I would recommend additional attention to institutionalizing the idea of quick response through user manuals, training seminars, case studies, and the like.

Quicker adoption of modern technology, including emerging transportation techniques, microcomputers, and digitizing and plotting capabilities, should be fostered.

Finally, research funding should be provided for projects to develop quick-response techniques in data collection, travel estimation, use of new technologies, and others.

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Quick-Response and Sketch-Planning Techniques: State of the Practice

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Following the publication of NCHRP Report 187 (1) in 1978, the term "quick response" became an often-used expression in the urban transportation planning field. By virtue of the implication of being able to provide information to decisionmakers in a relatively short time frame, quick-response procedures have been widely embraced by the transportation planning profession. Managers and decisionmakers, in particular, are enamored with the prospect of the urban planning process actually being able to provide timely inputs to the decisionmaking process. This infatuation with the quick-response procedures is in part due to the frustration that developed with the cumbersome, data-intensive technical process that emerged from the 1960s. Too often, decisions were made before the urban planning process was able to provide useful information.

Unfortunately, the quick-response procedures are viewed by some as the panacea to all the previous problems associated with the technical procedures used in urban transportation planning. This perception has created an environment where quick-response procedures are recommended as the analysis tools for evaluating all urban transportation problems. In some instances, this has resulted in unsuccessful attempts to apply the quick-response techniques; the lack of success has resulted primarily from an inappropriate application of the procedures. Therefore, I think it is extremely important that we carefully define the quick-response procedures as they currently exist and highlight the limitations associated with them. To initiate the discussion, I will provide some illustrations on how the procedures have been successfully applied to contemporary urban transportation problems.

For the purposes of this presentation, I will restrict my discussion to the applications of the quick-response procedures documented in NCHRP Report 187, realizing that uses of other sketch-planning procedures will surface during the workshop discussions. In addition, I will highlight the limitations of the procedures and problems encountered in applying the procedures. To do this, I will rely heavily on the results of two surveys conducted by the Federal Highway Administration (FHWA) on the use of the quick-response procedures.

APPLICATIONS OF QUICK-RESPONSE PROCEDURES

In April 1980 and November 1981, the Urban Planning and Transportation Management Division of FHWA conducted a survey to determine the applications of the quick-response procedures. Those surveyed represented some 721 persons trained in the 21 National Highway Institute-sponsored workshops on quick-response procedures. Some 66 of these persons represented federal agencies; 307, state departments of transportation; and the remaining 348, city, county, and regional planning agencies.

In the first survey conducted, in April 1980, the questionnaire solicited information on the type of problems addressed with the quick-response techniques, the specific procedures used, problems encountered, and the level of effort expended. The applications described in the responses were summarized into the following categories:

1. Long-range systems analysis,

2. Corridor or subarea analysis, and
3. Site-impact analysis.

These categories correspond roughly to the following three levels of planning described in the draft conference material: long-range system planning, project planning, and urban-microscale planning.

To get an idea of the type of problems being evaluated with the quick-response techniques, several examples within each of these three categories are listed below:

1. Long-range systems analysis

a. Santa Fe, New Mexico: To evaluate the performance of the highway system in a long-range planning context, it was necessary to develop an estimate of travel patterns for the forecast year. This was accomplished by using a computerized version of the quick-response trip-generation and distribution procedures. Conventional traffic-assignment techniques were used to determine the link volumes.

b. Rapid City, South Dakota: To identify future highway needs, the quick-response procedures (i.e., trip generation, distribution, and assignment) were applied manually. Some problems resulted from the all-or-nothing traffic-assignment analysis, and adjustment factors were calculated to smooth out the traffic volume.

c. Hot Springs, Arkansas: To evaluate the system effects of a major highway improvement, it was necessary to synthesize the changes in travel patterns caused by the improvement. The manual trip-generation and distribution procedures from NCHRP Report 187 were used to develop the trip patterns; these results were assigned to the highway network by using a computerized traffic-assignment procedure.

d. Santa Barbara County, California: To analyze the impacts of forecast growth on the transportation system, identify problems and needs, and make recommendations for improvements, traffic forecasts were developed for the area. The quick-response procedures for trip generation, distribution, and assignment were employed. A computerized version of the trip-distribution procedure was used to reduce the time required for computations.

2. Corridor or subarea analysis

a. Brockton, Massachusetts: Previous analysis of the existing traffic conditions indicated that the traffic flow along the east-west corridor appeared to be severely impeded at several locations. A further study was desired to determine the future traffic impacts at these sites and to evaluate the possibility of roadway improvements to improve the east-west traffic flow. To further study the problems at one of the critical locations along the corridor, the quick-response procedures were applied in combination with available computer traffic-assignment programs. The approach involved the sequential application of the conventional transportation planning steps of trip generation, trip distribution, modal split, and traffic assignment. This method produced traffic-volume estimates for a 1975 base year and 1985 and 1995 forecast years.

b. Manchester, New Hampshire: In order to evaluate the traffic impacts of the rapid growth of a subarea in Manchester, an analysis of the existing transportation plan was required to determine whether the plan provided adequate improvements to accommodate the new growth. This analysis was accomplished by applying the trip-generation procedures from NCHRP Report 187 for the traffic zones in the subarea. Computerized UTPS procedures were used for the quick-response distribution analysis.

c. Salt Lake City and Ogden, Utah: Several rapidly growing cities in a suburban area near Salt Lake City and Ogden (population ranged from 10 000 to 50 000) were developing master plans and needed information on future street and highway needs. To determine these needs, the roadway spacing technique described in NCHRP Report 187 was applied. Some adjustments were necessary to reflect the terrain in the areas.

d. Northern Charles County, Maryland: A proposed bypass was evaluated to determine whether the improvement would solve a traffic problem at the intersection of two major state routes. The quick-response trip generation, distribution, assignment, and intersection capacity analysis techniques were applied; adjustments were required to account for the highway system configuration in the corridor.

e. Washington, D.C., to Annapolis, Maryland: To evaluate changes in the Route 50 corridor work travel given alternative configurations of the facility as well as alternative high-occupancy-vehicle (HOV) treatments, the pivot-point analysis technique was applied. By using district-level trip tables supplied by the regional planning agency, the pivot-point technique estimated changes in the forecast choices of mode and route in the corridor.

3. Site-impact analysis

a. Phoenix, Arizona: A regional shopping center and associated commercial/residential development was proposed, and an analysis of the traffic impact in the vicinity of this development was requested.

b. Sioux Falls, South Dakota: Two large residential developments were proposed in an undeveloped area adjacent to the city, and the traffic impact of these developments on the surrounding streets was desired.

c. Hartford, Connecticut: A shopping mall was proposed, and the impact of the mall on regional trip patterns and on traffic congestion in the vicinity of the mall was desired.

d. Springfield, Illinois: A residential and commercial development was proposed on a 600-acre site and the traffic impact of the development was requested.

The general approach for conducting the above analyses was similar. That is, the trips generated by the proposed developments were estimated by using trip-generation rates, and these trips were distributed and assigned to the highway network serving the developments. This assigned traffic was then added to the ambient traffic to provide an estimate of the traffic after the development had opened. Various modifications were made to this general approach to reflect data availability and unique conditions within the vicinity of the developments.

The applications listed above obviously addressed a wide range of urban transportation problems. These illustrations, however, are not meant to represent an exhaustive listing of the quick-response applications but rather some examples of the types of problems being evaluated with these techniques.

From reviewing the responses to the first survey, some general observations on the quick-response techniques may be gleaned. These are listed as follows:

1. The predominant use of the quick-response procedure was in evaluating the traffic impact of proposed land use changes. This is probably due to the frequency of this problem type in urban areas as

well as the suitability of quick-response techniques for evaluating localized traffic impacts.

2. The manual application of quick-response techniques is extremely cumbersome and time-consuming (particularly trip distribution and trip assignment). This problem surfaces primarily when quick-response techniques are used for long-range system analysis.

3. Modifications to the procedures are necessary in order to reflect unique local conditions. Data availability also requires some changes to be made in the use of the procedures. If available, local data and travel-demand relationships should be used in lieu of the transferable parameters from NCHRP Report 187.

The second survey of quick-response users was conducted in November 1981 and produced results similar to those uncovered in the first survey. Again, the applications were summarized into three general categories. These were

1. Corridor or subarea analysis,
2. Site-impact analysis, and
3. Intersection capacity analysis.

These categories correspond roughly to the following levels of planning identified in the draft conference material: project planning, urban-microscale planning, and systems operations.

The categories were modified from those used in evaluating the results of the first survey. A long-range systems analysis category was not included because only one of the respondents had used the techniques for this purpose. A category on intersection capacity was added due to the large number of applications in this area. As was the case with the earlier survey, the predominant use of the techniques was for site-impact analysis (40 percent). About 34 percent of the respondents used the techniques for corridor or subarea analysis; the remaining 26 percent of the respondents used the procedures for intersection capacity analysis.

Some examples of the types of applications noted in the responses to the second survey are listed below:

1. Corridor or subarea analysis

a. Kansas City, Missouri-Kansas: The mode-choice technique for corridor-level review of needs for major transit improvements was used; however, the forms in DOT's sketch-planning manual (2) were used and a program was written for a programmable calculator. The trip-smoothing procedure from NCHRP Report 187 was used extensively in converting raw computer traffic assignments to smoothed volumes. A basic program was written for a microcomputer to perform the smoothing of the volumes.

b. Portland, Oregon: Quick-response techniques were used in the preparation of a transportation corridor refinement study to the areawide transportation master plan. The refinement study investigated several alternative routes and their impact on adjacent land development. The study also looked at the ability of several routes to serve projected land developments (e.g., regional shopping centers, multifamily housing, and eight industrial sites).

c. Jefferson County, Colorado: The quick-response procedures were used to conduct a small-area transportation study for a 9-mile^2 portion of Jefferson County. The regional travel demand models were used to estimate traffic for the rest of the urban area.

d. Brevard County, Florida: The quick-response techniques were used to evaluate zoning regulations for a subarea of Brevard County. This was undertaken to determine the transportation impact that would occur if the land was developed fully as provided for in the current zoning.

e. Jacksonville, Florida: The quick-response techniques were used in a subarea study to determine (a) 1990 highway and mass transit needs in light of projected population and employment, (b) highway facilities deemed deficient, either now or in 1990, and (c) improvements that would alleviate deficiencies and improve traffic operations.

f. Seattle, Washington: The automobile traffic impacts resulting from converting a major CBD arterial to a bus-only facility were estimated. This was accomplished by carving out the CBD from the regional network and capturing the regional trips entering or passing through the CBD. Detailed traffic assignments were then performed to the resultant subarea.

2. Site-impact analysis

a. Des Moines, Iowa: The number of trips that would be generated by the construction of a new office building was estimated. This information was needed for a City Council meeting during which the addition of a traffic signal near the proposed building was to be discussed.

b. Albany, Georgia: The need for additional transportation service to accommodate a major redevelopment in the Albany CBD was analyzed. This redevelopment proposal included a new civic center complex with an arts center, library, hotels, and shops. These impact evaluations were developed by using the conventional travel-estimation models and the trip-generation information from NCHRP Report 187.

c. Huntsville, Alabama: The traffic impact of a regional shopping center (1 000 000 gross ft^2 of floor area) was evaluated. In the evaluation, the trip estimates and travel-time factors were taken from the on-going planning process. The traffic-assignment procedure described in NCHRP Report 187 was used. This evaluation was conducted as part of an overall review of a rezoning proposal.

d. Columbia, South Carolina: The traffic impact of a proposed shopping center on a nearby intersection was determined. Also, the trip-generation tables and the percent of traffic by time-of-day tables were used to estimate the traffic that would result from new subdivisions.

e. Brevard County, Florida: The impact of a 1 200 000-ft^2 shopping center was evaluated. The analysis included systems effects (volume/capacity), intersection traffic operations, air-quality and noise analysis, and social neighborhood effects. The quick-response techniques were also used to evaluate rezonings of large tracts of land for industry use and for large residential developments.

f. Shreveport, Louisiana: The transportation impacts in the vicinity of an industrial park resulting from the addition of several developments within the industrial park were assessed. The quick-response techniques--trip generation, distribution, assignment, and capacity analysis--were used to perform the analysis.

3. Intersection capacity analysis

a. Omaha, Nebraska: The critical-movement-summation technique was used to determine the level of service for several intersections within a major travel corridor.

b. Tacoma, Washington: The critical-movement-summation technique was used to evaluate the capac-

ity of an intersection influenced by a major new development.

c. Eugene, Oregon: Two intersection-widening proposals identified in the transportation plan were analyzed from a level-of-service perspective.

Again, this second survey indicates a wide use of the quick-response techniques for evaluating various transportation problems. A rather interesting finding from the survey was the lack of quick-response applications for long-range systems analysis. It may be that applications were made for this purpose but were not documented or the limitation of the procedures for performing long-range systems analysis may be discouraging applications. Some of these limitations are presented in the following section.

LIMITATIONS OF THE QUICK-RESPONSE PROCEDURES

The quick-response procedures currently available for use by urban transportation planning analysts are being applied to address a variety of problems; however, these applications have served to identify certain limitations. These are listed below:

1. For the purpose of long-range systems planning, the quick-response procedures do not provide timely results or, in some cases, results at the desired level of detail. For example, sketch-planning procedures such as the Community Aggregate Planning Model (CAPM) and roadway spacing are very efficient yet do not yield traffic volumes on a facility basis. The quick-response procedures described in NCHRP Report 187 do result in traffic estimates on facilities but a significant amount of effort is required to obtain the estimates. This high level of effort is primarily due to the time-consuming process of computing the trip-generation, distribution, and assignment results. Some of this computation time is being reduced with the computerization (main-frame, microcomputer, and programmable calculator) of certain quick-response procedures. Many analysts, however, are continuing to apply the conventional, network-based procedures (e.g., UTPS) to perform long-range system planning.
2. Although the quick-response techniques were designed to operate with a limited amount of data input, in many cases these limited data are not available. The availability of the 1980 census urban transportation-related data may serve to mitigate this limitation.
3. The use of transferable parameters is viewed as an extremely desirable aspect of the quick-response procedures; however, certain of these relationships were developed from some rather dated information. This raises some credibility problems when it is attempted to use this information in an evaluation of alternative plans or projects. This problem is of particular concern when the residential trip-generation relationships described in NCHRP Report 187 are used, since these relationships were developed primarily from survey information collected in the 1960s.
4. In many urban areas, a major issue involves the analysis of external traffic. The quick-response procedures focus almost exclusively on internal traffic considerations; therefore, the analyst must rely on conventional approaches (e.g, roadside O-D surveys) to analyze the external traffic.
5. The manual, all-or-nothing traffic-assignment approach causes problems where there are several alternative routes to access proposed developments. In these situations, the subjective determination of routes is difficult to defend.
6. To streamline the application of the quick-response procedures, certain assumptions had to be made. In some cases, these assumptions inherent in the quick-response procedures were not fully understood. As a result, certain applications were performed that produced unrealistic estimates.

SUMMARY AND RECOMMENDATIONS

Despite the above limitations, many successful applications have been made of the quick-response procedures. These applications were made with a full understanding of the limitations of the procedures, and the results were viewed in the proper context. Although some accuracy may have been sacrificed, there is a general consensus that the quick-response techniques do provide reasonable results in a realistic time frame and are useful for evaluating a wide range of transportation problems. These applications cover several levels of planning, including long-range systems planning, project planning, urban-microscale planning, and systems operations. Clearly, certain enhancements and further developments are necessary to address some of the deficiencies noted in the applications. The following recommendations are offered:

1. A simplified method for defining networks for use in a computerized traffic assignment should be developed. The manual assignment techniques are useful for a many-to-one traffic assignment but become unmanageable for many-to-many traffic assignments (e.g., assignment of a regional trip table). The conventional network development and coding procedures are very time consuming.
2. Easy-to-use software for microcomputer applications of the quick-response techniques should be made available. Many users of the manual procedures become discouraged with the time-consuming calculations that are required for large-scale problem solving. In these instances, the aura of quick response is readily lost.
3. The use of transferable parameters is a highly desirable feature of quick-response applications, particularly from the time- and cost-saving perspectives. In order to facilitate the use of transferable parameters, the trip-generation relationships for specific land use categories and detailed residential analysis should be updated. More recent information would improve not only the accuracy of the results but also the credibility of those results in the minds of many state and local officials.
4. Given the common problem of evaluating the traffic impact of major new developments (e.g., shopping centers, industrial parks), more complete information is needed on the trip-making characteristics of such developments. Although the Institute of Transportation Engineers maintains a very comprehensive listing of trip rates for various developments, more detailed information is needed on the trip purpose, primary versus linked trips, and diverted versus undiverted linked trips. In any traffic impact analysis, the critical number, and the number subjected to the closest scrutiny, is the trips generated by the development. To ensure technically valid and justifiable analyses, a thorough understanding of the generated trips is required.
5. To overcome the lack of information available on external traffic analysis, data from external surveys should be reviewed to determine whether transferable relationships can be established.
6. Case studies should be developed that illustrate the applications of quick-response procedures. These examples would serve as a guide for future applications in addition to enhancing the credibility of the procedures.

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Research Needs

1. Impacts of transportation system changes on average trip lengths

a. To identify short-range relationships, use before-and-after surveys of travel behavior in response to major transportation system changes, such as new rail transit systems or extensions and new urban freeways
b. Determine the impacts of changes on both work and nonwork travel
c. To identify long-range relationships, use longitudinal data, taking care to account for life-cycle, income level, and other changes
d. Test results against city-to-city variations

2. Improved data-collection methodologies

a. Review current data-collection methods
b. Review quick-response data needs and survey-based needs
c. Develop approaches to data collection that take advantage of new technologies, data uses, etc.
d. Test methods
e. Develop manuals, case studies, and training

3. Streamlining of network-based analytical approaches, including simplification of modeling procedures

a. Identify weakness in current techniques vis-à-vis possibilities with new microcomputer and other computer technology
b. Specify new concepts
c. Develop and test new concepts
d. Prepare case studies and training materials

4. Adaptation of readily available microcomputer general software and technology in data collection and modeling

a. Review and evaluate projecting software and technology
b. Refine planning-context scenarios
c. Specify case studies
d. Prepare case studies based on existing software capabilities
e. Develop new software
f. Prepare any additional training approaches

5. Quick-response methods missing from current techniques for considering external travel

a. Develop framework for quick-response approach
b. Evaluate current external survey data
c. Develop quick-response method tables, nomographs, etc.
d. Prepare manual on case study and training

6. Manuals of reference data

a. Critique existing references such as Characteristics of Urban Transportation Systems (CUTS), Characteristics of Urban Travel Demand (CUTD), and Traveler Response to Transportation System Changes and define missing or outdated information
b. Specify rule-of-thumb techniques
c. Develop and test new techniques; collect data and update manuals
d. Prepare case studies and appropriate training materials

7. Transportation pricing on interactions between land use and transportation systems

a. Specify hypothesis about interactions
b. Define decision scenarios that can benefit from better understanding
c. Prepare research statement
d. Conduct research, including measurement of data collection
e. Develop plan to operationalize the research into transferable planning techniques

8. New methods for costing, pricing, and evaluation, including design standards

a. Establish specific requirements following survey of existing techniques
b. Develop new manual on computerized techniques
c. Prepare case studies by using new techniques
d. Prepare any additional training approaches

9. Traffic engineering and transit operations management tools

a. Survey what is available as detailed analytical tools
b. Develop typical application scenarios
c. Specify techniques
d. Develop and package tools, including necessary training
e. Develop research statements to fill the gaps

10. Existing techniques for identification and solution of prototypical problems and issues of today

a. Define planning-context scenarios and identify typical user groups
b. Survey and evaluate existing methods (manual and computerized)
c. Synthesize new approaches by applying available methods
d. Specify case studies
e. Generalize existing methods as case studies
f. Identify gaps in techniques requiring further R&D

11. Educational needs

a. Accelerate local acceptance of better techniques
b. Determine alternatives
c. Redirect formal academic training