Influenced by these two events, the suburban share of total ridership is also climbing.

Governing bodies, of course, tend to look critically at any factor that has adverse impacts on their budgets. Recently, several alterations have been sought in the WMATA formula. Some suburban jurisdictions have supported replacing passenger residence with whatever measure is adopted by Congress for distribution of Section 5 funds. There have also been discussions of using only population or only ridership to distribute the subsidy, and the relative utility of the cost/revenue approach is reexamined with some regularity.

In spite of all these attempts at alteration, however, the present approach has withstood the tests of time and critical review. It has been found to be the best method yet devised to fulfill the seven criteria listed at the outset.

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Rapid Transit Development in Medium-Sized Urban Areas: A Comparison of Planning and Decisionmaking in Two Canadian Cities

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Several North American urban areas with populations of 500 000 to 1.5 million are in the midst of rapid transit development programs. Although the systems being considered are smaller in scale than the rapid transit systems of larger metropolitan areas, their effect on the transportation systems and land use patterns of the smaller cities may prove to be much more significant. Detailed technical analyses of the many impacts of alternative modes, routes, and staging scenarios thus have a major role to play in the decisions to be made with respect to rapid transit development in such cities. Nontechnical factors, however, such as the characteristics of the political environment and the planning process undertaken in a particular city, can have just as great an influence on the rapid transit system ultimately implemented. The rapid transit planning processes undertaken in Calgary, Alberta, and Ottawa, Ontario, are compared to illustrate this balance between technical analyses and nontechnical factors. From the initial decision to proceed with a rapid transit program through the decisions made with respect to route alignments and mode selection, the analysis methods used and the decisionmaking processes followed in the two cities differ significantly. In both cases, however, nontechnical influences proved to be extremely important in creating two very different rapid transit solutions to similar transportation problems.

Costly experiences with the development of heavy rail rapid transit systems in a number of North American cities, together with recent funding cutbacks, have forced both planners and decisionmakers to reevaluate plans for extensive regional rail systems. Several medium-sized urban areas that once hoped to build heavy rail systems are now considering or undertaking the development of less costly rapid transit projects, financed through alternative means. The most notable U.S. example is the San Diego light rail line. In Canada, several cities with metropolitan area populations of 0.5 million to 1 million are also committed to the development of light rail or busway rapid transit systems. Although these Canadian cities are smaller than the U.S. cities that are considering rapid transit development, and although there are significant political and institutional differences, many of the decisions made and the processes followed in planning these systems are nevertheless comparable to those in medium-sized U.S. cities faced with similar transportation problems.

This paper examines three major decisions made in planning rapid transit projects in Calgary, Alberta, and Ottawa, Ontario: the initial decision to undertake a rapid transit development program, the selection of specific route alignments and profiles, and the selection of one particular mode over another. A comparative approach is used to identify the differing objectives of the two programs, the technical analyses completed, and the influences of political considerations and the planning process itself on the ultimate project outcomes in the two cities. Strikingly different planning environments and design processes suggest a number of conclusions as to the importance of technical evaluations in relation to nontechnical factors in determining the type of rapid transit system developed.

The rapid transit projects in the two cities differ substantially in terms of the mode selected and the types of route alignment to be used. In Calgary, an 8-mile light rail transit (LRT) line, located primarily along a railroad right-of-way and leading to a downtown transit mall, opened in May 1981. Planning for rapid transit in Ottawa has been under way for more than a decade, with the result that work will soon begin on the construction of a system of "transitways", exclusive rights-of-way to be used by articulated buses feeding the downtown area.

The discussion in this paper generally follows the rapid transit planning and decisionmaking sequence followed in the two cities. A brief description of the characteristics of each city is provided, and the transportation planning background relevant to each case is summarized. Separate sections of the paper are then devoted to the initial

rapid transit commitment, the selection of route alignments and profiles, and the selection of mode. A review of the impacts of funding and political constraints on these decisions is then presented, followed by a summary of the conclusions that can be drawn from this comparative analysis.

BACKGROUND

Population size and low-density patterns of urban development are two very basic characteristics shared by Calgary and Ottawa. With respect to rapid transit planning, however, there are important differences in their economic bases and rates of population growth and in the structures of their local governments. With the development of the Alberta oil industry, Calgary has taken on "boomtown" characteristics not unlike those of Houston, Texas. The wealth associated with the petroleum industry has brought to the Calgary region massive downtown construction projects and unprecedented population growth: from 495 000 in 1978 to a forecast 636 000 in 1986.

Ottawa, on the other hand, is dominated by the presence of the Canadian federal government, which, even in times of economic restraint, provides a relatively stable employment base. Although government policies have dispersed some employment away from the Ottawa core, by far the majority of federal government jobs remain in what could be called the center of the metropolitan area. The population of the region is expected to grow from 525 000 in 1978 to about 625 000 by 1991, a rate far slower than Calgary's. Both cities, then, like most other cities of similar size, have fairly centralized employment areas on one hand and rapidly growing suburbs of low-density housing on the other, which means that their transportation systems experience high levels of directional and temporal peaking during the day.

The other major difference relevant to an analysis of rapid transit development decisions involves the governmental settings in which the two cities function. There is much greater reliance by municipalities in Canada on their respective provincial governments for project funding, approval, and general support than in the United States. The level of federal government involvement in public transit in Canada, on the other hand, is far lower than in the United States. The Calgary urban area is governed by one unit of local government, the City of Calgary. In Ottawa, however, there exists a two-tier form of regional government. The Ottawa-Carleton Regional Council, responsible for region-wide services such as transportation, is made up of representatives of a number of area localities, one of which is the City of Ottawa. As discussed later in this paper, the presence of this regional decisionmaking body significantly affects the transportation planning and development process in Ottawa.

Serious consideration of rapid transit development in both cases can be traced to an evolving transportation planning process that had included a rapid transit alternative for more than a decade. In Calgary, actual planning for rapid transit first began in 1966. Originally, the system was conceived as a heavy rail system consisting of four legs, complemented by two express bus lines. Since 1966, however, the pattern of development proved to be of lower density than forecast, some of the predicted travel demand levels did not materialize, and construction costs skyrocketed. As a result, it was concluded in 1976 that "the capital cost of the 20-mile completely grade-separated network, amounting to several hundred million dollars, is clearly unrealistic for a city the size of Calgary" (1, p. 2).

A regional transportation plan review also provided the initial basis for rapid transit planning in Ottawa. Based on a 1973 preliminary study of rapid transit, the Regional Council in 1976 authorized "an examination of the need, location, priority, and staging for a rapid transit development program" (2). The preliminary study had concluded that the maintenance of a high level of transit service over the following 15-20 years required a policy that gave priority to the construction of rapid transit over new roads and road widenings. As was the case in Calgary, this study also found that "the investment to construct a fully grade-separated rapid transit system in the Region would be beyond its financial capacity over any reasonable time frame" (3).

RAPID TRANSIT DECISION

As mentioned, the initial decision to study and evaluate the potential for rapid transit in both cases was related to an ongoing urban transportation plan review process. When the decisions to proceed with rapid transit were made in the early to mid-1970s, however, the decisions were based on two very different rationales. Whereas the Ottawa decision reflected more of a system approach to rapid transit planning, the Calgary decision to proceed was primarily a response to a capacity deficiency in one corridor of the city's transportation network.

Calgary's Transportation Improvement Priority Study in 1976 determined that the existing road and transit systems were incapable of accommodating the forecast growth in travel demand over the period 1976-1986 (4). The study pointed to "particularly serious problems" in the southern part of Calgary and suggested that an integral part of any solution should be improved transit service to that area. The Transportation Plan Review for Ottawa-Carleton, on the other hand, presented reasons for rapid transit development based more on general growth trends and transit system operational trends. The basic reasons for considering rapid transit in Ottawa were (a) to meet the transportation needs of the future patterns of development in the region as set out in the official plan and (b) to improve the service and cost-effectiveness of OC Transpo operations (5).

The Ottawa decision to begin rapid transit design studies was thus a continuation of a metropolitan transportation and land use planning process first established in the 1960s. When the decision to proceed was made, although data from past transportation studies supported the view that capacity deficiencies would likely develop, transportation planners in Ottawa were uncertain as to the actual corridors to be considered for rapid transit. At that point, the planning process focused more on the transportation system because planners were not faced with any one corridor where immediate action was necessary.

The Ottawa decision also involved considerations of the current and future operations of the local transit system. With a level of transit ridership among the highest in North America for an all-bus system, Ottawa was presented with a situation in which further conventional bus service improvements could only marginally improve operating speeds and efficiency, especially since forecast growth in the transit system involved long-distance commuter-type routes. It was therefore concluded that a transportation policy that did not include transit operations on priority rights-of-way "would leave the transit system at the mercy of increased road congestion, resulting in lower operating speeds and, therefore, significantly higher operating costs" (5).

The Calgary decision to build, as mentioned, was

much more a response to a particular transportation need in a specific corridor. Demand forecasts for the MacLeod Trail corridor running south from the city center estimated peak-hour volumes of 4500-6000 persons/h in the peak direction by 1986 (6, p. 1). It was felt that even buses in reserved lanes along MacLeod Trail would be able to serve this level of demand as a maximum and that any further growth could not be handled. A transit-based solution was required to provide both speeds higher than existing transit operations in order to attract new ridership and a capacity of 5000 to 10 000 passengers/h in one direction. The emphasis on a transit solution can be attributed to Transportation Improvement Priority Study policies that promoted expanded transit services instead of continued road construction.

Although the rapid transit decision was based primarily on a need in a particularly fast-growing corridor, there had been some thought given to the overall transportation system in Calgary, through an assessment of total costs and system capacity, and consideration of alternatives to the immediate initiation of rapid transit development. For example, high-quality express bus service was considered as an interim measure for the corridor. Immediate rapid transit development was preferred, however, for many reasons, the most important being that the long-term capital costs of a rapid transit system were determined to be less than a "bus now, rapid transit later" alternative.

A decision was therefore made to proceed with the design and implementation of some form of rapid transit operating on exclusive rights-of-way along the MacLeod Trail corridor, and 1981 was set as a target date for revenue service. The initiation of the design process in Calgary was preceded by the identification of a specific corridor, as determined from demand and capacity forecasts. A change in transportation policy to undertake public transit development as an alternative to road construction, and a land use planning decision to use rapid transit to influence urban form, further reinforced the rapid transit commitment.

In summary, differences between the initial rapid transit decisions in Calgary and Ottawa are apparent in the planning approaches used and in the public transit and land use policies behind the decisions. Planners in Calgary began design studies with a corridor already identified, whereas those in Ottawa set out to design a rapid transit system consisting of then unspecified corridors. The Ottawa decision was based on a policy of improving the operational efficiency of an already extensively used transit system, whereas the Calgary project was initiated under the premise that a rapid transit line would attract more ridership to the transit system and thereby reduce the need for several future road system improvements. In light of the fact that the net result in both cities was a commitment to rapid transit development, these differences may appear to be inconsequential with respect to the overall projects. However, as will be discussed, these differences, when combined with other factors, provide the foundation for radically different decisions in terms of route alignments, mode selection, and implementation strategies.

ROUTE ALIGNMENT AND PROFILE DECISIONS

Because the decision to proceed with rapid transit design in Calgary was based on an identified capacity deficiency in a specific corridor, the selection of a route alignment was not nearly as complex as it was in Ottawa. The processes of route selection for service through the downtown areas were similar, however, in that both cities had to determine a route alignment and a route profile (i.e., the degree of right-of-way separation) through their central business districts (CBDs).

In Calgary, the presence of an almost ideally located railroad right-of-way in the selected corridor resulted in a route selection process that did not involve an analysis of route alternatives. One of the studies that recommended rapid transit along MacLeod Trail evaluated service on an alignment along the railroad right-of-way as a "test alternative", the selection of which was "necessary for calculation of capital and operating costs" (6). The MacLeod Trail corridor had been designated for rapid transit as early as 1966 as part of the above-mentioned four-leg system, but the original study specified no particular route alignment (7).

The railroad right-of-way was initially selected as a test alternative because it involved minor property acquisition, low construction costs, and "minimal environmental impact". As Figure 1 shows, the alignment starts at the south end of Calgary, follows the existing Canadian Pacific tracks, then follows a side street parallel to MacLeod Trail before entering tunnels under MacLeod Trail and Cemetery Hill into the downtown. The most costly features of the alignment were the grade separations specified for four locations where the railroad crossed major arterial roads and the two sections of tunnel. Given the characteristics of the corridor area and the presence of a "ready-made" right-of-way, the route alignment selected was thus likely the "best" in terms of cost, impact, and service considerations. Nevertheless, it is a noteworthy characteristic of the rapid transit planning process in Calgary that formal alternatives analysis was not undertaken for route selection.

Ottawa, in its commitment to the design of a rapid transit system, undertook an extensive route selection process that consisted first of corridor identification and then route alignment identification and evaluation. A screen-line analysis technique was used to identify travel demand and capacity deficiencies in future time periods. Based on the screen-line data, planners established a five-leg conceptual rapid transit system (see Figure 2). The corridors were identified primarily on the basis of anticipated capacity deficiencies, and little

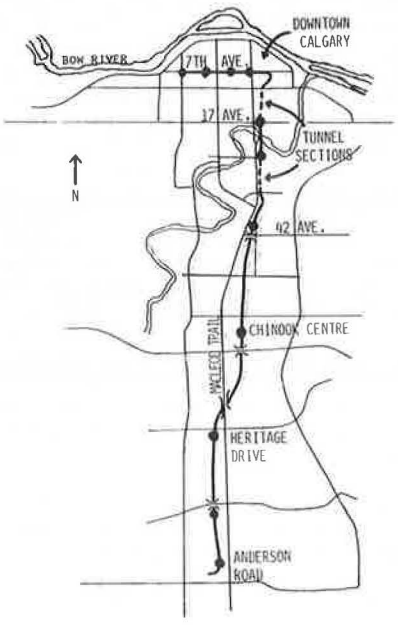
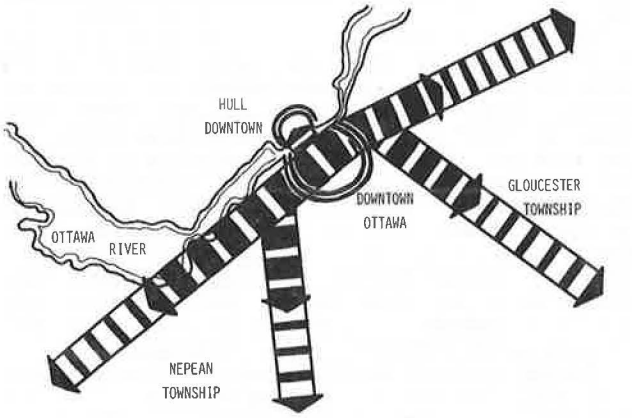


Figure 1. Calgary south corridor light rail alignment.

Figure 2. Ottawa rapid transit corridors.



emphasis was initially placed on existing modal splits or transit travel patterns. These other factors were taken into account later in identifying and selecting actual route alignments.

Ottawa planners considered 111 miles of railway, utility, and publicly owned corridors as potential route alignments. Many of these rights-of-way were neither continuous nor in desirable locations, although their use would have minimized property acquisition, construction costs, and overall disruption. Sixteen route alternatives were identified for the five-leg system and were evaluated as integral parts of both existing and proposed transit and road systems. Preliminary assessments of the route alternatives were based on right-of-way availability, station locations and their attractiveness to riders, existing population and employment patterns, and potential for stimulation of future development (8).

A detailed process of route evaluation was undertaken in 1977. Routes were selected for the central area, the southeast corridor, and the west-southwest corridor; political decisions forced the postponement of further analysis of the eastern and northern corridors. The route selection process included technical evaluations performed by a "study team", public participation, and the presentation of results to a political-technical advisory committee so that conclusions could be made. An integral part of final route selection in Ottawa was the determination of implementation staging. As mentioned, the eastern and northern corridors were set aside by decisionmakers. In addition, high construction costs forced decisionmakers to select an alignment along an existing parkway as an interim alternative to an exclusive right-of-way for one leg of the system.

Although the selection of route alignments was strikingly different in terms of the evaluative processes used in the two cases, the evaluation and selection of a route alignment and profile for the downtown segments of each system were quite similar. In both cities, it was decided that the initial operation of rapid transit vehicles through the CBD would involve street-level operations only partially separated from pedestrian and automobile traffic.

The selection of an alignment through downtown Calgary was based primarily on existing and projected distributions of employment and retail floor space. Rapid transit vehicles will share a transit mall along Seventh Avenue, parallel to and one block away from the Eighth Avenue pedestrian shopping mall. Similarly, in Ottawa, operation on streets through the heart of the employment and retail areas parallel to an existing pedestrian mall is planned.

In both cases, the decision not to undertake development of underground or elevated rights-of-way was primarily one that involved the construction costs associated with total grade separation, perceived to be out of reach for both cities at the present time. Ottawa planners opted for a system of transit vehicle priority on contraflow lanes on adjacent and parallel one-way streets through the downtown. The use of separate lanes on existing streets, it was argued, would be acceptable for both rail and bus operations. Thus, the alignment through downtown Ottawa and the degree of right-of-way separation were determined before a mode was selected.

In Calgary, on the other hand, the route alignment and profile for rapid transit through the CBD were determined after light rail had already been judged to be the most desirable mode. Underground, at-grade, and elevated alternatives along Seventh Avenue were evaluated specifically for rail vehicles. Because of prohibitive construction costs and because of the pressing need to separate existing bus traffic from automobile traffic on downtown streets to both speed bus flows and reduce overall congestion, a combined rapid transit/bus transit mall was the alternative chosen (9).

The relations between route selection, mode selection, and the determination of method of operation through the downtown area, as components of the design process in each case, therefore differed considerably. In Calgary, a test alignment was selected for comparison of the bus and rail modes. Based on favorable cost calculations for light rail operations, that mode was selected, and the test alignment was judged to be the lowest-cost and least-disruptive route. Selection of route alignments in Ottawa was based on a more formal analysis approach, and the final route alignments were significantly influenced by political decisions over staging of the rapid transit program. The alignment of rapid transit service through the downtown, as in Calgary, was primarily influenced by capital costs and activity distributions. In Ottawa, however, both the suburban and downtown alignments and the route profile through the CBD were determined before a mode was selected.

The route decision in both cases can therefore be related to the initial objectives of undertaking rapid transit development. The complexity of the route-alternatives evaluation process in the two cases was determined by whether the rapid transit program was a single-corridor response to capacity deficiencies, as in Calgary, or a process geared toward development of a rapid transit system, as in Ottawa. The lack of formal route-alternatives evaluation in Calgary was also a result of the presence of an easily identifiable low-cost corridor. These two experiences demonstrate how the route selection process can be affected both by the objectives of the rapid transit project being considered and by the sequential order of the decisions made in the planning process.

MODE SELECTION

Although cost considerations certainly influenced both the decisions to build the rapid transit projects and the selection of route alignments in Ottawa and Calgary, other factors and concerns had a significant impact on these decisions as well. The mode selection stage of the planning process, on the other hand, was the point at which different systems with different vehicles were considered specifically in terms of their capital and operating costs.

Table 1. Capital and operating costs for Calgary south corridor busway or LRT line.

Cost Category	Cost [$000 000s (1975 Canadian)][a] Busway	Light Rail
Capital costs		
Roadway or track (including electrification)	13.2	23.4
Bridges and tunnels	33.0	25.9
Stations, garage, and yards	9.7	9.4
Engineering	5.6	5.9
Land	7.6	6.8
Total	69.1	71.4
Annual costs		
At 5000 persons/peak-h/direction		
Annualized capital costs	6.13	6.34
Operating costs	4.155	2.67
Total	10.285	9.01
At 10 000 persons/peak-h/direction		
Annualized capital costs	6.13	6.34
Operating costs	7.713	4.65
Total	13.843	10.99

[a]$1 Canadian (1975) = $1.0172 U.S.

Although similar costing techniques were used, the actual mode selection was made at a different point in the design process in Ottawa than in Calgary and different modes were ultimately selected. Both cities examined annualized capital and operating costs, and both ended up selecting the lowest-cost option for their respective systems. To support the cost analyses, however, somewhat different assumptions about the operating characteristics of the alternative modes were made.

Calgary made use of its test route alignment along the MacLeod Trail corridor to compare the construction, capital, and operating costs of a busway with those of a light rail line. In terms of construction costs, the major difference between the modes was that the busway tunnel sections would be more costly due to the need for wider cross sections and the need for ventilation. In addition, a larger vehicle garage would be required whereas the costs of the actual busway would be less than for a rail guideway (see Table 1). In total, the construction and land costs for the two modes were estimated to be fairly equal (6): $69.1 million for busway and $71.4 million for light rail guideway, in 1975 Canadian dollars (Canadian dollars are used throughout this paper).

Operating costs were estimated for demand levels of 5000 and 10 000 passengers/peak-h; vehicle capital costs were included in the form of depreciation allowances. It was noted that bus operating costs would increase linearly with demand because of the need for more buses and more drivers as service expands. Light rail vehicles, on the other hand, could be coupled into trains to provide higher capacities and reduce labor costs relative to the number of passengers carried. The estimated annual operating costs and annual total costs for the two levels of demand for the two modes considered are given in Table 1. Both the operating costs alone and the combined capital and operating costs were estimated to be lower for an LRT system at both levels of demand, although the difference was minimal at 35 000 riders/day (i.e., 5000/peak-h).

Calgary planners evaluated only the bus and light rail modes and considered buses only in terms of a distinct busway rapid transit operation. Ottawa, on the other hand, evaluated the modes in terms of the possibility of integrating feeder services into the line-haul system. Four modal-operational alternatives were examined in detail (2): (a) standard feeder buses providing "no-transfer" service from local routes along the busways, (b) articulated buses operating on the busways and providing feeder services on the heaviest local routes, (c) light rail vehicles operating along the rapid transit routes and standard feeder buses on local routes, and (d) light rail vehicles fed by articulated buses on the heavier local routes.

Only bus and light rail alternatives were evaluated in Ottawa because of the constraints imposed by the route alignment and profile decisions that had already been made. The selected mode would have to operate on separate rights-of-way in suburban areas and on existing streets through the central area. Furthermore, level-of-service considerations combined with the type of on-street operations selected for the downtown placed additional constraints on the modal choice in that the ability of vehicles to overtake one another in the central area and to provide skip-stop and semiexpress service along the transitways was judged to be necessary.

The Ottawa mode evaluation included vehicle capital costs together with right-of-way and construction costs. Table 2 compares capital and construction cost estimates for all four alternatives at two levels of population and demand. The estimates show that, for an entire system of transitways, construction costs for light rail would be significantly higher than for a bus system. The study attributes

Table 2. Capital and operating costs for Ottawa rapid transit system alternatives.

Population Level	Cost Category	Cost [$000 000s (1977 Canadian)][a] Standard Bus	Articulated Bus	LRT/ Standard Bus	LRT/ Articulated Bus
625 000	Capital costs				
	Vehicles	59.57	63.72	108.91	112.32
	Garages and yards	15.87	15.12	25.12	25.12
	Right-of-way construction	77.33	77.33	104.97	104.97
	Total	152.77	156.17	239.00	242.41
	Annualized capital costs	17.719	18.184	26.887	27.335
	Operating costs per year	50.045	44.583	48.927	44.981
	Total annual costs	67.764	62.767	75.814	72.316
750 000	Capital costs				
	Vehicles	71.38	76.05	130.37	134.59
	Garages and yards	19.32	15.87	25.87	25.87
	Right-of-way construction	86.21	86.21	118.02	118.02
	Total capital costs	176.91	178.13	274.26	278.48
	Annualized capital costs	20.579	20.827	30.897	31.451
	Operating costs per year	56.353	48.744	54.221	48.836
	Total annual costs	76.932	69.571	85.118	80.287

[a]$1 Canadian (1977) = $1.0635 U.S.

this difference to the electrification and signaling costs of light rail guideways. It should be noted that this difference in construction cost occurs because no part of the Ottawa system is to be underground. The tunnel sections of the Calgary system served to raise the cost of the bus mode in comparison with light rail.

The vehicle capital, garage, and construction costs given in Table 2 are substantially higher for the alternatives that involve LRT. Aside from construction costs, vehicle capital costs are much higher for LRT alternatives, a difference not obvious in the Calgary analysis because of the inclusion of vehicle capital costs in the estimates of annual operating cost. Annual operating and total costs for the Ottawa system are also given in Table 2. Because of labor costs, the standard bus alternative was estimated to have the highest operating cost. The need for fewer vehicles and consequently less labor gave the LRT/articulated bus and articulated bus alternatives equally low operating costs. However, a summation of annual capital and operating costs, according to the estimates presented, gave articulated bus an advantage over the lowest-cost LRT/bus combination.

The basic differences between the cost analyses done in Ottawa and Calgary reflect the use of a systemwide costing approach as opposed to a corridor-based approach. Calgary calculated the operating cost of the proposed rapid transit service alone, whereas Ottawa attempted to estimate the effects of the proposed rapid transit system on the operations of the transit system as a whole. Calgary analysts made simple assumptions about the level of service that would be needed to serve forecast ridership on the route. Ottawa analysts ran detailed computer models that actually estimated schedules for the vehicles operating in a transit network with rapid transit as one component.

A related difference involves the fact that Ottawa considered the cost effects of integrating local feeder vehicles onto the rapid transit right-of-way whereas Calgary dismissed the concept as requiring "complex station and ramp facilities" (1). Finally, Ottawa considered articulated buses on the transitways as a mode offering the flexibility of standard buses and the labor-saving capacity (to an extent) of light rail vehicles. It is likely that, had Calgary planners considered articulated buses on its busway alternative, light rail might not have been as clear a cost winner.

All of the above methodological differences had impacts on the cost estimates derived in both cities and, consequently, on the mode ultimately selected. In addition, constraints imposed by past decisions on route alignments and operating characteristics affected the determination of capital and operating costs. Although both cities selected the alternative mode with the lowest estimated total cost, the decision in each case was based on operational and level-of-service considerations as well.

Calgary selected light rail technology because it was perceived as being "economically and operationally superior" (6). Labor costs were determined to be lower and capacity higher for a rail guideway system. A busway system was less attractive to planners because operational experience with high-speed busways was limited, because of the problems of handling an ever-increasing number of buses on the downtown street system, and because rail could not be installed along the same alignment in the future without disrupting bus operations. In addition, it was thought that light rail would be able to attract more new riders to public transit and be an effective force in guiding land development.

Ottawa decisionmakers, in addition to considering the costs of each alternative, had to balance the lower operating cost per unit of passenger-carrying capacity of the light rail vehicles against the flexibility provided by buses in their ability to leave the rapid transit rights-of-way to provide same-vehicle line-haul and feeder service. The level of service along the transitways was judged to be greater with buses, given their potential for fitting transit services more closely to the demand patterns along a corridor.

Perhaps the most important noncost consideration that affected the Ottawa decision was the staging pattern set out for the system by the Regional Council. The approved staging patterns involved construction of short transitway sections in each corridor to relieve capacity deficiencies as they occur over the development period. Existing roadways are to be used by transit vehicles on selected inner sections of the corridors as an interim measure. A rail system obviously could not be built under this type of staging plan. As a result, articulated buses were selected for rapid transit service along the transitways.

The order of decisions made in the Ottawa design process, particularly with respect to operating characteristics and staging, effectively served to predetermine the mode to be selected. Although both cities made detailed comparisons of capital and operating costs of alternative modes, Ottawa evaluated more alternatives and did that evaluation on a systemwide basis. In the final analysis, mode selection was rationalized on the basis of cost estimates; suitability in terms of established route, operating, and staging constraints; and the objectives originally set for rapid transit in each city.

IMPACTS OF POLITICS AND FUNDING CONSTRAINTS ON THE DECISION PROCESS

The three major decisions discussed above involved the use of technical analyses and evaluative methodologies, although a comparison of the decisions in the two cases examined suggests that nontechnical factors may have had as great an influence on the decisions actually made. In both cases, the sequence followed in the design process had a substantial impact on the ultimate form of the rapid transit program to be pursued. Two interrelated elements not yet discussed that had great impact on these decisions are the constraints imposed by available financial resources and by the local government structure itself.

For both projects, the funding situation changed between the time an initial commitment to rapid transit was made and the time when actual construction was to begin. In Calgary, the 1975 estimate of total cost for the south corridor project was $80 million, and at that time it was anticipated that the main source of funds for land and construction would be the provincial government. The most recent cost estimates for the project are approximately $160 million, of which federal and provincial government contributions will account for only $56 million (10). The financial picture in Calgary, however, is by no means bleak. First of all, the south corridor project was undertaken as an alternative to equally costly or more costly road improvement projects, which means that the expenditure was a part of the overall transportation improvement program. Second, although debentures finance this particular project in name, the City of Calgary receives substantial development funds from the Alberta Heritage Fund as part of a distribution of oil royalties to local governments, which means that this project is receiving indirect provincial assistance as well.

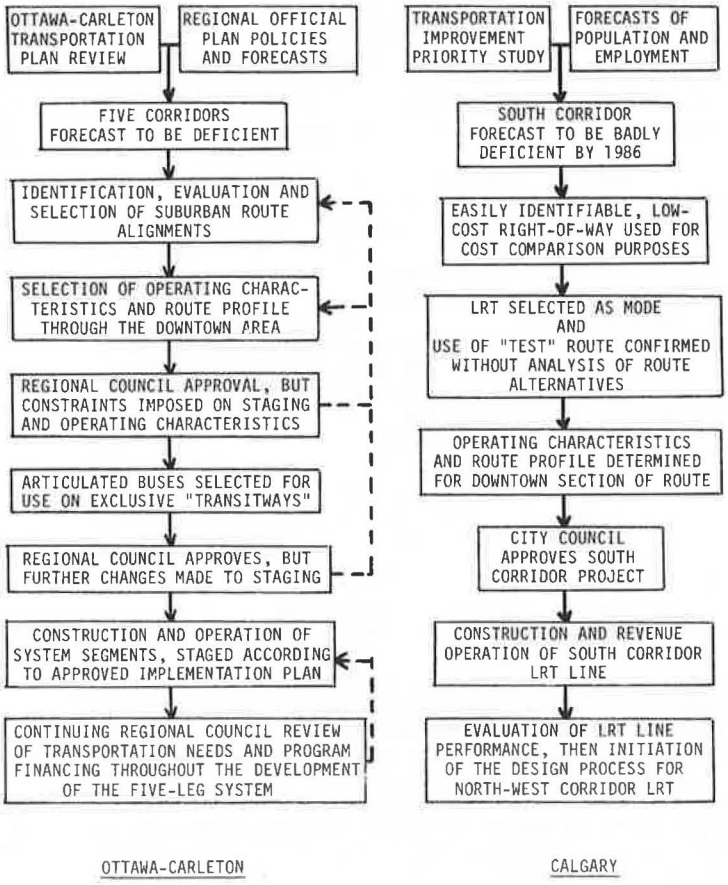


Figure 3. Comparison of decision processes in the two cases examined.

Ottawa decisionmakers do not have the financial resources at the local level that Calgary does. As a result, the $300 million 1976 estimate for rapid transit development in Ottawa is a significant burden for local governments in the area, even if the Province of Ontario subsidizes up to 75 percent of the capital cost. A 19-year development plan was therefore adopted by the Ottawa-Carleton regional government to reduce the impact of the program on local budgets. The decision made with respect to staging thus both eliminated two corridors from the initial development phase and delayed completion of the first phase, the west-southwest and southeast corridors, until 1991.

The reluctance of local decisionmakers in Ottawa to commit themselves to rapid transit expenditures and the decision to adopt a much slower implementation program are at least partially attributable to the two-tier political structure in the region. Because the Regional Council is responsible for the final decisions on rapid transit development and is made up of elected representatives from many localities in the region, the political decisions made on transportation investments tend to be more cautious than would be the case in a single-tier local government.

In Ottawa-Carleton, the City of Ottawa has pushed for rapid transit development whereas suburban and rural localities have not been convinced of the program's merits. The effect on the actual development of rapid transit has been delayed implementation and a staging program in which outer sections of the system will be constructed first. More recently, the Regional Council voted to delay the construction of contraflow lanes in the CBD, electing instead to initiate service on existing conventional bus lanes.

The linkages between funding and the political process not only can override the findings and recommendations of technical analyses in rapid transit planning and design but also can guide the planning process in terms of the sequence of, and the nature of, the recommendations made. A comparison of these rapid transit planning approaches demonstrates how the availability of funding at the local and upper levels of government and the structure of the decisionmaking process at the local level can effectively determine the ultimate form, implementation, and operation of a rapid transit system.

SUMMARY AND CONCLUSIONS

The different policy objectives, the technical methodologies used, and the impact of political decisions on the two rapid transit projects examined have combined to create two very different outcomes in terms of the actual systems designed. These three categories of impact on the design processes resulted in the different decisions made in Calgary and Ottawa with respect to the need for rapid transit, route alignments, and mode selection. Figure 3 summarizes the differences between the design and decisionmaking processes in the two cases. The influences on the planning and design of the systems have to this point been identified and discussed with respect to each of the three major decisions related to rapid transit development. The concepts that have emerged can best be integrated through a summary discussion of the major impacts on the decision process in each city.

The decision in Calgary to proceed with a rapid transit program stemmed from a specific need for additional capacity in one of its transportation

corridors. Because of policies promoting public transit improvements as alternatives to road system improvements, a rapid transit line design process was undertaken for the MacLeod Trail corridor. A clearly identifiable, low-cost, conveniently located right-of-way existed in the corridor, so a detailed analysis of route alternatives was not performed. Light rail was chosen because of its cost advantages on the initial test alignment, and that alignment was then the one accepted for development.

The rather straightforward design process in Calgary encountered few obstacles, both because funding was not considered to be a serious problem and because the local government was committed to implementing rapid transit. A single local government body was able to focus transportation investment on the corridor that needed rapid capacity expansion. This focus on one leg of what is planned to be a larger system permitted decisionmakers to take a longer-range view of their investment in transit in terms of future capacity, the ability to attract riders, and development potential.

The planning and design process in Ottawa was more complex in terms of a less conventional sequence of decisions and a greater number of political reviews with respect to funding and the transportation needs of the region, as shown by the feedback loops in Figure 3. Rapid transit design in Ottawa was initiated to respond to the transportation needs arising from future development and the need to maintain a high level of transit service in the region. The objective was development of a rapid transit system, and the system approach characterized many of the decisions made in planning and design.

The approach to developing a rapid transit system in Ottawa-Carleton was likely necessitated by the composition of the regional government. A single-corridor approach would have been politically infeasible because the Regional Council would not have approved a major investment in a rapid transit line to run through only one or two municipalities. The desire to develop a system of rapid transit lines in an urban area with only a moderate population and a constrained financial situation resulted in political decisions to delay implementation and to carefully stage construction, not only by individual corridor but also by segment within each corridor. Overall, the planning process has been characterized by continuing political review of funding constraints and the actual need for rapid transit.

There is one basic question that a comparative analysis like this one cannot answer. It is not at all clear which of the two decision processes has created the "best" rapid transit system, or at least the most appropriate system for its urban area. The simplicity of Calgary's planning and decision processes may mean that the LRT line that opened in 1981 will be an effective solution to a transportation problem, as planned. On the other hand, the speed of the process and its relative lack of critical political evaluation may have created a white elephant that will be a financial burden. In a similar vein, the complex and relatively sluggish decision process in Ottawa may have saved it from an unnecessarily glamorous rapid transit system, or it may have severely constrained the long-term transit potential of the region.

It is clear, however, that political and nontechnical considerations, and the related funding constraints, are just as powerful as, if not more powerful than, technical considerations in determining the form of rapid transit projects. Technical evaluations are in many cases used to support design decisions actually induced by nontechnical factors and can provide rather convincing arguments for one position or another. The framework of the planning and decisionmaking processes in rapid transit development programs can differ substantially from one urban area to the next and can have far-reaching impacts on the transportation decision ultimately made. The relation between the technical, nontechnical, and political elements in each process is therefore a critical issue to be addressed in the analysis of the decisions behind any rapid transit development program.

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