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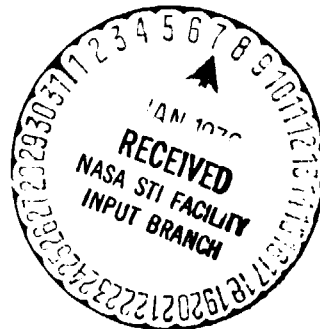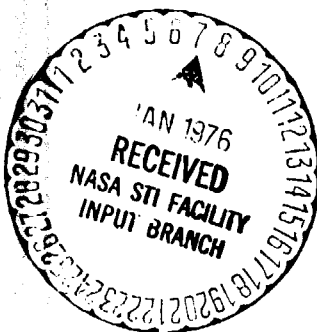
INTEGRATED MASS TRANSPORTATION SYSTEM
STUDY/DEFINITION/IMPLEMENTATION
·PROGRAM DEFINITION

by:

R. K. Ransone

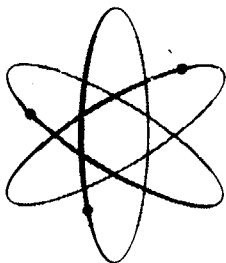D. A. Deptula

G. G. Yorke

SCHOOL OF ENGINEERING AND

APPLIED SCIENCE

RESEARCH LABORATORIES FOR THE ENGINEERING SCIENCES

UNIVERSITY OF VIRGINIA

CHARLOTTESVILLE, VIRGINIA 22901

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16. Abstract

Studies by University of Virginia systems engineers have identified specific actions needed to plan and effect transportation system improvements within the constraints of limited financial, energy and land-use resources, and diverse community requirements. A specific program is identified which would develop the necessary generalized methodology for devising improved transportation systems and evaluate them against specific criteria for intermodal and intramodal optimization. The expected value of this work is in providing a consistent, generalized method for study and evaluation of transportation system improvements. Application is envisaged by state agencies as part of a Federally sponsored program coordinated by the U. S. DOT into a National Transportation System Plan.

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REQUIREMENTS FOR A PROGRAM
TO IMPROVE SHORT-HAUL TRANSPORTATION
TO SMALL COMMUNITIES

SUMMARY

Systems engineers of the University of Virginia have
studied the improvement of short-haul transportation between
small Virginia communities. This was done in response to
a desire by the Commonwealth of Virginia state planners to
utilize expertise from various Virginia universities to
solve state problems, one of which is transportation. Some
of this work has been NASA sponsored, and some has been done
under a U. S. Department of Transportation research grant.

These studies have identified specific actions needed
to plan and effect transportation system improvements within
the constraints of limited financial, energy and land-use
resources, and diverse community requirements. A specific
program is identified which would develop the necessary
generalized methodology for devising improved transportation
systems and evaluate them against specific criteria in order
that they may be optimized both intermodally and intramodally.

The expected value of this work is in providing a consis-
tent, generalized method for studying and evaluating trans-
portation system improvements. Although its emphasis is on
short-haul, it may be readily adapted to other markets. In
this usage, application could be envisaged by state agencies
as part of a Federally-sponsored program coordinated by the
U. S. DOT into a National Transportation System Plan.

CONCLUSIONS

The biggest problem in effective transportation system
planning is in accurately estimating the size of the market.
There are many market-generation and modal-split analyses

available. Unfortunately, to be accurate they must be calibrated against the specific market in question, and if you know enough about the market to calibrate the analysis model, then you know enough about the market that you do not really need to calculate anything! Attempts have been made by planners to use calibrations from one well defined market area to predict a new but "similar" market area. But what is "similar", and how different can the new area be and still be similar enough that the calibration factors are interchangeable? Very few modeling methods provide for uncertainty or variability in the input data or output data.

A need was identified for an evaluation of various market-generation and modal-split modeling analysis methods to determine:

- Absolute and relative accuracies, calibrated and uncalibrated.
- Type and format of input data required.
- Sensitivities to inaccurate input data.
- Guidelines for determining under which conditions each should be used or avoided.
- Special attention for "probablistic" models.

Short-haul transportation planning for small communities is of no interest to large, well-staffed companies. The companies who may be interested are small and perhaps inexperienced in sophisticated planning. They have neither the manpower, the expertise, the analysis tools, nor the operational and economic data needed for an accurate market and economic analysis. Furthermore, there is no accepted method for evaluating different transportation modes against each other, such as bus and air, where such factors arise as the passenger's perceived value of time versus the nationally perceived need for energy conservation.

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A need was identified for a generalized planning method-
ology for the use of transportation systems planners, entre-
preneurs and potential backers. It would include necessary
vehicle operational and economic data in readily usable
computer programs. A simple application of the methodology
would automatically result in an impartial and complete
evaluation of all transport modes and intermodal as well as
intramodal optimization. Provisions would be made for easy
modifications of certain data to meet specific local require-
ments (i. e., local labor costs, etc.) and for handling
uncertain input data probablistically. Program output would
be in a probablistic format giving the likelihood of various
results for various determinate operating conditions.

Planning methodologies lack credibility until they have
been proven. A reasonable way to prove the reliability of a
planning methodology is to demonstrate its use in an actual
case. Within the Commonwealth of Virginia there are communi-
ties and routes sufficiently representative to prove out the
planning program. Ideally, the study should lead to an actual
demonstration with bonafide fare paying passengers on a
regularly scheduled service basis.

The generalized transportation system planning method-
ology would be evaluated by application to a specific, selected
short-haul route to a small Virginia community. The market
would be selected that would support a viable system. The
selected system would be optimized both intermodally and
intramodally. Finally, an actual service demonstration should
be defined and evaluated for possible implementation.

RECOMMENDATION

The program described in this report should be implemented
in its entirety as soon as possible.

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INTRODUCTION

Short-haul transportation is universally recognized to be a national problem, but national solutions are not forthcoming. This is probably because the workability of these solutions is too dependent upon specific local conditions of topography, economics, sociology, existing transportation modes, local needs and personal desires to be suitable for nationwide application. A national solution would also require essentially unanimous agreement by such an enormous number of public, private, governmental, institutional and emotional influences that it is probably unworkable.

A more likely nationwide solution may well be realized from several state or regional solutions which can eventually grow into a coordinated solution nationwide. There should be enough common elements to benefit from the economics of mass applications, but sufficient flexibility to meet diverse local requirements. An integrated transportation system, it may include air, rubber-tired, and rail elements, and should feature easy intermodal interchanges and coordinated routes and schedules. It should be neither an air system, bus system, rail system nor highway system, but an integrated state or regional mass transportation system, serving intra-metropolitan, inter-metropolitan, and thru-state needs of people and freight.

The Commonwealth of Virginia is a good place to start. It has low density and rural areas, industrial and manufacturing areas, and seaports. Its so called "Urban Corridor", stretching from the District of Columbia south along Interstate 95 to Richmond, then southeast along Interstate-64 to Norfolk, has some of the congestion problems, albeit to a lesser degree, of the Northeast Corridor. The very real future threat of Northeast Corridor-level congestion problems along this Virginia Urban Corridor is a strong force in motivating Virginians to seek early solutions.

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Virginia state officials are eagerly seeking these transportation solutions; under the Virginia Department of Transportation, the state is interested in defining a state-wide transportation system, and the mechanism exists for utilizing the expertise of the state universities to solve these problems. Furthermore, the straightforward structure of Virginia governments avoids conflicts of interest between state, county and city authorities prevalent in other areas.

A statewide integrated mass transportation system study/definition/implementation plan would have no greater chance of success than in the Commonwealth of Virginia, and the time is now.

BACKGROUND

Short-haul transportation is in a state of crisis.
Pressures of congestion and increasing travel demand are
calling for expanded transportation systems, but economic,
energy, and environmental constraints are limiting this
growth; in some cases, even to the point of service deterior-
ation. Short, out-of-town business and pleasure trips are
more difficult, more expensive, and less convenient than
they used to be, and than they should be or need to be.
Higher gasoline prices, lower miles-per-gallon (from anti-
pollution devices), and traffic congestion are even beginning
to erode the glamour of the private automobile.

The systems engineers of the Department of Engineering
Science and Systems have accepted this challenge and have
been engaged in a program dedicated to improvement of short-
haul transportation to small communities. Government research
grants and contracts have been obtained to support these
efforts. Sponsors have included the Virginia state government,
the U. S. Department of Transportation, the Federal Aviation
Administration, and the National Aeronautics and Space Admini-
stration.

A large portion of the research work is oriented towards
passenger and public acceptance of transportation systems.
Passenger acceptance is the key to economic viability of any
transportation system, and public acceptance is the key to
whether its construction and operation will be permitted. An
understanding of these acceptance factors is essential to
sound policy planning by government transportation officials,
research and development program decisions by government and
industry, and long-term production planning objectives by all
sectors of the transportation industry.

The acceptance data are expected to be most useful when
applied through mathematical modeling of proposed new

transportation systems to predict how well such systems may satisfy their requirements. Development of advanced modeling methods is a main program objective.

Improved short-haul systems are also being designed and evaluated against the criteria being developed as outlined above. Implementation problems, economic viability, and real-world institutional constraints should, of course, be considered.

A brief description of some specific research projects will be of interest in indicating how this work is being done:

Passenger acceptance data on commuter airlines are being obtained through in-flight questionnaires administered by the research engineer during regularly scheduled commuter airline service. The questionnaire is used to identify the important factors and quantify the passenger's judgement of them on that particular flight. The research engineer also has a small, completely self-contained, briefcase-sized instrumentation package which he slips neatly under his seat. It records the aircraft motion and cabin environmental data for later correlation with passenger reactions. Over 250 flights have been recorded and over 1500 bona fide passengers have been interviewed. This work is almost completed. It has been made possible through the splendid cooperation of several commuter airlines operating under the Allegheny Airline Commuter System, New York Airways, and the Canadian government which is now operating a new city-center to city-center commuter air service between Montreal and Ottawa.

In addition to the in-flight questionnaires, 750 flight-type questionnaires were completed by frequent travelers in their own offices in cities throughout Virginia. This work is completed.

Another project was aimed at obtaining passenger experiences and opinions regarding airports. Personal interviews

were made at several Virginia airports, and the terminals' physical and passenger service characteristics were noted for correlation. Much more work needs to be done in this area.

To get more generalized passenger acceptance and modal choice data, a questionnaire was sent directly to peoples' homes via direct mail marketing methods. The subjects were preselected based on representative demographic characteristics. The objective was to characterize the individuals' opinions of and identify their specific needs for air, rail, bus, and private automobile for short out-of-town business and pleasure trips. A 1700-subject sample mailing was made in August 1974 to determine the feasibility and cost-effectiveness of this type of data acquisition.

Work was done with Virginia state transportation officials with the objectives of determining travelers' needs, designing improved systems and evaluating their usefulness and economic viability.

In addition to these field task and questionnaire efforts considerable use has been made of both in-flight and laboratory motion simulation to study human reaction to the variables which control the individual's perception of comfort in a transportation system. Special NASA facilities at both the Langley Research Center and the Flight Research Center at Edwards, California, have been used in this work.

In summary, the Systems Engineering Transportation Research Programs were a coordinated effort whose single objective was the improvement of short-haul transportation. They provided graphic insight into the real-world needs of the transportation system planner, enabling us to formulate the program defined in this report.

PROGRAM OBJECTIVES

Purpose

The purpose of the work outlined in this study is to provide transportation planners with a sound, generalized methodology for planning improved short-haul transportation to small communities. The methodology would be suitable for studies of any mode (i. e., air, auto, bus, rail or water).

Method

The work should be done in three parts:

I. Methodology Development--Development of the analysis methods, providing specific, detailed guidelines, data of general value, and computer programs for use by transportation systems planners. Probabilistic concepts would be used, with provisions for inputs of specific localized variabilities.

II. Methodology Application--Application of the methodology developed in the first part to a selected, small Virginia community to illustrate by example the way the methodology could be used.

III. Service Demonstration Definition--Definition of a possible actual service demonstration for the specific case analyzed in part II, including detailed financial, management, and service plans and mode/equipment selection.

Prospective Value

The expected value of this work is in providing a consistent, generalized methodology for studying and evaluating transportation improvements. Although its emphasis is on short-haul service for small communities, the methodology will be readily adaptable to medium and long haul, and medium and large communities. In this usage, application could be envisaged

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by state agencies as part of a Federally-sponsored program coordinated by the U. S. DOT into a National Transportation System Plan.

PROGRAM DEFINITION

The following activities are believed to be essential to a sound program development:

I. Methodology Development

Activity 1: Market Demand Estimation

Objective

(1) To identify the most practical and effective future market demand estimation methods.

(2) To identify the most practical and effective methods of estimating present intercity travel demands.

(3) To provide guidelines on the most efficient methods of collecting data or tripmaker characteristics which will be used in analysis of following segments of the overall methodology.

Purpose

To obtain the necessary information for conducting a reliable transportation improvement analysis for small community intercity travel needs, encompassing all relevant inputs into the study.

Procedure

(1) A search of current and relative information pertaining to methods of forecasting intercity travel should be initiated. An inventory should be made of the market generation and modal split models for intercity travel and those urban models which may be modified for that use. Each model should be studied separately, with special consideration to the following characteristics:

(a) The assumptions of the model (stated or
     implied)

(b) The logical development of the model

(c) The type of data required by the model

(d) The technique which the method uses:
     --deterministic
     --probabilistic
     --analytical
     --statistical
     --other

(e) The reliability of the forecasting ability
     of the model

(f) The feasibility and applicability of using
     the model for the methodology purpose

(g) Other

In addition to the study of these characteristics,
models developed for urban transportation plan-
ning should undergo special studies to justify
their adaptability for use in intercity travel
studies.

The optimum forecasting methods under different
city-specific conditions should be identified
from this study, and a description of those
conditions under which each method should be
used will be presented.

(2) Identifying present demand for intercity travel
     is an integral part of the preliminary work users
     of this methodology will have to accomplish. To
     meet this second objective, a similar procedure
     of search and evaluation of those models and

techniques which are concerned with identifying present intercity travel demand should be carried out as in the preceding objective.

An example of similar work already in progress at the University of Virginia will give an idea of some of the methods to be considered. This work has involved the investigation of a method in which the total market is split up into components. When this method was implemented, each component (e. g., industry, local government, large institutions, etc.) was contacted for data on their present travel habits. Data were obtained from present scheduled trip information and recent past travel vouchers from the market components. Supplementary data from federal, state, and local statistics were also collected. The expected result is that present demand estimated in this fashion would be much more reliable than if an abstract mathematical model had been applied.

The outcome of the review and evaluation of models for estimating present intercity travel demand would be similar to that of Objective 1. Methods for identifying present demand under different city-specific conditions should be given and a description of those conditions under which each should be used should be presented.

(3) Characteristics of the tripmaker population including desirable attributes that they would like to see in a transportation system should be identified and methods for obtaining this

information formulated. The data collected
in this section would be used for the follow-
ing purposes:

(a) Analyzing existing service
(b) Identifying a minimum service criteria
(c) Evaluating possible service alternatives
(d) Forecasting model calibration

Some of the variables and characteristics to be
obtained are the perceived and actual importance
for different modes and/or trip purposes of:

(a) Comfort
(b) Cost
(c) Convenience
(d) Travel speed
(e) Safety
(f) Stopping schedule
(g) Vehicle capacity
(h) Other

Methods which should be evaluated for collecting
the required data include:

(a) Census
(b) Statistical surveys
(c) Actual counting
(d) Research of existing data sources
(e) Other

Optimum ways in which to apply transportation
surveys to acquire information should be out-
lined, and a standardized questionnaire possibly
developed to collect such data.

Activity 2: Inventory of Existing Service

Objective

To formulate a standardized method for obtaining a complete inventory of the existing transportation service between two communities.

Purpose

To provide a basis for determining the transportation improvement needed between two communities.

Procedure

It is necessary to have complete knowledge of the existing system(s), and the service it (they) provides in order to develop plans for improvement.

A system is defined, for the purpose of this study, as any mode or group of modes and interchanges which provide service between two communities.

Guidelines should be developed to enable the residents of participating communities to identify the extent to which transportation systems presently serve their needs. A mode-by-mode search and record procedure should be developed for the inventory of rubber wheel, fixed rail, air, and other transportation modes. Accommodations should be made for the inventory of systems which consist of more than one mode.

An extensive list of variables, representing the service characteristics of the system, should be measured and recorded for each system. A listing of these variables would become a standard tool for the inventory, and would include variables such as:

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(a)   Daily schedules

(b)   Special service capabilities

(c)   Pricing schedules

(d)   Average travel speeds

(e)   Stopping schedules

(f)   Seating capacity

(g)   Peak/off-peak characteristics

(h)   Expected load factor

(i)   On-time performance

(j)   Directness of route

(k)   Interchanges and layovers

Activity 3: Transport Mode Characteristics

Objective

   To compile a catalog containing operational and
economic data on state-of-the-art transport vehicles
(rubber wheel, air, rail, guideways) and associated
hardware.

Purpose

   To save communities cost, time, and effort in
searching for possible transport system hardware
to be used in implementing intercity transportation
improvements.

Procedure

   Essentially the procedure to be followed in this
segment of the work should be one of search, record,
and modification of data in order that it could be
presented in readily-understandable form. All factors
affecting passenger use should be included for each
vehicle of a specific mode. This data should be
collected by means of inquiries to manufacturers and
users. Emphasis should be given to manufacturer
information in terms of cost data and to user infor-
mation for actual vehicle operation data. Data should
also be recorded on the operating characteristics of
vehicles under different operating conditions. This
information would provide the user with some idea
of how a vehicle would perform for a community's
needs in a situation resembling its own operating
environment.

   Items to be included in this catalog are:

(1) Ride qualities (e. g., noise, vibration, etc.)
(2) Maintenance frequency and associated costs

(3)   Fuel type and consumption

(4)   Operating personnel requirements

(5)   Life expectancy

(6)   Capital investment costs

(7)   Operating costs

(8)   Estimated break-even load factors for various fare structures

(9)   Other

Activity 4:   Minimum Service Criteria

Objective

To provide guidelines for using the empirical data collected in Activity 1 to determine the threshold values of the service characteristics that would be acceptable to the residents of the participating communities.

Purpose

To provide a basis for evaluating alternative systems, thereby reducing the possibility of implementing systems which do not satisfy the needs of the community and would not be utilized.

Procedure

This activity should describe a method of transforming the data on travel behavior, collected in Activity 1, to variables representing the service characteristics of the system (described in Activity 2 above). Threshold values of the service characteristics should be determined and should describe the minimum service criteria.

Activity 5: Identification of Possible Service Alternatives

Objective

To develop a procedure which would result in the consideration of all possible transportation systems which might satisfy present transport needs and also those projected to arise in a community's future.

Purpose

To promote the generation of alternative service possibilities for user communities which might not otherwise be considered if conventional methods of solution proposal are used.

Procedure

The guidelines to be developed in this section would place much emphasis upon considering total systems where the integrated mode concept would be incorporated. The idea here is to allow more inputs into the alternative proposal process than only single mode proposals. Systems that have at their center a single mode would not be eliminated, however.

Inputs from market demand estimates along with existing service level identification would indicate the magnitude of transport system improvements needed to meet or exceed the established minimum service level.

The information developed in Activities 2, 3, and 5 would guide the planner in developing alternative systems. However, this task is complicated, and much effort could be wasted if planners are uncertain about the definition of a system. If the definition provided in Activity 3 is maintained, one can develop many alternative systems from each mode, and one can combine modes in many ways to form a multiplicity of alternative systems. It is difficult to specify a priori the factors

that make one rubber wheel system, for example,
different from another rubber wheel system. However,
it is necessary to find the "optimum configuration"
of a system before comparing it with other systems.
This optimization of a system would dictate the
variables that distinguish different systems. In
other words, there are rwo levels of optimization--
within a system and between systems. It is important
that the planner be knowledgeable of the distinction,
and choose his alternative systems such that he is
not duplicating his effort.

Guidelines should be provided for optimizing a
system and for choosing the variables that provide
the "best" distinction between alternative systems.
These guidelines should also be developed such that
systems would be formulated even if there is no
immediate indication that such a system would be
feasible. For example, a community might not ini-
tially consider a rail system because it has no
existing track or station. To implement such a
system might be held to be too expensive. However,
if many surrounding communities are in the same
situation, it might prove cost-effective and bene-
ficial to the communities involved to collectively
undertake such a system concept.

Activity 6: Operational and Economic Evaluation of Possible Service Alternatives

Objective

To provide guidelines for the operational and economic evaluation of the possible alternative systems identified in Activity 5.

Purpose

To encourage a comprehensive, unbiased investigation of the performance of each alternative, and to reduce the possibility of premature elimination of certain alternatives.

Procedure

The evaluation process should be divided into two stages: the operational evaluation described here; and the institutional evaluation to be described in Activity 7.

Various evaluation techniques are presently used in selecting a solution among alternative transportation systems. A distinction is made in this section between selection and evaluation. It is not the intent of this outlined procedure to provide, as a result of it- implementation, a feasible solution, but instead to stimulate a comprehensive unbiased investigation of each alternative.

In this evaluation the minimum service criteria developed in Activity 4 would provide a criteria for determining feasible systems based on operational characteristics. The systems should be evaluated not on their state of development, but rather on the characteristics they will ultimately demorstrate after implementation. Systems which do not satisfy the minimum service criteria should be rejected.

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Activity 7: Institutional Evaluation of Feasible Alternatives

Objective

To provide guidelines for evaluating the performance of alternative systems, when they are subjected to present and anticipated institutional constraints.

Purpose

To ensure that certain social, economic, political, and other environmental factors are considered in the evaluation of alternative systems.

Procedure

In this evaluation, guidelines should be presented for testing the systems under similar institutional conditions. Several tests should be developed and guidelines for conducting the tests presented. Examples of such tests are:

(1) The Environmental Test
(2) The Implementation Test
(3) The Resource Availability/Utilization Test
(4) The Citizen Participation Test
(5) Other

In the Environmental Test all relevant effects on the environment should be considered, and attempts made to project future effects resulting from changes in both the system and the environment. The Implementation Test should consider all factors affecting the implementation of a (system) solution, and the effect of those factors on the implementation schedule. The Resource Availability/Utilization Test should consider all resources--physical, financial, and human resources needed to implement and operate the system, and conservation of such resources. The

(public) Citizen's Participation Test should include
methods of obtaining and analyzing input to the
decision making process from members of the community.
Methods such as public hearings, TV and radio adver-
tisements, and special programs should be evaluated
and suggestions presented for increasing their
effectiveness.

Activity 8: Cost-Effectiveness Analysis

Objective

     To promote the use of a method which could be used for comparing the cost-effectiveness of each alternative.

Purpose

     To aid participating communities in further evaluation of proposed system alternatives.

Procedure

     While cost considerations have been a factor in some of the previous section formulations, their importance to local, state, and federal organizations is paramount. Therefore, in this section a method should be outlined for comparing the performance of each feasible alternative in the realization of some objective (e. g., reduction of travel times, convenience improvements, land use, energy conservation, environment, etc.) in terms of relative system costs.

     In this activity, the economic benefits which might accrue from the implementation of a particular system should also be investigated. Guidelines should be provided for user communities to accomplish this. This is an important part of the overall methodology in that through its use systems would be identified which might prove more cost-effective in terms of benefits to the community than other systems identified as such without this analysis. As an example, consider the case where a few systems have been identified as being feasible, one of which is to implement a commuter airline service. However, the particular community in question has no airport and at the completion of

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Activity 7 it appears that this alternative would
cost more initially than any of the other feasible
system alternatives. Looking at the possibility of
the development of an industrial park sometime in
the future, however, the economic benefits brought
into the community by such development could possibly
offset the higher initial cost of implementing the
airport alternative as opposed to the lower cost
systems. The provision for such evaluation in the
planning and selection process should be one of the
outcomes of this activity.

II. Methodology Application

General

The methodology developed in Part I above should be applied
in an actual study of short-haul improvements to a specific,
small Virginia community.

Objective

The objective of this part is two-fold:

(1) Actual application to a specific community would
illustrate by example the actual usage of the me-
thodology, and assure that it is really workable.

(2) It would provide the analytical basis for a possible
follow-on actual service demonstration which, if
approved, would further validate the methodology and
also provide actual real-world improvements in
short-haul transportation to small communities.

Community Selection

The community should be selected on the following basis:

1. Meets the intent of the program objectives by being
a "small" community on a "short-haul" route.
2. Has inadequate existing transportation service on the
study route.
3. Is felt to be reasonably representative of other small
communities around the country which are in need of
short-haul transportation service improvements.
4. Intuitively, it seems that a demonstration program
could be successful.
5. The community would be interested in a demonstration
program, and would support the study by providing the
required detail data.
6. Approval by the sponsor of the community selected.

Study Method

The methodology application proposed for this Part II should follow the same 8-step pattern as the Methodology Development, Part I above, using the developed data, computer programs, data acquisition, and data analysis techniques.

III. Service Demonstration Definition

General

A specific service demonstration, with bonafide service levels and fare-paying passengers, should be defined and evaluated based on the results of Part II, Methodology Application, above, for the same small Virginia community.

Objective

The objective of this part is three-fold:

(1) Further checkout of the methodology developed above to insure its validity before application on a broad-scale program.

(2) To establish confidence in the methodology.

(3) To provide a focal point and example that improvements are indeed possible for short-haul service to small communities.

Service Selection

The type of service and mode selected should be based on:

1. Community service needs.
2. Factors such as energy and land-use conservation.
3. Potential value for applications to other communities.
4. Cost-effectiveness and self-sufficiency.
5. Continuing service benefits after the demonstration period.
6. Innovative service within the technical state-of-the-art.

PROGRAM MAN-MONTHS

The following estimates were made for the man-month requirements for this program.

	Man-Months
ESTIMATED TOTAL MAN-MONTHS REQUIRED.	27.0
I. METHODOLOGY DEVELOPMENT	19.0
Activity 1: Market Demand Estimation. .	5.5
(1) Market generation & modal split modeling evaluation.	3.0
(2) Identify present market demand .	1.5
(3) Determination of traveler needs.	1.0
Activity 2: Inventory of Existing Service	0.7
(1) Develop inventory procedure. . .	0.7
Activity 3: Transport Mode Characteristics	6.0
(1) Computerized vehicle operating & cost data.	6.0
Activity 4: Minimum Service Criteria. .	0.5
(1) Analysis of Activity 1.1(3). . .	0.5
Activity 5: Identification of Possible Service Alternatives. . . .	1.5
(1) Develop planning procedure . . .	1.5
Activity 6: Operational & Economic Evaluation of Possible Service Alternatives.	1.5
(1) Guidelines for operational & economic evaluation.	1.5
Activity 7: Institutional Evaluation of Feasible Alternatives . . .	2.0
(1) Guidelines for Institutional evaluation	2.0
Activity 8: Cost-Effectivity Analysis .	1.3
(1) Develop method for cost-effectiveness analysis	1.3

			Man-Months
II.	METHODOLOGY APPLICATION.		6.0
	(0)	Community-pair selection.	1.5
	(1)	Estimate market demand.	1.0
	(2)	Inventory existing service.	0.3
	(3)	Compute operational & cost data . .	0.6
	(4)	Determine minimum service criteria.	0.6
	(5)	Plan possible service alternatives.	0.5
	(6)	Operation & economic evaluation . .	0.5
	(7)	Institutional evaluation.	0.5
	(8)	Cost-effectiveness evaluation . . .	0.5
III.	SERVICE DEMONSTRATION DEFINITION		2.0