leadership function in several important areas.

LPOOC-Consultant Role

LPOOC took responsibility for the transportation requirements of the Olympics. Specifically, LPOOC tasks were to

1. Acquire, construct, operate, and restore the various parking facilities, including the peripheral parking lots, event sites, and centrally located bus facilities (for this task, LPOOC used a transportation consultant to finalize preliminary plans and a parking contractor to operate the facility, and construction was done by LPOOC's major contractor);

2. Operate the bus transportation system, which

included contracting for 300 buses and managing their operation, including maintenance, dispatching, and control (LPOOC anticipated contracting out all but the management, which was to remain with LPOOC); and

3. Operate an official fleet of vehicles for LPOOC use.

The relative roles and duties of LPOOC and NYSDOT were defined in a series of correspondence. There were, however, some questions about the conditions under which NYSDOT could intercede. In New York State Senate hearings after the Olympics, this issue was discussed at length. It was concluded that the relationship had never been spelled out, although neither LPOOC nor state officials disagreed on individual responsibilities. (In fact, the issue was the timing of intervention, not who was in charge of any function.)

PLAN REFINEMENT

As the Olympics approached, LPOOC made various refinements in its portion of the plan. Most of these refinements were directed at reducing costs. When the state expressed the critical nature of the earlier assumption, LPOOC concurred and developed even more stringent assumptions. The main two changes to the original transportation plan concerned ticket and charter bus policy.

Not only would 50 percent of the tickets available to the public be packaged with public transportation (thereby reducing demand on peripheral parking lots), but also every effort would be made to package charter sales into bus loads of spectators with the same tickets. These charter buses would then become the sole transportation for these spectators, which would also reduce shuttle demand. Estimates for these sales were as high as half of the total charter sales.

Because these policy decisions were outside NYSDOT responsibility, it could only react with review critiques. NYSDOT questioned the feasibility of selling such ticket packages but, after receiving repeated assurances, hoped for the best. Fortunately, the original design capacities of the peripheral lots were not altered to consider this option because package sales were much less than LPOOC estimates. State efforts to monitor the ticket sales were exceedingly difficult. The ticket sales company experienced confusion and computer problems. However, NYSDOT received assurances through January that, although all sales were lagging, the ticket policy would be strictly adhered to and all would be well.

THE BUS CONTRACT

Even with the changes in charter ticket policy, there was still a margin of safety in most key areas that would provide safety valves if something should fail. However, the one element critical to all phases of the transportation plan was the bus contract.

Early in 1979, LPOOC began to actively look for a bus company to operate the shuttle system. School-bus operators were to be considered only for the village shuttle, since it was felt that mountainous access roads would reduce school-bus speeds to the point of reducing highway capacity. The search began during the end of the 1979 energy crisis. Contracts with major companies were not successful. Most companies were expecting a post-energy-crisis boom in demand and did not want to commit their fleets for such a short period. As the Olympics approached and ticket sales had not reached expecta-

tions, some transit companies did express interest in the contract in private discussions. However, by then, the LPOOC economic situation was becoming increasingly serious.

NYSDOT supplied LPOOC with a list of potential operators, suggested a consortium approach, and even drafted a request for proposal. LPOOC did its own searching and, when the operator was selected, LPOOC signed a contract it had developed. The new bus contractor was a Canadian firm, Autocar Rive Sud. Although LPOOC was looking for a company that could supply buses at \$500-\$550/bus/day, it negotiated with Rive Sud on the basis of \$325/bus/day. Between the fiscal problems and the apparent difficulty of obtaining American buses, LPOOC felt there was no alternative but to contract with the Canadian firm.

Because NYSDOT had no involvement in the contract negotiations, it did not find out about these developments until November. NYSDOT immediately met with Rive Sud representatives in Montreal. Under law, NYSDOT had to begin inspecting buses and was anxious to begin working with the operator.

The contracts were not encouraging. Whereas the contract called for 300-350 full-sized intercity coaches (or as many as possible), Rive Sud actually owned 6. The Rive Sud repair facilities in Montreal were rented. It appears that they hoped to use their extensive fleet of school buses to serve the contract needs. NYSDOT bus inspectors were given a chance to review some of their fleet. Unfortunately, the school buses did not meet American safety standards in several key areas.

When informed of this problem, the president of the company declared, "There's still no problem. I will raise the fleet through subcontracts." In fact, for a significant part of the fleet, he did just that! He was able to subcontract over half of his fleet with a single American company, Bluebird Coach Line, Inc., which had buses that were state inspected.

OTHER CONCERNS

During the last half of 1979, other problems were surfacing. LPOOC suggested "busmeisters" (volunteers) to board each charter bus and act as tour guides. For lack of housing and funding, this never happened.

Additional demands were being placed on the dedicated spectator bus fleet. Buses from the 300 originally contracted for spectators only were being planned for the use of athletes and officials. The 75 originally planned for this purpose grew to more than 100, their use to be determined on a priority basis. Ticket sales were lagging, and no one seemed able to provide periodic sales reports. Construction of peripheral parking lots lagged. In fact, it was fortunate that the winter was mild because construction did not begin until late October and in fact was never completed before operations began.

MOVEMENT TOWARD IMPLEMENTATION: NOVEMBER-FEBRUARY

By January 1980, many of the concerns about the transportation plan were being effectively addressed. The bus contract was signed on December 10. The base bus schedules, maps, and demands were identified. Bus routes were determined. The fuel facilities had been planned. A tour package was highlighted and issued to the press. A dry run was held for a small event and, though there were some problems, it was a learning experience. The peripheral lots were 90 percent complete. A parking-lot contractor was selected.

Despite these steps, however, several critical areas were still unresolved in late January. These included the following:

1. The bus contractor promised weekly to supply a list of his fleet for state inspectors, but this did not occur until January. By then, NYSDOT inspectors had to exert almost superhuman effort to complete their work. Their reports were disconcerting. The buses were old (the contract called for 1976 or newer vehicles wherever possible), and some were rejected.

2. The trailers at the parking sites and the related operational facilities were not finalized. Some trailers needed heat, telephones, or power. Although pedestrian controls had been agreed to, none were in place. In particular, there were no devices designed to facilitate the loading of the buses.

3. No bus signing was in place, and there seemed to be no plans for driver training other than on the first day.

4. Although there was a parking-lot operator to collect money and park cars, there were no assigned personnel for bus operations or ground control.

5. The management team promised by LPOOC was woefully understaffed and overworked. The dispatchers were responsible to their own company only and were generally unavailable before the Olympics.

6. There were serious problems with ticket sales. NYSDOT received rumors that charter tickets were being sold individually and charter sales in general were low.

7. NYSDOT began hearing about labor problems with the bus contract. American unions, which were experiencing high local unemployment, were demanding a portion of the bus driver jobs. (We did not know this at the time, but this problem was the main reason Rive Sud used for supplying old buses; they did not want "school bus drivers" in their expensive intercity coaches.) NYSDOT was assured by LPOOC that the problem would be resolved.

8. Immigration papers had not been filed by LPOOC. After several warnings, the Canadian bus company management was asked to return to Canada until the matter was resolved.

As the deadline approached, many items remained undone. Individually none were insurmountable, but collectively they implied major problems. Despite repeated assurances, NYSDOT began receiving "off-the-record" reports from LPOOC staff that all was not well. In hindsight, even if NYSDOT had taken over at this point, it might have fared little better since many problems (e.g., ticket sales) had no answer at the time. There were still, however, valid reasons for hope. People experienced in large-scale events repeatedly assured NYSDOT that the problems and confusion encountered were typical.

The buses were finally inspected in late January. A new bus expert was named in January to head the management team. The buses scheduled for pre-Olympic duties were on time.

IMPLEMENTATION

As NYSDOT and LPOOC actually began to implement the transportation plan, the early indications were encouraging. The airport, although operating below estimated capacity, was functioning well. After some early confusion, the one-way system began working. The towing contract kept the roads clear. The public followed the stringent parking restrictions with few complaints. The event sites were operating training sessions with only minor problems.

Monday, February 11, was the first day of the shuttle-bus operation. No events were scheduled, but a religious ceremony was scheduled for that night and a few thousand people were expected to attend. The previous three days had been incredibly

hectic. The NYSDOT staff assigned to monitor transit and traffic operations had dropped training in order to assist the LPOOC staff with many last-minute chores. Together, the two staffs made a lot of progress: Warning tents were installed at some locations, the work-site trailers got heat, and most of the signs were in place at the parking areas. Still, there was apprehension. Charter sales were unknown, staffing for bus operations was unclear, pedestrian planning was overrated, and many smaller issues had been neglected. There was no LPOOC staff at the lots to control the loading of buses and no channelization for crowd control.

The early morning hours on Monday, February 11, were generally quiet, and efforts to complete various tasks continued. Monday was the first day of travel restrictions, and most people in the Olympic area were not authorized to travel by motor vehicle except on the bus system. Lengthy delays were reported by the press. The New York Times reported that early in the day passengers were waiting as long as an hour and a half for shuttle buses that were supposed to arrive every 15 min. The press director for LPOOC was quoted as saying that a special bus program for athletes was operating smoothly and that there were only a few short delays on the buses carrying the first spectators away from the peripheral parking lots. With relatively few spectators in the area on Monday, a major victim of whatever flaws there were in the system appeared to be the press. LPOOC's solution to this problem was to take 40 buses from the public system and dedicate them strictly to the press.

Reports from NYSDOT transit monitors gave a picture of limited confusion but certainly no crisis; this was probably due to the light demand since no events were scheduled. A driver for one of the co-operating bus companies, who arrived at the Olympic Press Center, loaded three passengers, and was dispatched to Wilmington, said, "What they forgot to tell me was how to get there."

When people began to arrive for the Monday evening religious service, additional delays were reported. However, with the assistance of LPOOC's radio-taxi fleet, most of the visitors arrived at the Olympic arena on time. The end of the event went less smoothly. As several thousand people poured out of the arena and into the municipal lot, there were few buses there to meet them. Incredibly, there were no bus company dispatchers. NYSDOT monitors telephoned reports from the lot to the LPOOC bus dispatch center, but the telephone was frequently busy and respondents were obviously harried. They explained that drivers had worked all day and that many had just arrived. Fortunately, the crowd was patient (and the arena was used to keep them warm), and the problem was gradually eliminated.

Part of the problem on Monday arose from labor disputes. Labor unions insisted that American, not Canadian, drivers be used on the buses (there had been a similar, although reversed, situation at the 1976 Montreal Olympics). LPOOC suggested that because of these problems it had a driver shortage and did not have the supervisory staff it expected from Canada.

The next morning, Tuesday, February 12, the events of the previous day were discussed. Approximately 200 additional buses had arrived late Monday, and about 40 Canadians were given work permits to drive the buses. The only events scheduled for Tuesday were hockey games in Lake Placid Village, the first of which was at 1:00 p.m. Morning telephone reports were similar to those of early Monday. Bus service was irregular and confusion remained along some routes, but generally complaints

were few and NYSDOT requests for additional service were noted by the dispatch center. An LPOOC spokesman was quoted in the press as saying that traffic flow was "working very, very good."

The first charter buses began to arrive on Tuesday, and drivers were totally confused. NYSDOT monitors at the charter parking areas (and in other locations) reported that there were no LPOOC staff to direct the charters and shuttle service to these charter parking areas was infrequent. The charter bus companies had received instructions with their tickets, but LPOOC's planned "busmeisters" or even on-site staff at the parking areas were lacking. In addition, the roadway signing was apparently not sufficient.

Another related problem was the lack of LPOOC staff for bus loading operations. The NYSDOT transit monitors had expected LPOOC temporary staff (mostly college students), but few arrived and none were trained. From the first day, the NYSDOT monitors, in addition to their normal duties, began loading buses, queuing spectators, and generally operating the spectator bus system.

The only on-site bus dispatchers were seven at two locations, and even those dispatchers worked for a specific company and took orders from the LPOOC center only when it did not conflict with their company's needs. NYSDOT monitors assumed an unplanned role and became bus dispatchers. The bus drivers welcomed their assistance as they, too, looked for direction.

Throughout these early days, a pattern was emerging on overall operations. The bus contract had been subcontracted by Rive Sud primarily to four bus companies. Each of these companies was assigned a portion of the bus system. Generally, these were corridors. There was little coordination between these companies. In fact, the dispatcher for each company was located in a different location and in one case could not even be reached by telephone! Our visits to the bus dispatcher center indicated confusion and command-control problems. The LPOOC management staff was simply overwhelmed, and each company went its own way.

For some corridors or some periods of time, this arrangement worked. Bus service could be excellent in one area while at the same time, in another corridor, people were kept waiting. At the event sites, this problem was highlighted. Some companies would not serve the event site because it was outside their corridor. Instead, transfers at the central loading area were required for spectators who were unfortunate enough to unknowingly cross a corridor service boundary! This had never been intended in planning and was obviously unworkable. The event schedule demanded efficient handling of the 300 buses.

There were delays in service for the hockey arena, and people were being inconvenienced beyond what anyone had expected. Along the three corridors, some buses would stop and others would not. The demand at the peripheral lots often so exceeded bus service that buses always left fully loaded and could not stop for waiting passengers.

In spite of these problems, overall the system had worked to some extent, mainly because of special efforts by two of the bus subcontractors.

Wednesday, February 13, was to be the first real test of the LPOOC bus system. There would be a huge crowd for the opening ceremonies and later a luge event at Mt. Van Hoevenburg. Crowds for the opening ceremony were originally estimated at 18 000-20 000 based on ticket sales. However, LPOOC had issued staff IDs to 22 000 people! Many of these IDs allowed nonticketed access to outdoor events.

Early Wednesday there were some problems, but un-

til 11:00 a.m. most demand was met. The unpublished training events were causing some problems, and the need for crowd control became more and more apparent.

By 11:30 a.m., telephone reports from monitors were becoming frantic. Charter buses arrived to drop off passengers faster than the shuttle service could pick them up. Crowds at the lots were growing quickly, and hundreds of people were waiting at each parking site. The press reported that in Lake Placid visitors were lined up 10 deep for two city blocks. "Private enterprise" moved in, and rides in cars and trucks were being offered to people at the lots for fees of \$3 or more.

The situation in the northern corridor was serious. The State Police began commandeering buses in order to get people out of the cold. A New York state trooper reported that he had tried to flag down a nearly empty bus to transport spectators to the opening ceremonies but "the driver said that wasn't on his route and he drove away." Crowds were everywhere. They continued to build in size, and the bus service could not handle it.

Monitors noted an absence of dispatchers or attendants at the event sites. By 1:30 p.m., the transfer problem had grown out of control at the central location. The bus companies were also becoming concerned. Even the reluctant companies began aiding their fellow subcontractors. By the start of the opening ceremonies, most spectators had reached the event except for those in the northern corridor. Here, hundreds missed the event. LPOOC dispatched personnel to get names for refunds. The New York Times reported that state transportation officials monitoring the traffic flow attributed the system's problems to a shortage of bus dispatchers and a resulting lack of coordination. However, Norman Hess, LPOOC's transportation director, denied that the system was short of bus drivers or dispatchers: "This is a massive plan and it worked substantially today. It moved about 23 000 people and left only a few hundred stranded."

The ending of the opening ceremonies was near disaster. Despite NYSDOT's frequent calls to begin stacking buses, none were there. (Later, NYSDOT found out that about 25 buses were waiting and had been sent away because of their fumes. By the time they returned, the crowds had swarmed the roadways and loading areas.) The buses that arrived were blocked by the crowds. NYSDOT, LPOOC, and the State Police did what they could. Every available bus was called in and the radio-taxi fleet as well. Many spectators simply walked the mile into town rather than wait for the buses.

By evening, the requested additional improvements to staffing and operations at the sites had not been provided. The NYSDOT monitors had been working 18-h shifts since Monday, and still no relief was in sight. The only assistance came from State Police and Environmental Conservation officers.

The basic problems plaguing the bus operations from the start continued and grew with the crowds. Charter buses were confused. There were even reports of stranded charter passengers (which were resolved). Bus dispatching was left to each company. There were no LPOOC staff at the peripheral lots and event sites. There was a need for operational staff, effective management (with central authority), and more buses or drivers (the drivers were being shuttled in daily, 60 miles each way, and by the end of the day they were exhausted).

On Wednesday evening, a luge event was scheduled for Mt. Van Hoevenberg. After some delays, everyone arrived. NYSDOT staff reported that the LPOOC bus management staff was off duty. The bus operation was left to the company dispatchers. Most of the bus drivers were exhausted and out of driving hours

(there is a legal limit). Despite calls for more buses, there were simply none available when the event ended. Because of the cold, the crowd grew understandably ugly.

Three and one-half hours later, the spectators had been moved. But not before ambulances were dispatched for frostbite and exposure cases and the State Police had to break into a building to get spectators out of the cold.

After midnight, key state and LPOOC officials held an emergency meeting. In the all-night session, the decision was made for the state to effectively take over bus operations. A task force was appointed and went to work to address the immediate needs. Around 2:00 a.m., Greyhound was contacted through NYSDOT Commissioner Hennessy. Greyhound agreed to supply additional buses and a bus management team.

At 6:00 a.m., NYSDOT began calling resident engineers throughout the state to tell them to pack their bags and head to Lake Placid to help out. By 9:00 a.m., additional NYSDOT staff began to arrive to act as lot managers, help with crowd control, and assist with dispatching and management. Environmental Conservation officers added their resources by assisting in bus loading operations, providing radio communications to the dispatch center, and providing supplies to complete lot needs.

The Greyhound management team and a convoy of some 30 buses arrived in midafternoon; the buses were immediately pressed into service, and the management team went to work. Most of the 7500 hockey spectators who poured out of the arena after seeing the United States beat Czechoslovakia found buses waiting for them. In the words of a spectator on Thursday, "Today has worked very well. Yesterday was horrible."

Needs were addressed in all of the following areas:

1. More buses--Greyhound and school buses were contracted to supplement the existing fleet;
2. Operational staff--Fifty college students were hired by LPOOC to work for NYSDOT monitors;
3. Communications--New telephone lines and both an emergency Environmental Conservation mobile radio system and a similar NYSDOT system were put into operation within 12 h;
4. Supplies--Manpower and equipment (including barriers, cones, loudspeakers, and other things needed to effectively operate the bus loading areas) were made available; and
5. Effective cooperation--The bus subcontractors were requested to work under the new management team and supply a dispatcher full time to the center (they welcomed the arrangement, since by that time they too were looking for coordinated direction and all were anxious to do a good job).

The next few days were very hectic and difficult, but things began to smooth out as the new resources were integrated into the system. Many jury-rigged solutions were quickly found. The gravity fueling system, which took 40 min to fuel a bus, was supplemented with an electric pump that reduced fueling time to 4 min. An Environmental Conservation fire truck was pressed into service to wash bus windows; NYSDOT arranged to have box lunches delivered to drivers so they did not have to stop driving. Most important, the Greyhound-NYSDOT management team began to achieve control over the bus operation, and it began to operate as one coordinated system. The corridor division was eliminated, and buses were re-dispatched where needed and were lined up ahead of time to anticipate heavy demand.

All hoped and expected that management changes, extra Greyhound buses, and some additional school buses would be sufficient to turn things around. There was marked improvement on Thursday and Friday, but problems persisted, especially late in the day as drivers ran out of hours or became too tired. The 300 or so buses called for in the plan had arrived but were not available for the 16-h--or longer--day necessary because there was, in most cases, only one driver for each bus. Extra drivers appeared to be the answer, but no local housing was available. There were some problems on Saturday because the weather was very cold and because a very large number of visitors had arrived for the three-day weekend (Monday was a holiday). The line for buses at Keene was reported in the press to be five abreast and about a half-mile long.

New York State law restricted drivers to a certain number of hours and required that buses owned by school districts could only be used to transport schoolchildren or the elderly. The legislature had given special authority to LPOOC to contract with the districts but, given the precarious financial condition of LPOOC, districts were reluctant to sign contracts. On Saturday, February 16, Governor Carey declared a limited state of emergency for transportation that allowed the state to waive driver-hour restrictions and contract directly with school districts.

In the next few days, the total number of buses increased to around 500. This total allowed peak demands (all day) to be met in spite of the driver shortage. By Sunday, major problems began to disappear. About 15 000 persons watched the women's downhill race Sunday morning, and after the event some had to wait from 90 min to 2 h for buses. By early afternoon, more than 14 000 of the 18 000 spectators at the ski jump were cleared within 1 h. The longest wait at parking lots was approximately 1 h. Sunday, however, was very cold, and State Police reported approximately 150 cases of hypothermia. The problem was that many spectators did not know how to dress properly for the cold. State Police even reported some wearing tennis shoes and sandals. State Police and NYS DOT staff reported that people were complaining that they had arrived at parking lots 2 h early because of the bus shortage and did not have anything to do when they arrived at the event site long before starting time.

Some minor problems continued; getting drivers' box lunches to the right place at the right time was a major challenge. Bus destination signs became a popular souvenir, selling for \$7 apiece. Parking lots thawed. Potholes developed. Finally, after an unusually dry winter, there was a snowstorm. Despite this, we were able to get through the last two-thirds of the Winter Olympics with little inconvenience to the public. There were some delays but nothing very serious. One alpine event at Whiteface was cleared within 30 min. However, some major events drew as many as 26 000 spectators, which created huge logistics problems. "I would have to have had 600 buses parked at the gate waiting for them," said a dispatcher for Greyhound. "That would have taken a parking lot two miles long and two miles wide."

By Tuesday of the second week, press stories about the Olympics transportation system were generally favorable. The bus system was no longer news. The U.S. hockey team and Eric Heiden dominated the headlines.

As mentioned earlier, after the Lake Placid Olympics, a committee of the New York State Legislature investigated the games (8). The general manager of LPOOC, Peter Spurney, was criticized for waiting "until everything fell apart" before asking

the state for help. The committee found that "state officials were repeatedly misled about the state of readiness of the transportation system for Olympics spectators" and that the "state government, when it belatedly acknowledged its awareness of such mismanagement and misrepresentation, performed diligently in improving the transportation system."

CONCLUSIONS AND RECOMMENDATIONS

In the aftermath of an incredibly hectic time, the survivors of the transportation management team met together to discuss what had been learned and what recommendations could be made. These were as follows:

1. Efficient bus loading operations are absolutely essential for an effective system. They must be managed by an experienced individual, who should have adequate staff and resources.
2. Bus management and dispatchers should be well trained in advance and agree to follow the direction of a central management. Every day these dispatchers should meet to plan for the next day.
3. Bus contractors should include spare drivers (generally 1.5 drivers/bus) to ensure uninterrupted operation.
4. Communications must be available to all key locations and, if possible, be supported by a mobile unit.
5. Advance training must be provided for all personnel.
6. Access to events for support staff should be limited to locations where their numbers would not unduly influence operations.
7. Event schedules should be closely examined. Training events and estimates should be included, and possible early ending of events should be identified.

For future special events, the following recommendations are made:

1. All operators of events should be licensed to demonstrate their ability (financially and physically) to operate the event.
2. An approved transportation plan should be submitted as part of this demonstration.

ACKNOWLEDGMENT

The 1980 Winter Olympics transportation effort required the expertise of many professionals from many fields. We want to thank all those involved in this effort. Although the first few days were plagued with troubles, the problems were resolved expeditiously and, for the remainder of the games, the plan was successfully implemented.

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Abridgment

Service-Sensitive Indicators for Short-Term Bus-Route Planning

ALAN J. HOROWITZ

Transit performance indicators are useful means of monitoring existing systems and planning for future systems. The development of one type of transit performance indicator, a service-sensitive indicator, is discussed. The purpose of the service-sensitive indicator is to succinctly summarize the effectiveness and fairness of short-term route changes. Included in the indicator are considerations of the important performance variables perceived by riders: in-vehicle time, transfer time, walking time, waiting time, requirements to wait, and requirements to transfer. The service-sensitive indicator is applied to a case study—the improvement of transit service to the Milwaukee County Institutions Grounds, where major public medical care facilities are located. Because questions of equity are of greatest importance, the indicator is separately calculated for each of the potential rider groups. It is shown that the indicator measures the impacts of route alignment and route extensions on relevant population groups and does so without the need for extensive travel survey data.

Recently, there has been an increasing emphasis on the need to provide high-quality yet efficient public transportation services to all segments of the population and throughout urban areas. This emphasis has led to provision of services to population segments such as the elderly, the disabled, women, minorities, and low-income individuals. In addition, efforts have been made to offer convenient service to locations that provide different types of facilities and services, such as jobs, health care, education, recreation, and shopping. Consequently, transit operators have been faced with both the task of monitoring how well their systems serve diverse segments and geographic areas and the responsibility for developing new routes and schedules to remedy perceived deficiencies.

Systemwide indicators of transit performance have been developed to provide operators with information on how effectively and efficiently they are serving their communities. Examples of systemwide indicators are revenue passengers per service area population, revenue passengers per vehicle hour, and percentage of population served (1). Indicators such as these permit the operator to determine whether the transit system is improving over time and whether its quality of service is comparable to that of transit systems in similar communities. However, systemwide indicators are not prescriptive. Many potential short-term route or schedule changes are

not revealed by using these overall aggregate measures.

If indicators are to be truly useful for planning system improvements, they must be "service sensitive". That is, a route or schedule change that qualitatively improves service should be reflected as a significant quantitative change in the appropriate indicators. Service-sensitive indicators should determine whether proposed system modifications are suitable, are efficient from current riders' perspectives, and are adequately serving groups of potential riders. Furthermore, service-sensitive indicators should be simple to calculate by using data normally available to transit operators, and they should not require extensive statistical analysis or model calibration.

The purpose of this paper is to demonstrate that service-sensitive indicators can be useful for short-term transit route planning and scheduling. A quality-of-service indicator is developed and applied to a route-planning problem in which equity issues are of paramount importance. Specifically, the problem concerns providing better transit service to the Milwaukee County Institutions Grounds (MCIG), where all the important county medical facilities are located. The example is particularly interesting because transit access to the location from low-income areas of Milwaukee is poor.

SERVICE-SENSITIVE INDICATOR

If a service-sensitive indicator is desired, then it should be based on a concise definition of service quality as perceived by riders. Surveys of current and potential bus riders have led to a better understanding of the notion of service quality (2,3). Riders want to reach desired destinations; they want to do so quickly and reliably. They want to avoid walking, waiting, transferring, or standing while riding. They want protection from weather, but they attach little importance to physical luxury while traveling.

For questions of equity, systemwide indicators may be made more service sensitive by simply breaking them down by population segments or by geo-