Generic Objectives for Evaluation of Intermodal Passenger Transfer Facilities

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A list of generic objectives is a tool for initiating the evaluation process for project alternatives for an intermodal passenger transfer facility. Such a list should contain all objectives that might be important to any project. This paper presents a list of 70 objectives developed through a literature review and through interviews with users. Each objective on the list was rated by a panel of experts on transportation planning and station design. An analysis of the ratings revealed that most important were objectives for ensuring safety and security and objectives for improving transfers and transfer opportunities. Less important were objectives relating to the environment and to finance. Architectural, building, and site considerations were rated as least important.

Like many other cities in the United States, Milwaukee has become concerned about the ability of its transportation system to continue to provide a high level of mobility while still attaining its environmental goals. To better meet these sometimes conflicting goals, public officials, planners, and citizens have started to place a greater emphasis on intermodal solutions to mobility problems. One effort in this direction is a study into the possible development of an intermodal station in Milwaukee's central business district.

Building an intermodal station in Milwaukee is both an opportunity and a challenge. The various transportation modes are widely dispersed throughout the downtown area, and historically there has been little effort toward coordinating functions or facilities. Further complicating the picture are yet unfinished plans to implement high speed rail service from Chicago and to build a light rail line and a busway from the western suburban communities. In such an ambiguous planning environment, planners need to explore a wide range of alternatives, exercising careful judgment, to find the best possible intermodal station. How should those judgments be made? There are no pat answers.

The last concerted effort to develop evaluation methods for intermodal stations in the U.S. dates to the 1970s. Since then issues, technologies, experiences, and priorities have shifted and evolved. Another look at intermodal evaluation seemed appropriate.

GENERIC OBJECTIVES

An evaluation framework needs a set of objectives, any one of which when met would foster the achievement of project goals. Objectives should be selected at the earliest point in the design process, but that selection is impeded by the size and complexity of an intermodal passenger transfer facility and by insufficient knowledge of project alternatives. There are many possible objectives. The selection of objectives would be helped by the availability of a rank-ordered list of generic objectives that span all potentially important design issues.

Lists of specific objectives are routinely created by planners when evaluating project alternatives. Some authors have developed lists of objectives or lists of design criteria as part of more general evaluation frameworks. Notable lists of station design criteria were written by a research team at the University of Virginia (*1*,*2*) and by Schneider (*3*). The Virginia list concentrated on interior design and site plans, and Schneider's list emphasized modal connections. Particularly interesting was a rank-ordered list of 10 objectives produced by Ross and Stein (*4*). This list was limited to the environment near a station, but it still illustrated the potential advantages for evaluation of ranked generic objectives.

RATIONALE FOR GENERIC OBJECTIVES

Many communities besides Milwaukee are seeking ways of improving their intermodal transfer facilities. The cost of these improvements can range from inexpensive to very expensive, and their impacts can range from minor to profound. It is essential that each facility be efficiently designed in a manner that satisfies the community's transportation needs and makes the best use of available resources. Critical to the design process is evaluation. The evaluation of a proposal for a new or improved intermodal transfer facility is a way to ensure that transportation objectives are met, that funds are well spent, and that the surrounding environment is protected and enhanced.

Evaluation requires judgment. An intermodal transfer facility is among the most complicated of transportation system components, often composed of hundreds of different design elements. An effective design must carefully balance these elements to achieve the best facility at a given cost. Hence, evaluation is not a single step but a process that starts with the design of alternatives and ends with a decision incorporating the opinions of experts, potential users, and the community at large. Designers must be cognizant of evaluation criteria, just as evaluators must be knowledgeable of the details of an alternative design.

At the inception of the design process, it is difficult to know what the community expects from the facility. Without plans and drawings and models to serve as a focus for early discussions, decision makers are unlikely to be able to give specific advice for selecting and refining the design elements. However, decision makers should be capable of expressing a set of general goals for the facility. A statement of goals, when available, is useful in defining the breadth of alternatives and in selecting a set of more specific objectives.

The final design of an intermodal passenger transfer facility has inputs from a variety of people, many of whom can influence the choice of alternative, including the choice of doing nothing. A

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successful facility will require the cooperation of public and private operators, governmental agencies, and community organizations. Many of these decision makers are business competitors; other decision makers compete for public funds or for private sector investment. They are of different sizes, have different missions, and have different constituencies. There are potential winners, and there are potential losers. Thus, it would be unreasonable to expect decision makers to provide a clear direction for the facility in the early stages of the design.

An intermodal passenger transfer facility is part of a very large system of transportation services. Its design requires it to be integrated with existing modes, perhaps making fundamental changes to the operation of those modes. It is necessary to involve the expertise of transportation planners and managers, as well as engineers and architects, in the design. Even broader expertise might be needed to mitigate adverse impacts on the physical environment and on society.

The evaluation of a large transportation project is often started after the alternatives have been completely defined and at least partially detailed. At that point each alternative is tested to determine how well it meets the project objectives. This procedure is reasonably good for projects with few objectives and for projects with few design elements. However, intermodal passenger transfer facilities can be very complex. Each alternative in itself may require numerous design decisions and tradeoffs. As indicated in Figure 1, each physical design must be influenced by the external environment, modal operators, financial needs, and travel requirements. This influence can only occur if the objectives are defined before the alternatives and if the staff interprets those objectives as it creates the design details (Figure 1).

There are many ways that an evaluation procedure may be implemented. However, a good evaluation procedure for an intermodal passenger transfer facility should have certain essential features. The evaluation procedure must:

- Be capable of generating and evaluating alternatives;
- Incorporate available expertise, including knowledge of modal operations;
- Foster the establishment of goals, objectives, and criteria for the project;
- Have sufficient staff support to accomplish necessary data collection, analyses, and reporting;
- Contain mechanisms for fast and clear communication among the many participants in the process;
- Satisfy the many laws and regulations associated with implementing a large transportation project; and
- Have the ability and authority to choose an alternative.

Furthermore, the process must be consistent with the style of planning that exists within the local community.

The design and evaluation process must have one or more groups of individuals with the responsibility to set project goals and to translate those goals into objectives. Each goal may have one or more objectives. An objective is a desired end-product of the project, but an objective is often operationalized as something the project should maximize, minimize, as well as achieve. There can be many objectives, and some objectives can be in direct conflict with each other. In defining objectives, it is especially helpful to look at those developed elsewhere. This paper presents generic objectives that cover the range of commonly established goals for intermodal passenger transfer facilities.

Ultimately, the evaluation process must determine whether some or all of the objectives have been satisfied. This determination may be aided by defining criteria for many of the objectives. Criteria are optional, quantitative measures of objectives.

BUILDING GENERIC OBJECTIVES

A list of generic objectives must be comprehensive without being specific to any particular alternative. Building such a list requires the opinions of many people familiar with the planning, design and operation of intermodal passenger transfer facilities.

As a first step, a comprehensive literature review of important objectives was performed. We sought every issue anyone has mentioned as being important to the evaluation of stations and terminals. The resulting list of issues was organized, and duplications were eliminated. At the same time, a review was conducted of evaluation methods that related to these issues.

To get users' opinions, an international, electronic group interview was conducted with knowledgeable and frequent users of intermodal passenger transfer facilities. The interview took about 1 month to complete. Administered through the Internet's "transit list," this group interview provided a good understanding of the issues most important to users. In addition, meetings were held with persons representing agencies and firms interested in intermodal station development in Milwaukee. They gave a sense for local concerns, expectations, and constraints.

The literature review and the interviews resulted in a long list of issues that at least one person thought was important. It was still necessary to determine whether some issues were more important than others. Consequently, a tight list of 70 generic objectives was developed, and planners from throughout the U.S. were asked to rate them. Individuals from the Internet's transit list and representatives from local agencies also gave ratings. The generic objectives

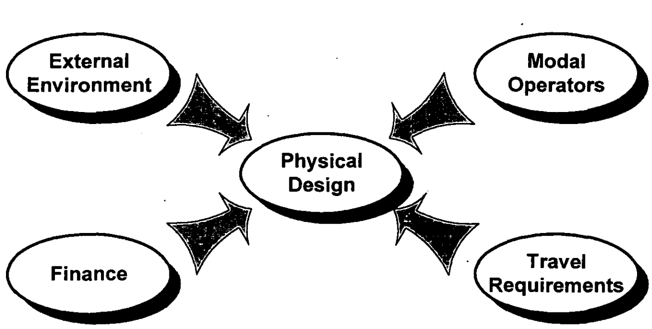

FIGURE 1 Factors affecting physical design.

Objective		Not Important									Extremely Important	
Minimize Disorientation and Confusion	N	0	1	2	3	4	5	6	7	8	9	10

FIGURE 2 Example question.

spanned all categories of system planning, internal design, external design, and modal interfaces. Results are described later in this paper.

QUESTIONNAIRE DESIGN AND ADMINISTRATION

Questionnaire Design

The Generic Objectives Questionnaire organized the 70 objectives into four groups:

- System Objectives relating to the complete regional transportation system (*13*);
- Internal Objectives relating to the design of the facility and its site (*27*);
- External Objectives relating to the environment and the surrounding community beyond the site (*19*); and
- Mode Interface Objectives relating to aspects of the facility directly affecting transfers (*11*).

All objectives were rated on an 11-point category scale, as illustrated in Figure 2. A respondent had the capability of circling an "N" to indicate no opinion. Because of the possibility of confusing jargon, the respondents were provided with detailed descriptions of about half of the objectives. An attempt was made to reduce order bias by distributing two different forms with the questions reversed (Figure 2). A complete list of these objectives is found in Figures 3 and 4.

Selection of Expert Panel

The rating of a generic objective requires a person to work at two levels of abstraction. First, a panel member must be able to deal with a brief and technical description of a facility attribute. Second, a panel member must be able to relate the objective

OBJECTIVE CLASSIFICATION KEY

■	Transfer	⌘	Modal Enhancement
◆	Safety/Security	♣	Physical Environment
●	Access	♥	Nonphysical Environment
✱	Efficiency	□	Space/Site
★	Passenger	⊙	Architectural/Building
$	Financial	✪	Coordination

OBJECTIVE CATEGORY KEY

Mode Interface Objectives
Internal Objectives
System Objectives
External Objectives

Rank	Objective	Type	Rating
1	Maximize reliability of transfers.	■	9.0
2	Maximize security.	◆	8.8
3	Maximize safety and security of operations of modes.	◆	8.7
4	Minimize institutional barriers to transferring.	■	8.6
5	Maximize passenger information.	■	8.5
5	Achieve handicapped access.	●	8.5
7	Maximize safety.	◆	8.4
7	Maximize user benefits.	■	8.4
9	Maximize reliability of facility services.	✱	8.3
9	Maximize system legibility.	■	8.3
11	Maximize efficient access and egress.	●	8.2
11	Minimize disorientation and confusion.	■	8.2
11	Maximize coordination of transfer scheduling.	■	8.2
14	Minimize waiting.	✱	8.1
15	Minimize physical barriers of transferring between modes.	■	8.0
15	Minimize physical barriers to handicapped.	●	8.0
17	Minimize queuing delays.	✱	7.9
18	Minimize difficulty of ticketing or fare payment.	✱	7.8
18	Maximize ease of operations for modes.	✱	7.8
18	Maximize passenger comfort.	★	7.8
18	Maximize weather protection.	★	7.8
22	Maximize system coordination of information and fares.	■ ✪	7.6
23	Maximize directness of paths for modes.	✱	7.4
23	Maximize ease of fare collection.	✱	7.4
23	Maximize amount of connections between routes.	■	7.4
23	Minimize negative cultural impacts in surrounding neighborhood.	♥	7.4
27	Minimize path conflicts between modes.	●	7.3
27	Maximize directness of path.	✱	7.3
29	Achieve elimination of hazardous materials.	♣	7.2
29	Maximize quality of waiting areas.	★	7.2
31	Minimize costs.	$	7.1
31	Maximize joint development.	$	7.1

FIGURE 3 Composite ranking and scores of top-rated objectives.

OBJECTIVE CLASSIFICATION KEY

■	Transfer	⌘	Modal Enhancement
◆	Safety/Security	♣	Physical Environment
●	Access	♥	Nonphysical Environment
✱	Efficiency	◻	Space/Site
★	Passenger	⊙	Architectural/Building
$	Financial	✪	Coordination

OBJECTIVE CATEGORY KEY

Mode Interface Objectives
Internal Objectives
System Objectives
External Objectives

Rank	Objective	Type	Rating
33	Minimize barriers.	●	7.0
33	Minimize exertion.	★	7.0
33	Maximize market areas for each mode.	⌘	7.0
33	Maximize community pride.	♥	7.0
33	Minimize negative social impacts in surrounding neighborhood.	♥	7.0
33	Minimize physical impacts to surrounding neighborhood.	♣	7.0
33	Maximize flexibility for expansion.	◻	7.0
40	Minimize difficulty of baggage handling.	★	6.9
40	Maximize pedestrian assists.	✱	6.9
40	Minimize path length.	✱	6.9
40	Minimize crowding.	★	6.9
40	Achieve compliance with historic preservation requirements.	♣	6.9
45	Minimize conflicting paths.	✱	6.8
46	Minimize maintenance requirements.	⊙	6.7
46	Minimize service duplication.	✱	6.7
46	Achieve property rights.	◻	6.7
46	Achieve same or lower air pollution emissions.	♣	6.7
46	Minimize conflict with surrounding land uses, existing & proposed.	♣	6.7
51	Maximize aesthetics.	⊙	6.6
51	Maximize quality of architectural design.	⊙	6.6
53	Maximize amenities.	★	6.5
53	Maximize sense of place, historic significance, community image.	♥	6.5
55	Minimize regional air pollution emissions.	♣	6.4
56	Minimize construction impacts.	♣	6.3
56	Minimize disruptive land acquisition.	♥	6.3
58	Minimize level changes.	✱	6.1
59	Minimize fare inconsistencies.	$✪	6.0
60	Maximize urban renewal.	◻	5.9
61	Maximize reuse of existing buildings/infrastructure	◻	5.8
61	Maximize positive cultural and social elements.	♥	5.8
61	Maximize use of local employment.	♥	5.8
64	Maximize alternative uses of time while waiting.	★	5.7
64	Maximize openness of interior design.	⊙	5.7
66	Minimize regional energy consumption.	♣	5.6
67	Minimize wasted space.	⊙	5.5
67	Minimize negative impact on existing transportation services	$⌘	5.5
69	Maximize income from nontransport activities.	$	4.7
70	Maximize informal vending.	⊙	4.1

FIGURE 4 Composite ranking and scores of bottom-rated objectives.

to hypothetical alternatives. A rating will only be valid when a panel member is comfortable working with such abstract concepts. Thus, it would be unlikely that a typical user of a facility would be able to provide a meaningful rating. To overcome this limitation, we chose to recruit a panel of experts, recognizing that experts may not accurately represent the feelings of the population at large.

The expert panel selected to complete the Generic Objectives Questionnaire was composed of three subgroups. The first subgroup consisted of individuals from Metropolitan Planning Organizations (MPO), Regional Transit Authorities (RTA), and local governments who had been or were currently involved in an intermodal passenger transfer facility project. Several of the MPO and RTA had also been involved in intermodal facility projects. Attempts were made to incorporate panel members from regions and cities of all sizes and locations; however, no attempt was made to draw a random sample.

Agencies were contacted before distributing the questionnaires. At that point they were questioned about their willingness to participate and were asked for the name of the staff member most capable of responding to the questionnaire. A few agencies expressed reservations about their ability to answer the questionnaire because of a lack of prior involvement with intermodal facility projects. In these instances the agencies were not sent questionnaires. Agencies were contacted until a predetermined sample size of 50 was reached, of which 38 agencies returned questionnaires.

The second subgroup was composed of members of the Planning Advisory Group (PAG) from the Intermodal Station Feasibility Study for Milwaukee. Nine members of the group were sent questionnaires, and seven members returned questionnaires. The small sample was a result of both a small Planning Advisory Group and the fact that only one questionnaire was allowed from each agency. The Planning Advisory Group had many agencies represented by more than one individual. To avoid the chance that agency biases become reflected in the results, each agency was limited to one questionnaire.

The third subgroup consisted of members of the Transit List on the Internet (USR). Individuals in this discussion group are involved in the transportation field, either as consultants, transit agency personnel, professors, students, or hobbyists. The response rate from this group was only 7.3 percent, or 22 questionnaires. This low response rate was expected because the questionnaire was not sent directly to individuals. Many members of the discussion group do not regularly participate and may have missed the questionnaire during the period that it was posted.

Although the panel members were asked to rate objectives on a scale of 0 to 10, most members rated the objectives fairly high. The average score of all objectives was 7.0. The above average ratings were expected because of the care taken to only include objectives that were determined to have importance to somebody. Furthermore, the panel members showed considerable enthusiasm for the subject.

Because the panel was not drawn randomly and because the panel was composed of people from throughout the United States, the ratings are not necessarily predictive of the importance of the objectives in any given metropolitan area. The ratings are provided only as a starting point for evaluation of local facility designs.

RATINGS OF GENERIC OBJECTIVES

Overall, the Mode Interface objectives were rated highest (average score of 7.98), with Internal objectives second (7.24), System objectives third (6.84), and External objectives scoring the lowest (6.45). This order was preserved among the panel subgroups, with the exception of the PAG, which ranked System Objectives (6.80) slightly higher than Internal objectives (6.74). Caution should be exercised, though, in gauging the significance of results from the PAG because of its small sample size.

No Mode Interface objective scored below 6.9, and no External objective scored above 7.4. Seventeen of the 20 highest rated objectives were Mode Interface or Internal objectives, whereas 15 of the 20 lowest rated objectives were System or External objectives. Figure 5 shows this generally high rating of the Mode Interface and Internal objectives compared with the System and External objectives.

Among the three subgroups, the Transportation Planning Agencies (TPA) panel members on average rated all objectives the highest, and the PAG generally rated all of the objectives the lowest. Only a few objectives differed substantially in rating from one subgroup to another. Table 1 lists these objectives and the rank they received within their category.

The results based on the original four objective categories (External, Internal, System, and Mode Interface) did not reveal many interesting patterns in the data. Consequently, the objectives were regrouped and reanalyzed based on facility attributes, services, or impacts. The objectives were regrouped under 12 new classes: Safety and Security, The Transfer, The Passenger, Access, Efficiency, Coordination, The Physical Environment, The Nonphysical Environment, Finance, Space and Site, Modal Enhancement, and Architecture and Building. A few objectives were placed into two classes. The questionnaire did not make reference to these particular classes.

Table 2 shows the average ratings of each class. Safety and Security objectives were rated highest with an average score of 8.63. Transfer objectives were rated second highest with an average score of 8.22. No other class rated above 8.0. It should be noted that the Transfer class had three times the number of objectives as the Safety and Security class, which tended to lower the Transfer's final rating. Transfer objectives accounted for three of the top five objectives, including the highest rated objective. Furthermore, 5 of the 10 highest rated objectives were from the Transfer class. Table 2 shows the minimal importance given to the Architecture and Building objectives. Of this class' five objectives, three were rated among the lowest six objectives, including the overall lowest rated objective.

The five highest rated classes (Safety and Security, The Transfer, The Passenger, Access, and Efficiency) contributed 27 of the 28 highest rated objectives and 30 of the 39 objectives with an average score of 7.0 or higher. The five lowest rated classes (Nonphysical Environment, Finance, Space and Site, Modal Enhancement, and

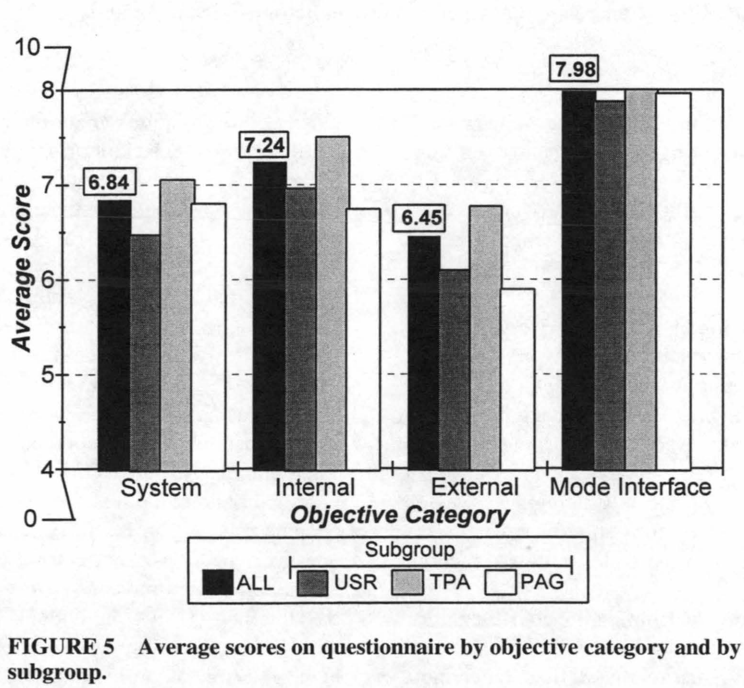

FIGURE 5 Average scores on questionnaire by objective category and by subgroup.

TABLE 1 Objectives Receiving Significantly Different Ratings Among Subgroups

Category	Objective	Rank in Category		
		TPA[a]	USR[b]	PAG[c]
EXTERNAL	Maximize use of local employment	17	18	1[d]
EXTERNAL	Minimize negative cultural impacts on surrounding neighborhood	2	12[d]	3
EXTERNAL	Achieve same or lower air pollution emissions	3[d]	12	16
EXTERNAL	Achieve compliance with historic preservation requirements	7	2	15[d]
INTERNAL	Maximize safety	3	4	17[d]
INTERNAL	Achieve handicapped access	1	10[d]	3
INTERNAL	Achieve elimination of hazardous materials	6[d]	26	26

[a]TPA: Transportation Planning Agency Subgroup
[b]USR: INTERNET Subgroup
[c]PAG: Planning Advisory Subgroup
[d]Subgroup that significantly varied from other subgroups.

Architecture and Building) accounted for 9 of the 11 objectives that received an average rating below 6.0.

The detailed results of the questionnaire are displayed in Figures 3 and 4.The ranking and scores reflect a compilation of all subgroups. Figures 3 and 4 list both the original category and the class of the objective, its ranking among all objectives and the average rating it received.

DISCUSSION OF RESULTS

The list of generic objectives covers only those issues that should be considered when choosing an alternative. Intentionally omitted are many objectives that relate to design details, operation, and maintenance.

An analysis of the ratings revealed that most important were objectives for assuring safety and security and objectives for improving transfers and transfer opportunities. The expert panel clearly stated that intermodal passenger transfer facilities should be evaluated primarily on how well they improve existing trip making. Everything else is of secondary importance. Architectural and building considerations, which are often the focus of station rehabilitation projects, were rated as being least important.

Many of the objectives are similar or functionally redundant. For example, the objective of maximizing user benefits fully encompasses the objective of minimizing waiting and partially covers many other objectives. Any given project could get by with a much smaller list of objectives by simply eliminating those objectives whose design elements are covered elsewhere.

To a large extent these results represent conventional wisdom among those involved in the planning and evaluation of intermodal passenger transfer facilities. Innovative or timely ideas tend to fare badly in these types of surveys. For example, informal vending (push carts and the like) has been strongly recommended by Beimborn and coauthors (*5*), but it was rated dead last by the experts in this panel.

TABLE 2 Objective Ratings by Classes

Objective Classes	Average Score	Number of Objectives
Safety/Security	8.63	3
The Transfer	8.22	10
Access	7.80	8
Efficiency	7.34	5
The Passenger	6.98	13
Coordination	6.80	2
Environment, Physical	6.60	8
Environment, Nonphysical	6.54	7
Space/Site	6.35	4
Modal Enhancement	6.25	2
Finance	6.08	5
Architecture/Building	5.87	6

CONCLUSIONS

A good evaluation of an intermodal passenger transfer facility is complicated; simple formulas do not exist. Of primary importance is the ability of a facility to improve trip making. Improvements in trip making can come from reductions in cost, in-vehicle time, out-of-vehicle time, physical and institutional barriers to transferring, and positive changes to the transfer environment.

Because of the large number of factors involved in intermodal transfer facility design, it is important that goals and objectives be articulated very early in the design process. However, decision makers may find it difficult to establish project objectives without reference to specific alternatives to be developed later. A list of generic objectives, like those presented in this paper, is helpful in arriving at a working set of project objectives before the formulation of any of the alternatives.

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