Critical Factors in Planning Multimodal Passenger Terminals

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The critical factors for a multimodal passenger terminal policy for Canada were determined. The research methodology consisted of a literature review, data collection, and analysis. The data-collection phase used two questionnaires. The results of the first questionnaire, which was an open-ended questionnaire administered in Europe, Japan, and the United States, were used as input for a closed-ended questionnaire administered to all multimodal passenger projects in Canada. The results were analyzed by using paired comparisons of factor scores and an importance index. The results indicated that the critical factors, in order of priority, are integration of various modes of transportation, promotion of public transportation, cost of terminal, government cooperation, operating factors (safety, security, etc.), historical building preservation, environmental concerns (noise, air pollution), urban development, and reduction of local traffic congestion.

Multimodal Passenger Terminals (MPTs) are transportation centers in which several modes of transportation are physically and operationally integrated, usually under one roof. At an MPT, vehicles arrive and depart while passengers interchange among the modes in one terminal complex. These terminals can serve bus, rail, transit, taxi, automobile, ferry, and aircraft modes. Operational integration of modes could be accomplished through such methods as coordinated schedules, joint use of services, and fare integration. Intercity surface transportation and local transit operators, the traveling public, and the municipalities in some Canadian communities and provinces are currently interested in multimodal passenger terminals.

PROBLEM STATEMENT

MPTs appear to have certain potential benefits, but if their exact nature and extent in practice are to be determined, data from a number of operating MPTs will be needed. To develop operating MPTs, it was necessary to determine the factors that are critical in fostering successful MPT development. Determination of these factors was also required for formation of a policy that will create the climate necessary to develop MPTs in Canada. The critical factors for multimodal passenger terminals in Canada were identified in research carried out at Carleton University in Ottawa (*1*).

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POTENTIAL FOR MULTIMODAL PASSENGER TERMINALS IN CANADA

There is substantial potential in Canada for developing multimodal passenger terminals. A study carried out for the Transportation Development Centre of Transport Canada identified potential sites for Canadian MPTs (*2*). This extensive study and analysis used such criteria as the number of modes, accessibility by time and distance, frequency of service by mode, and potential for expansion of existing terminals in terms of cost. In all, 131 Canadian urban areas with populations of 15,000 to 300,000 were reviewed. The study concluded that there were 14 cities with high potential and 98 sites with moderate potential. Numerous other studies and reviews have also established that there is good potential for MPTs in Canada (*3–5*).

CONCERNS

A number of concerns have restricted the development of multimodal passenger terminals in Canada. The first is the difficulty in bringing together the two major public intercity passenger modes, bus and rail. The bus industry believes that the considerable subsidization of the rail passenger mode puts the bus mode at an unfair competitive disadvantage. The Canadian bus industry is regulated by the provinces and is fragmented into some 60 separate companies, providing mainly regional service.

The second concern is that efforts to develop surface passenger terminals for bus and rail have been uncoordinated in Canada due to a lack of incentive to combine efforts. Each carrier prepares its own plans without consulting others. An incident from Saint Johns, New Brunswick, in 1979 provides a good example. VIA Rail consolidated a former Canadian National railway station and a Canadian Pacific railway station, located in the suburbs, into one downtown location. While VIA was preparing its plans, SMT, the major regional intercity bus carrier, was preparing plans for its own terminal at another location only a short distance away. This example illustrates a missed opportunity.

A third concern is the unknown scope and magnitude of any potential benefits. There has not been enough experience in Canada to define the benefits of MPTs. In the case of the Winnipeg MPT a cost-benefit study was attempted before development. The research could not be completed because the results varied with the assumptions on revenue gained through rental rates, tax incentives, passenger volumes, and so on. Another source of difficulty was the number of noneconomic benefits identified in the Winnipeg MPT project.

RESEARCH METHODOLOGY

The heart of the current research methodology was a literature review, followed by an extensive worldwide data collection effort. The data-collection phase consisted of the development and administration of two questionnaires. The first was an open-ended questionnaire, administered in France, Italy, the Netherlands, West Germany, England, Sweden, Denmark, the United States, and Japan. This first instrument was designed to develop factors for input into a second (Canadian) questionnaire. This second questionnaire, which was used to determine the important factors in the development of MPTs in Canada, was administered to representatives of all known Canadian MPT efforts.

The Canadian questionnaire was designed to be closed-ended. The respondents were asked to score the importance of each of the terminal development factors on a scale of one to seven, similar to a Likert scale. A low score was least important, and a high score was most important. This was not a priority ranking but an importance rating of each factor, independent of the others. This numerical scoring was then used for analysis.

ANALYSIS

The present analytical technique was based partly on studies conducted by Ross (*6*) and Cheung (*7*). Ross developed a method to rank the attractiveness of parks to a given type of user. The approach used origin/destination flows and data on the spatial interactions of individuals using 12 parks to produce attractiveness rankings for the parks.

Cheung used a similar method to develop a linear programming model that, subject to the constraints of air travel demand and aircraft capacities, allocates the origin/destination air passengers between two cities to the various feasible passenger routes defined for that city pair. Each of the passenger routes is assigned a weight to indicate its relative attractiveness. These weights actually represent penalties that the passengers incur in traveling from one place to another.

The method used in this research consisted of a paired comparison of the factor scores to determine the frequency of the score of one factor, i, exceeding the score of another factor, j. Analysis was performed with a computer program, and the resultant information was presented in matrix form. In the first matrix, the (i, j) entry is the number of times that factor i was judged to be more important than factor j. A second matrix was used to contain information on the number of times that two factors were judged to be equally important. These two matrices have the following properties:

$$C(i, j) + C(j, i) + E(i, j) = \text{total observations}$$

where

$C(i, j)$ = number of times that factor i was judged to be more important than factor j;
$C(j, i)$ = the number of times that factor j was judged to be more important than factor i; and
$E(i, j)$ = the number of times that factor i was judged to be as important as factor j.

A third matrix, formed by summing the first two matrices, indicated the frequency with which factor i was judged greater than and equal to factor j.

A fourth matrix was derived from the first matrix. The entries in this, the proportion matrix, gave the proportion of times that any factor i was judged to be more important than factor j. An entry in this proportion matrix is defined as

$$P(i, j) = [C(i, j) + E(i, j)]/[C(i, j) + C(j, i) + E(i, j)]$$

where $P(i, j)$ is the proportion of times that factor i was judged to be more important than factor j, and $C(i, j)$, $C(j, i)$, and $E(i, j)$ are defined as previously.

The proportion matrix was also developed for the percentage of time that factor i was equal to and greater than factor j. All this analysis was carried out three times: once for the responses from the communities, municipalities, and so on; once for the responses from the terminal planners; and once for the combination of the two.

To produce a relative ranking of the factors, an importance index was created for each factor by using the formula

$$I(i) = P(i, j)/n - 1$$

where

$I(i)$ = importance index for factor i;
$P(i, j)$ = proportion of times that factor i was judged more important than factor j; and
n = number of elements in the row.

To achieve $I(i) = 1$, it was necessary to use a constraint in $P(i, j)$: the elimination of $E(i, j)$ in the numerator and denominator. The factors were then ranked according to the size of the importance index, and a spread and gap were calculated for each interval. The spread is the ratio of the importance index in question over the largest importance index for that analysis, whereas the gap is the numerical difference between the spread from one factor to another in descending order of size. The spread provides an indication of the relative importance of each factor, as shown in Figure 1.

CRITICAL FACTORS

In priority order, the factors affecting MPT development in Canada were determined to be

- Integration of various modes of transportation,
- Promotion of public transportation,
- Cost of terminal,
- Government cooperation,
- Operating factors,
- Historical building preservation,
- Environmental concerns,
- Urban development, and
- Reduction of local traffic congestion.

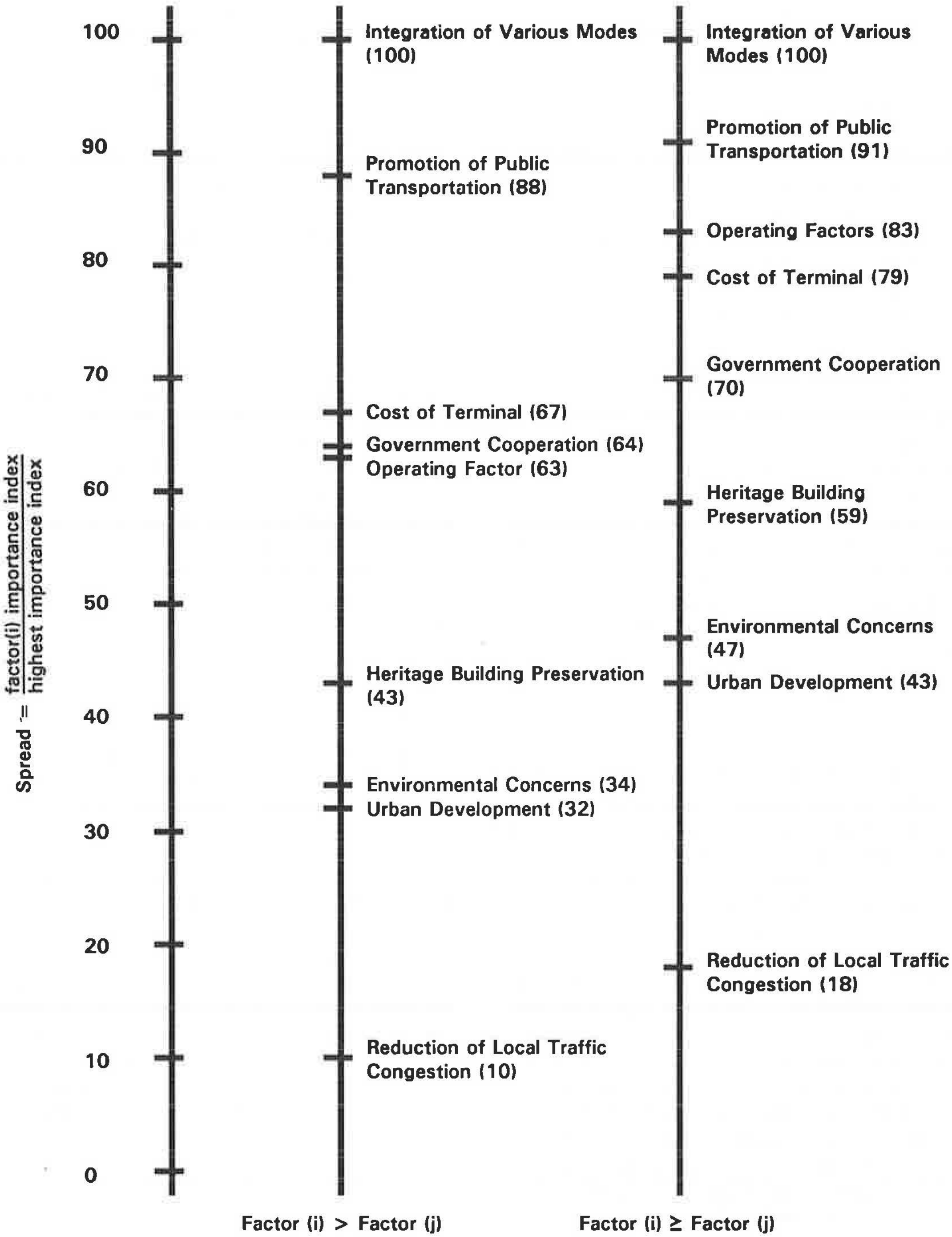

FIGURE 1 Display of relative factor importance.

VALIDATION

A modified Delphi technique was used to validate the results, which were also checked against two projects. These projects, one successful and one unsuccessful, were in Canadian cities of equal size with similar potential. The check suggested that the participants in the successful project were pursuing the more important factors, whereas the participants in the unsuccessful project were putting emphasis on the less important factors.

CONCLUSIONS AND RECOMMENDATIONS

In Canada, there is currently a pronounced lack of knowledge, literature, and research on the subject of MPTs. There is definitely a potential, however, for developing these facilities. Successful development of MPTs requires a policy that considers certain critical factors, in order of priority: integration of various modes of transportation, promotion of public transportation, cost of terminal, government cooperation, operating factors (safety, security, and so on), historical building preservation, environmental concerns (noise, air pollution), urban development, and reduction of local traffic congestion.

It is recommended that a policy be established to encourage the development of MPTs in Canada. A pilot project (or projects) should be constructed under the new policy. Finally, a research project (or projects) should be instituted to monitor any pilot projects.

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