9.8

UNIVERSITY of PENNSYLVANIA

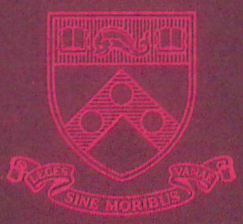
DESIGN FOR A NATIONAL URBAN TRANSPORTATION REPORTING SYSTEM

- Final Report -

Dr. Vukan R. Vuchic, Principal Investigator

Tom Komninos
George List
Kamil Siddiqi
John Worster } Research Fellows

College of Engineering and Applied Science



Department of Civil and Urban Engineering

Philadelphia, Pennsylvania 19174

DESIGN FOR A NATIONAL
URBAN TRANSPORTATION REPORTING SYSTEM

- Final Report -

Dr. Vukan R. Vuchic, Principal Investigator

Tom Komninos
George List
Kamil Siddiqi
John Worster
} Research Fellows

Department of Civil and Urban Engineering

University of Pennsylvania

Philadelphia, Pennsylvania

1976

This research was sponsored by the Urban Mass Transportation Administration, U. S. Department of Transportation, Grant Pa. 11-0002.

TABLE OF CONTENTS

Section 1

REPORT IN BRIEF

This report analyzes the contents and uses of a National Urban Transportation Reporting System. The study was performed to assist UMTA in implementation of Section 15 of the National Mass Transportation Act of 1974.

Report Organization

A review of the PennDOT transit reporting system, its implementation and results is given in Section 2. A recommended set of data items and indicators is defined and analyzed in Section 3. Section 4 contains detailed information on a subgroup of the data items and indicators felt to provide a minimal yet comprehensive base for comparison of transit agencies. The last section, Section 5, gives a recommended set of data items and indicators to be included in an annual report and the format for their presentation.

The Pennsylvania Experience

The work done by Dr. Vuchic's research team during the early 1970s in preparation of the reporting system for PennDOT served as the starting point for this project. It was apparent from the start, however, that an exact transfer of that system to the national level would be impossible and that certain modifications would be required. Most significantly, the PennDOT reporting system did not include the collection of highway data. In addition, its items were selected for the conditions in Pennsylvania cities and thus cannot handle the diversity found on the national level.

Consequently, the initial research involved a detailed analysis of highway data and of pertinent geographic and demographic information.

Simultaneously, a review of the work done for PennDOT and experiences in its implementation was made. The review is presented in Section 2 of this report.

Development of Data Items and Indicators

An extensive research and analysis served as the basis for development of the Data Set. An initial set of very comprehensive data was assembled and then the least important items were excluded to arrive at a set which is practical for implementation. The culmination of this effort is contained in Section 3. A detailed description is given of each data item, including who is to collect it, who will supply it to UMTA, when the first reporting should be required, how often it should be supplied, how easily the data can be obtained, and how reliable the data item is once it has been obtained. In some cases a formula is also provided. It should be noted, however, that every effort was made in the selection of data items to minimize: (1) the need for surveys of any kind (especially those involving field surveys); and (2) the need for either the transit agency or the Metropolitan Planning Organization to do any detailed computational work.

Indicators which can be derived from the data items were also selected. While it is not at all difficult to derive an immense number of indicators, the effort was concentrated on selecting only those indicators felt to be both meaningful and practically useful. These indicators, also listed in Section 3, are segregated from the data items. For example B_t-1 through B_t-11 represent data items, whereas B_{ti}-1 through B_{ti}-7 represent indicators

based on those data items and other data items. The large number of possible indicators is particularly apparent in part D where costs and revenues can be computed on the basis of a number of transit service input or output items. The list gives only those costs considered relevant for any conceivable uses of the Reporting System.

Transit Service Evaluation

Efficient operation of transit agencies is of great interest not only to the agencies themselves and their passengers, but also to the governments providing financial assistance to transit. Defining efficiency is not, however, an easy task since it can encompass a number of different items.

Since one of the basic purposes of developing the Urban Transportation Reporting System is to make it possible to measure efficiencies of individual systems as well as comparative evaluation of different systems, the research reported here also focused on a comprehensive definition of this concept. Results of this work, presented in Section 4, show that a large number of various efficiency indicators can be easily understood when they are classified into seven major categories (detailed definitions are given in Section 4);

1. Potential for transit service, measuring the conditions for transit operations (e. g. population and population density);

2. Offered service, i. e. its quantity and quality (e. g. capacity-miles/year);

3. Work performed, or use of transit (e. g. passenger-miles/year);

4. Service utilization, representing the relationship of use to offered service;

5. Efficiencies of service and work, measuring efficiencies of the use of resources (financial, material, labor) (e. g. capacity miles/year/employee);

6. Revenues, or compensation for the performed services (e. g. revenue dollars/passenger-mile).

7. Financial efficiency of operations, representing the relationship of costs and revenues (e. g. the operating ratio).

Section 4 contains a brief discussion of each category and an extensive list of indicators classified into the seven categories.

Development of an Annual Report

The final task of the project on the Reporting System was to develop the format for an annual report which DOT should publish to make the data easily accessible to potential users. The results of this effort are contained in Section 5. In general the report is conceived to consist of three parts: national statistics, totals and averages for different city size groups, and data for individual cities.

National: This part contains national totals and averages of selected data items and indicators. It extensively utilizes graphs and diagrams for both trends in time for individual parameters as well as for presentation of correlation between parameters and city sizes.

City groups by size: The second part consists of the same items as in the preceding part, but summed and averaged by city size groups. Graphical presentations are again used extensively, particularly for time trends of various parameters. Graphs depicting parameter correlation to city size are not included, but they could be added if desired.

Individual cities: This last section serves as the basis for the preceding two parts. It is suggested that it be numerical only and that it will list more information than is presented in the other two sections.

The exact contents and layout of the annual report, as well as the type

of presentation of each data item, are given in Section 5.

Summary of Results

Major results of the reported research work include the following materials:

(1) A review of experiences from the operation of a transit reporting and monitoring system in Pennsylvania which are relevant for the National Reporting System (Section 2).

(2) A recommended set of data items to be collected by UMTA to enable a good monitoring of urban transit and highway conditions throughout the country (Section 3).

(3) A recommended set of indicators derived from the data items (Section 3).

(4) A selected subset of data items and indicators which allow evaluation of different types of efficiencies of transit systems and their comparative analyses (Section 4).

(5) A recommended list of data items to be presented in an annual report, complete with formats for their presentation (Section 5).

The basic idea behind the development of the Urban Transportation Reporting System is that sufficient data should be collected on a systematic and permanent basis to allow various types of reviews, analyses and evaluations of urban transportation by the operators, planners and government officials, including the Congress. The approach taken in this project was to find a reasonable compromise between an ideal set of data which would be extremely comprehensive but very difficult and costly to collect, and a very limited set of data which would be easy to collect but inadequate for many of its intended uses. It is believed that the presented set does represent

a solution which will satisfactorily serve its purposes at least in the foreseeable future, and which will be practical to assemble and maintain in reasonably complete and accurate form.

Section 2

TRANSIT INFORMATION SYSTEM IN PENNSYLVANIA

The Background

The Commonwealth of Pennsylvania was one of the first states of the union to start a transit assistance program. Introduced in 1965, the program provides for various categories of assistance, including both capital and operating funds. This program was based on precisely defined goals for improvement of public transportation in Pennsylvania which would result in significant social and economic benefits. The goals were included in Act 7 of the Pennsylvania Urban Mass Transportation Assistance Law of 1967, Act 8 of 1968, and Act 120 of 1970.

This assistance found the urban transportation systems in Pennsylvania, not atypical for most of the nation's cities, in rather poor shape. The serious deficiencies included obsolete equipment and fixed facilities; inefficient operations and poor service; lack of cooperation among agencies and planning bodies; and ineffective managements, which were discouraged by many years of adverse development for transit and lack of assistance from any side, as well as unaware of modern developments in public transportation. In addition, there was an apathetic public, also unaware of possible improvements which would drastically change the level of transit service.

Under these conditions, the financial assistance was useful, but was not sufficient to reverse the trend of decreasing patronage and increasing costs. A particularly serious danger existed in the possible adoption of the attitude that the availability of public funds reduces the need for improvement of efficiencies. In other words, considerable waste of public funds could result if these attitudes would prevail in some cities.

It was the intention of the Pennsylvania Department of Transportation (PennDOT) that its funds be used to the greatest possible benefit for the public and that the belief in inefficiency of public agencies be proved an unjustified prejudice. With this purpose, PennDOT, in cooperation with a research team from the University of Pennsylvania, developed a program for improvement of transit services and efficiency of operations.

The improvement program consisted of several different sets of guidelines. In addition to specifying the procedures for applying for capital and operating assistance, the guidelines also included very specific instructions and standards with respect to quality of transit service offered. The intention behind the guidelines has been not only to insure that the operator is offering a good service, but also that he operates efficiently so that the funds are well utilized.

It was clear from the beginning of this program that one of the major problems and obstacles to improvement was a lack of data on many basic facts and statistics of transit operations in individual cities. This lack of data made evaluation of efficiencies of individual agencies, of utilization of assistance funds, and many other needed analyses practically impossible. Planning of improvements was also highly unreliable without such information. It was therefore decided that all transit agencies be required to report data on their systems and operations. A Questionnaire was developed which was sent to all the agencies which obtain assistance from PennDOT (the program was later expanded to also include some operators who do not receive assistance) and the intention was that the data would be transferred from the completed Questionnaires to a "data file system", i.e., another form which would also contain different indicators computed by PennDOT. It was intended that eventually the data be stored by computer on the basis of a program which allows easy retrieval of individual items as well as derivation of individual indicators or their comparisons among different cities.

The content of the Questionnaire was divided into four major categories: (A) general data about the city, its area, population, etc.; (B) data about the transit system, including the number and length of routes, number of vehicles, frequency of service, etc. ("supply side"); (C) the data on transit systems usage, i.e., the number of passengers, passenger-miles, capacity utilization, etc.; and (D) the information about the transit agency management, its revenues and expenses, etc. Since the principle was followed that only the minimum amount of data items should be asked of the transit agencies, only the indicators that could not be derived from the basic data were included in the Questionnaire. A number of additional indicators were included in the data file system which would be computed by PennDOT once the basic information is received.

The Questionnaire was planned to be sent to transit agencies every year so that they could complete and return them with the application for purchase of service (financial assistance). This method was expected to influence compliance and cooperation in providing the data. It was foreseen in the planning of this program that the operators would not have all the data and that there would be some additional burden on the agencies in completing them. However, it was considered that the very procedure of collecting data would be of use, not only to PennDOT, but also to the individual agencies, since it would increase their knowledge about their own operations. It would thus tend to intensify analysis of operations, draw their attention to any inefficiencies, and stimulate comparison with other operations. The assistance provided by PennDOT, consisting of definitions of different terms, detailed clarification of computations and their different examples was provided in writing, by telephone or personally. It was believed that with this assistance the problems of obtaining a reasonably accurate and reliable set of data would not be excessive. These optimistic expectations were proved to be justified.

The Implementation and Experience with the Transit Information System

The first transit Questionnaires were sent to operators in 1973 for collection of data for that year. It was expected that some incomplete returns would be obtained, since many operators had not collected some of the items. For example, practically no operator had information on the average trip length, and therefore on the total number of passenger-miles. The operators were informed that the data might be incomplete in the first year, but that they were expected to plan for collection of complete data in the second and subsequent years.

The first set of returns did have some problems, but not more than had been predicted. From the experience with those and subsequent annual Questionnaires, certain modifications were made on the information system. Thus, the number of general questions about the city (such as economic activity, city form, land use distribution, etc.) were eliminated, since the use from them was found to be marginal. Definitions of the items which caused some confusion (e.g., explanation of route length for routes with loops at one or both ends) were modified and explanations elaborated. Some additional items were added.

It is interesting that the data on trip length were obtained in the second and subsequent years since most of the operators managed to make some limited counts and estimates for individual routes and then to aggregate the data in order to compute this item. However, the most significant change in the method of data collection was that instead of using two separate forms, the Questionnaire and the data file, one combined form was developed, which includes both the basic data and the indicators. This was found to be more practical and to involve less work than transcribing the Questionnaire. Most of the computations of indicators continued to be performed by PennDOT personnel.

Another significant change has been that the data have been stored by computer, utilizing a program which allows derivation of all indicators. This method of data handling allows convenient and fast retrieval of any items as a time series, for all cities, indicators in different forms, and any other desired data item or relationship. In addition, it has become possible not to put the indicators on the Questionnaire at all, thus simplifying it considerably.

Accuracy of data has been generally satisfactory. Initially, there were some errors caused by incorrect interpretation of the Questionnaire. Once those were resolved, PennDOT believes that the accuracy has become quite satisfactory. In some cases, there is a tendency to overestimate some data, but usually not to intentionally deceive. The errors, intentional or accidental, can be caught in the Questionnaire in several ways. One is just by reviewing the reasonableness of data; another, by cross

referencing various items; and finally, through spot checks and field visits. All this is possible at the state level, and with quite a moderate number of hours of PennDOT's personnel. Naturally, the scale would be correspondingly larger on the national level, and it would have to be handled by states or regions. In that way, the effort does not seem to be excessive. One must also bear in mind the fact that whatever system and however simple data are collected, their accuracy will be undeterminable unless there is some checking of them; supervision by the collecting agency is therefore unavoidable.

PennDOT's experience is that the knowledge of reliability of data is extremely important. PennDOT considers that if the agency indicates which data are exact, which are estimated but probably accurate, and which are estimated with undetermined reliability, this allows PennDOT to treat the data correspondingly and in most cases is adequate for the purposes of the information system.

Cost of data collection is absorbed by the transit agencies, but PennDOT does give the agencies assistance in different ways. The fact is that the collection does not involve excessive direct costs, since it is performed nearly exclusively by the agency's personnel, only sometimes supplemented by limited field studies. Most of the data that are required are those which the agency should have for its own purposes anyway. This is the reason that no major financial support from PennDOT has been found necessary for this purpose.

There is no reason that this rationale cannot be applied to the transit data collection on a national basis. Although collection of highway data which must be collected through field surveys may require some financing, there does not appear to be much rationale in allocating extensive financial resources for agencies involved with transportation planning or operations to collect the data needed for that planning and operation. They should have such data for their work anyway.

Uses of the Information System

According to PennDOT, its relatively new information system has a number of different uses, several of which are quite significant and beneficial.

PennDOT uses the data items and indicators in its process of making funding decisions. Its purchase of service agreements (operating financial assistance) are provided to individual agencies upon the approval of the purchase of service application filed by the operator. Included as a part of this application is a set of certain financial and operating data. These data are compared with the guidelines and standards established by PennDOT, and the allocation of funds is influenced by the efficiency of service estimated through this comparison.

For example, if a service change, such as an addition or elimination of a route, is proposed, PennDOT uses the standards and actual data to evaluate the operational and financial effects of that change.

If the analysis shows that the indicators are not within the acceptable ranges of efficiency, PennDOT may undertake one of the following steps: (1) call for further analysis; (2) suggest a method to bring the system within the acceptable range of values; (3) some combination of actions (1) and (2); or (4) reject the application for purchase of service or for changes of service. It is obvious that such an evaluation process is heavily dependent on the availability of operating and financial data contained in the information system.

A second use of the data is for the development and analysis of urban transportation plans. The data have an important role in this process. Transit consultants, regional planning agencies, transit operators' planning departments, and PennDOT itself use these data to project future transit needs. Based on these projections, capital projects are developed. To apply for funds for such projects, urban areas and their interested organizations must justify the needs by projecting the effects of the project. Very often, PennDOT makes such projections on its own to arrive at decisions for allocation of its capital funding. The usefulness of data for this purpose is quite obvious.

The data are also used in a similar fashion in applications for technical studies. Transit planners use the data for projecting the effects of the considered service improvements or experiments.

Transit operators can use, and have used, the data as a tool in management and evaluation of their own systems. Statistical comparisons with other systems often provide a valuable insight for an operator about his efficiency as compared to those in similar systems in other cities. In some instances, he can use these comparisons to assist him to gain an understanding as to why certain aspects of his system are not functioning effectively. Such an analysis often allows the operator to undertake the necessary actions for improvement of his system.

Another important use is for the legislators who sometimes look for this type of information for an input into policy formulations on urban transportation matters. Other divisions of PennDOT and other state government agencies also sometimes use the information system to develop statistical trends which allow them to perform various analyses and develop alternative plans. A typical example of this type of use is by the Budget Department with its need to have precise information available with respect to different trends in urban areas, and public transportation specifically. This type of analysis has a direct influence on budgeting of funds.

The last, but not the least important, user is the public. Various professionals, industrial or public organizations, citizens groups, as well as interested individuals, often need such data for various evaluations and analyses of different projects, policies or specific activities.

PennDOT officials point out the fact that in addition to an improvement in their planning, analysis and policy formulation due to the availability of the information system, there is a direct financial saving from it because of the reduced time required by various analysts for collection of such data. In the case of consulting contracts, this is directly reflected in lower project costs.

Finally, the information collected has been used to put together an annual statistical report on transit operations in Pennsylvania which will be published on a regular annual basis from now on. A copy of the first statistical report has been submitted. The uses of these kinds of reports are well known, so that they do not have to be elaborated upon here.

It is believed that this statistical report is among the first, if not the first, of its kind published by a state.

Conclusion

PennDOT feels very strongly that it is not only desirable, but absolutely necessary that as a public agency distributing funds. its Bureau of Mass Transit Systems must obtain information necessary to insure that the Commonwealth funds are properly used and public transportation services are improved. This purpose alone would have justified the introduction and continuous operation of the information system. As was pointed out above, there are a number of other significant uses which represent additional benefits from this action.

The initially designed data system has proved to be a very good start. The continuing process of data collection, reviews by PennDOT personnel and additional contributions from the University of Pennsylvania, transit agencies and other interested bodies have led to an information system which PennDOT feels is quite complete, has adequate reliability and accuracy and serves the purposes for which it was founded. Consequently, the whole effort is considered to have been extremely successful, fulfilling all the initial expectations.

Additional Comments

PennDOT officials were asked in the course of the interviews for this report what their opinion was concerning the role the state DOT's should play in the national urban transportation information system. They believed that the state DOT's should be intermediate agencies between the federal government and urban areas wherever the states have

or are willing to assume such a role. The problem is, however, that although an increasing number of states are becoming active in data collection, only a small number of them are performing the task efficiently at this time. To achieve a comprehensive and reliable national reporting system, it is necessary that the federal government not only take the initiative to implement the system, but also introduce a legal requirement for the responsible agencies to report the data.

Section 3

THE PROPOSED NATIONAL URBAN TRANSPORTATION REPORTING SYSTEM

Based on reviews of various proposed organizations of the National Urban Transportation Reporting System, considerations of different classifications of data and extensive discussions of appropriateness of each data item, the attached structure of the Reporting System has been developed.

The required data have been classified into five major categories:

- General Information
- Urban Transportation Supply
- Urban Transportation Usage
- Organizational and Financial Data
- Transportation Impacts.

Each category except for the first and the last one is further broken down into transit and highway data.

Data in each category are divided in three groups:

Priority I - items which are very important and should certainly be included into the Reporting System.

Priority II - items which are of somewhat lesser importance, or which may not be easily available. These items would be desirable, but not necessarily essential to have, at least in the initial period of the Reporting System's implementation.

We suggest that through further research and discussions the decisions be made as to which Priority II items will be included into the System at this time, and which ones will be considered for later use or be eliminated.

An additional table is included for the data on highway toll facilities. This table is supplementary to the Priority I table for Urban Transportation Demand - Highways category.

Indicators - items which are derived from the collected data are given in separate tables by category. These indicators include some of the most important items for analyses of transportation in each urban area - or among areas.

It is pointed out that the indicators can be computed after the data are collected. Consequently, the questionnaires going to different cities and agencies will not be excessively elaborate: they will contain only Priority I and some of the Priority II items.

The tables are followed by a list of definitions, uses and instructions for collection of each item listed in the tables.

DEFINITIONS OF THE DATA TABLE COLUMNS

1. Code - Identification number assigned to each data item. The code consists of:

   - A letter designating the section of data:

     A - General Information
     B - Urban Transportation Supply
     C - Urban Transportation Usage
     D - Organizational and Financial Data
     E - Transportation Impacts;

   - Subscripts identifying characteristics of the item:

     i - indicator
     t - transit item
     h - highway or parking item; and

   - A sequence number.

2. Item - Designation of the data item to be collected or indicator to be computed.

3, 4, 5, 6. Area - The geographical unit for which individual data items are collected.

3. CBD - Usually the downtown business and retail trade area of a city. The CBD is an area of high land valuation characterized by a high concentration of retail and business offices, theaters, hotels and service businesses, and with a high traffic density. CBD's have been defined in cities with population of 100,000 or more. (1)* (Those cities without specifically defined CBD should note this in their report so that the data can be interpreted accordingly.)

4. Central city - The largest city in the urbanized area. Additional cities are also central cities if their population is 1/3 or more of the largest city's and at least 25,000. (1)

---

* Underlined numbers in parentheses refer to respective sources listed at the end of each section.

5. Urbanized area - An area which contains a city (or twin cities) having a population of 50,000 or more plus surrounding closely settled incorporated and unincorporated areas which meet certain criteria of population size or density established by the Bureau of Census. (1)

6. Transit service area - Legally defined area which transit agency serves.

7. Data collector - The organization responsible for the actual collection of the data.

8. Data supplier - The organization that supplies the data to UMTA/DOT.

9. First report - Date when data should be reported for the first time.

10. Report interval - Time, in years, between successive reports of the data. (A) designates items which must be reported for each year, even if the report is sent to UMTA/DOT every 2 or more years.

11. Availability - A measure of the effort required to collect the data item. A scale of 1 to 5 is used with approximately the following meanings:

    1 - Data item readily available.
    2 - " " available to the reporting agency from another source.
    3 - Moderate amount of collection/derivation effort required.
    4 - Rather simple survey required (e.g., passenger or traffic counts).
    5 - Major survey required (interview, household, etc.).

12. Reliability - A measure of the confidence that can be placed in the data. A scale of 1 to 5 is used where 1 refers to the most reliable data and 5 to the least.

13. Comments - Miscellaneous information, opinions, warnings.

Definition sources:

1. U.S. Department of Commerce - Bureau of Census, 1970 Census Users Guide - Part I, Washington D.C., 1970.

A. General Information

Priority I

1 Code	2 Item	3 CBD	4 Central city	5 Urbanized area	6 Transit service area	7 Data Collector	8 Data supplier	9 First report	10 Report Interval	11 Availability	12 Reliability	13 Comment
A-1	Land area	✓	✓	✓	✓	MPO	MPO	1977	Once & changes	1	1	
A-2	Population		✓	✓	✓	CB, MPO	MPO	1977	2(A)	3	2	CB = Census Bureau
A-3	Employment	✓	✓	✓		BLS, MPO	MPO	1977	2(A)	2	2	BLS = Bureau of Labor and Statistics
A-4	Vehicle registration by class			county		SDOT	MPO	1977	2(A)	1	3	SDOT = State Department of Transportation or equivalent
A-5	Persons daily incoming	✓				MPO	MPO	1977*	2	3	2	Requires cordon count. Available in some cities.
A-6	Number of transit agencies - Names - Modes operated			✓		MPO	MPO	1977	2	1	1	

* where available

A. General Information

Priority II

1 Code	2 Item	3 CBD	4 Central city	5 Urbanized area	6 Transit service area	7 Data collector	8 Data supplier	9 First Report	10 Report interval	11 Availability	12 Reliability	13 Comment
A-21	Urban form and changes	✓	✓	✓		MPO	MPO	1977	5	2	2	
A-22	Economic activity	✓	✓	✓		MPO	MPO	1977	5	3	3	
A-23	Topography and climate			✓		MPO	MPO	1977	Once	1	1	
A-24	Households		✓	✓		CB, MPO	MPO	1977	2(A)	3	2	Marginal utility
A-25	Population by age, income, race, and handicaps					CB	MPO	Future	5	4	3	Marginal utility
A-26	Auto distribution and ownership by household		✓	✓		Survey	MPO	Future	5	4	3	
A-27	Office floor area	✓				*	MPO	1977	5	3	2	Voluntary
A-28	Retail floor area	✓				*	MPO	1977	5	3	2	Voluntary
A-29	Crimes	✓	✓	✓		FBI	MPO			2	4	No standard definitions, poor reporting. Not recommended.

*Building Owners' Assoc.
Merchants' Assoc.
MPO.

A. General Informational Indicators

Code	Item	CBD	Central city	Urban area	Derivation formula	Comments
λ_i-1	Population density		✓	✓	$\frac{A\text{-}2}{A\text{-}1}$	Population density is closely correlated with character of city, transport patterns and applicability of modes.
λ_i-2	Employment density		✓	✓	$\frac{A\text{-}3}{A\text{-}1}$	Describes intensity of economic activities.
λ_i-3	Auto ownership			✓	$\frac{A\text{-}4}{A\text{-}2}$	Has a direct influence on use of and need for public transport.
λ_i-4	Employment in CBD as percent of urban area	✓			$\frac{A\text{-}3_{CBD}}{A\text{-}3_{URBAN\ AREA}}$	Concentration of employment in CBD influences efficiencies of different modes, part. transit.
λ_i-5	Entering persons per CBD area	✓			$\frac{A\text{-}5}{A\text{-}1_{CBD}}$	Expresses physical concentration of travel in CBD.

B_t - Transit Facilities and Service

Priority I

1 Code	2 Item	Applies to the total transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
B_t-1	Number of routes - by mode - Regular service - Commuter service		TA	MPO	1977	2(A)	1	1	TA = Transit authority
B_t-2	Length of routes - by mode - Regular service - Commuter service		TA	MPO	1977	2(A)	1	1	
B_t-3	Length of lines - Regular service - Commuter service		TA	MPO	1977	2(A)	1	1	
B_t-4	Area coverage - by mode and total		TA	MPO	1977	2(A)	2	2	
B_t-5	Population within area covered - by mode and total		MPO	MPO	1977	2(A)	2	2	"Service availability"
B_t-6	Number, average age, and average capacity of vehicles owned - By mode		TA	MPO	1977	2(A)	1	1	

B_t - Transit Facilities and Service
Priority I

1 Code	2 Item	Applies to the total transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
B_t-7	Maximum number of vehicles in peak hour service - by mode		TA	MPO	1977	2(A)	3	3	
B_t-8	Annual vehicle miles of revenue service - by mode		TA	MPO	1977	2(A)	2	2	
B_t-9	Annual vehicle hours of revenue service - by mode		TA	MPO	1977	2(A)	2	2	
B_t-10	Total capacity of park-and-ride lots at rail stations		TA	MPO	1977	2	1	1	
B_t-11	Commercial speed - by mode		TA	MPO	1977	2	3	2	
B_t-12	Average distance between stations/stops - by mode		TA	MPO	1980	2	2	2	
B_t-13	Operating speed - by mode		TA	MPO	1977	2	2	2	

B_t - Transit Facilities and Service

Priority II

1 Code	2 Item	Applies to the total transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
B_t-21	Number of vehicles in base service - by mode		TA	MPO	1977	2	3	3	

B_{ti} - Transit Facilities and Service Indicators

Code	Item	CBD	Central city	Urban area	Derivation formula	Comments
B_{ti}-1	Area served as per cent of total area			✓	$\frac{B_t\text{-}4}{A\text{-}1}$	A measure of the quantity of coverage provided by the system.
B_{ti}-2	Density of network			✓	$\frac{B_t\text{-}3}{A\text{-}2}$	An indicator of spatial availability of transit service.
B_{ti}-3	Population served as per cent of total population			✓	$\frac{B_t\text{-}5}{A\text{-}2}$	A measure of transit service availability to population.
B_{ti}-4	Maximum vehicles in peak service as per cent of owned			✓	$\frac{B_t\text{-}7}{B_t\text{-}6}$	Shows efficiency of scheduling and vehicle maintenance.
B_{ti}-5	Peak-to-base ratio - by mode			✓	$\frac{B_t\text{-}7}{B_t\text{-}21}$	Reflects character of demand. High ratio causes low vehicle utilization.
B_{ti}-6	Annual capacity - - miles offered			✓	$\sum_{\text{modes}} (B_t\text{-}8)(B_t\text{-}6)$	Gives an indication of total transporting capacity offered by the system.
B_{ti}-7	Length of routes/Length of line - by mode			✓	$\frac{B_t\text{-}2}{B_t\text{-}3}$	Shows the duplication or overlapping of transit service.

B_{ti} - Transit Facilities and Service Indicators

Code	Item	CBD	Central city	Urban area	Derivation formula	Comments
ti-8	Annual capacity - miles/vehicle			✓	$\frac{B_{ti}\text{-}6}{B_t\text{-}6}$	Gives an indication of vehicle productivity
ti-9	Annual capacity - miles/capita			✓	$\frac{B_{ti}\text{-}6}{A\text{-}2}$	Gives an indication of the transporting capacity offered each resident
ti-10	Annual vehicle - miles/vehicle			✓	$\frac{B_t\text{-}8}{B_t\text{-}6}$	Gives an indication of vehicle productivity
ti-11	Commercial speed/ operating speed			✓	$\frac{B_t\text{-}13}{B_t\text{-}11}$	Gives an indication of the transit agency's efficiency in scheduling; labor arrangements, and dispatching.

B_h - Highway and Parking Facilities

Priority I

1 Code	2 Item	3 CBD	4 Central city	5 Urbanized area	6 Transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
B_h-1	Route miles - by functional class - by design type		✓	✓		SDOT LGSD MPO	MPO	1977	2	2	1	LGSD = Local government streets department SDOT = State Department of Transportation or equivalent
B_h-2	Lane miles - by functional class - by design type - by jurisdiction		✓	✓		SDOT LGSD MPO	MPO	1977	2	2	1	
B_h-3	Off-street parking - by ownership	✓				PA PFOA MPO	MPO	1977	2	2	2	PA = Parking authority PFOA = Parking facility owners' association
B_h-4	On-street parking	✓				LGSD MPO	MPO	1977	2	3	3	
	Add supplement for toll facility data where applicable.											

B_h - Highway and Parking Facilities
Toll Facility Supplement

1 Code	2 Item	3 CBD	4 Central city	5 Urbanized area	6 Transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
h^{-11}	Facility name			✓		BA TA	MPO	1977	Once & changes	1	1	BA = Bridge authority TA = Turnpike authority (or similar organization)
h^{-12}	Location			✓		BA TA	MPO	1977	Once	1	1	Supply maps showing location of all facilities.
h^{-13}	Number of lanes			✓		BA TA	MPO	1977	Once & changes	2	1	
h^{-14}	Toll rates			✓		BA TA	MPO	1977	2	2	1	

B_h - Highway and Parking Facilities
Priority II

1 Code	2 Item	3 CBD	4 Central city	5 Urbanized area	6 Transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
h^{-21}	Capacity miles - by functional class - by design type		✓	✓		SDOT MPO	MPO	Future	2	4	4	Difficult to compute precisely. Careful interpretation required.
h^{-22}	Number of signalized intersections		✓			LGSD MPO	MPO	1977	5	3	3	
h^{-23}	Land area occupied by parking facilities		✓			LGD	MPO	1977	2	3	2	LGD = Local government department at which property deeds and titles are filed.
h^{-24}	Parking rates		✓	✓		PA PFOA MPO	MPO	Future	2	4	4	Wide range of rates charged throughout CBD. Precise definition required.
h^{-25}	Parking spaces at long distance transportation terminals			✓		TPS	MPO	1977	2	2	2	TPS = Terminal parking service

B_{hi} - Highway and Parking Indicators

Code	Item	CBD	Central city	Urban area	Derivation formula	Comments
B_{hi}-1	Lane mile density - by functional class - by design type		✓	✓	$\frac{B_h\text{-}2}{A\text{-}1}$	Indicates the concentration of the highway system. It can also be viewed as the extent to which the area is occupied by that highway system.
B_{hi}-2	Lane mile per capita - by functional class - by design type		✓	✓	$\frac{B_h\text{-}2}{A\text{-}2}$	A measure of the amount of highway service provided for each resident.
B_{hi}-3	Number of daily incoming persons per parking space	✓			$\frac{A\text{-}7}{B_h\text{-}3 + B_h\text{-}4}$	Characterizes the influence the availability of parking has on modal choice for trips to the CBD. Helps to identify surplus or deficiency of parking space in CBD.
B_{hi}-4	Percent of CBD occupied by by parking facilities	✓			$\frac{B_h\text{-}23}{A\text{-}1}$	Indicates the demand for parking facilities in the CBD and evaluates the efficiency of those facilities constructed to satisfy that demand. The computation of this indicator requires a priority II data item.

C_t - Transit Usage

Priority I

1 Code	2 Item	Applies to the total transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
C_t-1	Average daily total passengers - by mode - by day (weekday, Saturday, Sunday)		TA	MPO	1977	2(A)	3	3	TA = Transit authority
C_t-2	Annual revenue passengers - by mode		TA	MPO	1977	2(A)	2	2	
C_t-3	Annual total passengers - by mode		TA	MPO	1977	2(A)	3	3	
C_t-4	Average trip length - by mode		TA	MPO	1980	2(A)	5	4	
C_t-5	Peak hour passenger boardings - by mode		TA	MPO	1980	2(A)	3	3	Requires a passenger count

C_t - Transit Usage

Priority II

1 Code	2 Item	Applies to the total transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
C_t-21	Average number of routes used per passenger trip		TA	MPO		2	4	4	Requires a passenger survey

C_{ti} - Transit Usage Indicators

Code	Item	CBD / Central city / Urban area	Derivation formula	Comments
ti-1	Average daily passenger miles - by mode		$(C_t\text{-}4)(C_t\text{-}1_{weekday})$	Evaluates the transporting work done by the transit system.
ti-2	Annual passenger miles - by mode		$(C_t\text{-}4)(C_t\text{-}3)$	Evaluates the transporting work done by the transit system.
ti-3	Offered capacity utilization ratio - by mode		$\frac{C_{ti}\text{-}2}{B_{ti}\text{-}6}$	Shows capacity used as a percentage of capacity offered.
ti-4	Density of usage		$\frac{\sum_{mode} C_{ti}\text{-}2}{\sum_{mode} B_t\text{-}3}$	Measures intensity of usage of the network.
ti-5	Peak-to-base ratio of demand		$\frac{C_t\text{-}5}{C_t\text{-}1}_{weekday}$	Measures unevenness of demand which affects economics of operations.
ti-6	Annual transit rides/capita		$\frac{C_t\text{-}3}{A\text{-}2}$	Measures overall system use by the population.
ti-7	Annual passenger miles/capita		$\frac{C_{ti}\text{-}2}{A\text{-}2}$	Measures overall system work done per capita

C_h - Highway Usage
Priority I

1 Code	2 Item	3 CBD	4 Central city	5 Urbanized area	6 Transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
h^{-1}	Daily vehicle miles - by functional class - by design type - by vehicle type - by day of week		✓	✓		SDOT LGSD MPO	MPO	1977	2	3	2	SDOT = state department of transportation LGSD = local government streets department
h^{-2}	Annual vehicle miles - by functional class - by design type - by vehicle type		✓	✓		SDOT LGSD MPO	MPO	1977	2	3	3	
h^{-3}	Average vehicle occupancy - by vehicle type		✓	✓		SDOT LGSD MPO	MPO	1977	2	2	2	
h^{-4}	Average travel speeds - by functional class - by design type - by time of day		✓	✓		SDOT LGSD MPO	MPO	1977	2	4	3	
h^{-5}	Number of highway accidents annually			✓		SDOT	MPO	1977	2(A)	2	2	

C_h - Highway Usage

Priority I

1 Code	2 Item	3 CBD	4 Central city	5 Urbanized area	6 Transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
h-6	Number of highway injuries annually			✓		SDOT	MPO	1977	2(A)	2	1	
h-7	Number of highway fatalities annually			✓		SDOT	MPO	1977	2(A)	2	1	

C_h - Highway Usage

Priority II

1 Code	2 Item	3 CBD	4 Central city	5 Urbanized area	6 Transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
$_h$-21	Daily vehicle trips - by functional class - by design type - by trip purpose		✓	✓		SDOT MPO	MPO	1977	2	4	3	
$_1$-22	Annual vehicle trips - by functional class - by design type - by trip purpose		✓	✓		SDOT MPO	MPO	1977	2	4	3	
$_1$-23	Average trip length - by trip purpose		✓	✓		SDOT MPO	MPO	1977	2	4	3	
$_1$-24	Travel time contours from CBD - by time of day			✓		SDOT MPO	MPO	Future	2	4	3	

C_{hi}- Highway Usage Indicators

Code	Item	CBD / Central city / Urban area	Derivation formula	Comments
hi-1	Daily vehicle miles per lane mile - by functional class - by design type		$\frac{C_h\text{-}1}{B_h\text{-}2}$	A measure of usage of highway facilities.
hi-2	Daily person miles - by functional class - by design type - by vehicle type - by day of week		$C_h\text{-}1 \times C_h\text{-}3$	A measure of volume of passenger transportation and its variations among listed categories.
hi-3	Annual person miles - by functional class - by design type - by vehicle type		$C_h\text{-}2 \times C_h\text{-}3$	"
hi-4	Daily person trips - by functional class - by design type - by trip purpose		$C_h\text{-}21 \times C_h\text{-}3$	Demand for highway travel by listed categories.
hi-5	Annual person trips - by functional class - by design type - by trip purpose		$C_h\text{-}22 \times C_h\text{-}3$	"

C_{hi}- Highway Usage Indicators

Code	Item	CBD / Central city / Urban area	Derivation formula	Comments
C_{hi}-6	Daily person miles per capita - by functional class - by design type - by vehicle type - by day of week		$\frac{C_{hi}\text{-}2}{A\text{-}2}$	Unit (per person) volume of transportation
C_{hi}-7	Annual person miles per capita - by functional class - by design type - by vehicle type		$\frac{C_{hi}\text{-}3}{A\text{-}2}$	"
C_{hi}-8	Daily person trips per capita - by functional class - by design type - by vehicle type		$\frac{C_{hi}\text{-}4}{A\text{-}2}$	Unit (per person) demand for highway travel.
C_{hi}-9	Annual person trips per capita - by function class - by design type - by vehicle type		$\frac{C_{hi}\text{-}5}{A\text{-}2}$	"
C_{hi}-10	Annual highway accidents per per 100,000 VMT. per million person miles		$\frac{C_h\text{-}5}{C_h\text{-}2/10^5}$ & $\frac{C_h\text{-}5}{C_{hi}\text{-}3/10^6}$	Indicates highway safety.

C_{hi} - Highway Usage Indicators

Code	Item	CBD / Central city / Urban area	Derivation formula	Comments
$_{1i}$-11	Annual highway injuries per 100,000 VMT per million person miles		$\frac{C_h\text{-}7}{C_h\text{-}2/10^5}$ & $\frac{C_h\text{-}7}{C_{hi}\text{-}3/10^6}$	Indicates highway safety.
$_{1i}$-12	Annual highway fatalities per 100,000 VMT per million person miles		$\frac{C_h\text{-}7}{C_h\text{-}2/10^5}$ $\frac{C_h\text{-}7}{C_{hi}\text{-}3/10^6}$	Indicates highway safety.

D_t - Transit Organization and Finance

Priority I

1 Code	2 Item		7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
D_t-1	Type of agency		TA	MPO	1977	Initial	1	1	
D_t-2	Number of employees (total and by categories) - Management and administration - Planning and marketing - Dispatching and supervision - Operators - Maintenance - Other		TA	MPO	1977	2	1	1	
D_t-3	Annual revenue (total and by categories) - Passenger fares - Charter service - Purchase of service - Other		TA	MPO	1977	2(A)	1	1	

D_t (Priority I, cont'd)

1 Code	2 Item		7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
D_t-4	*Annual costs (total and by categories)* - Operating - Fuel, power - Maintenance of rolling stock - Maintenance of fixed facilities - Depreciation - Administration - Information and advertising - Damages and injuries - General, miscellaneous		TA	MPO	1977	2(A)	1	2	
D_t-5	Base fare		TA	MPO	1977	2(A)	1	1	
D_t-6	Operator's wage rate		TA	MPO	1977	2(A)	1	1	

D_{ti} - Transit Organizational and Financial Indicators

Code	Item	CBD / Central city / Urban area	Derivation formula	Comments
D_{ti}-1	Operating ratio		$\frac{D_t\text{-}3}{D_t\text{-}4}$	D_t-3 should be operating revenue only, not including subsidies.
D_{ti}-2	Average weekday passengers per operating employee		$\frac{C_t\text{-}3_{Weekday}}{D_t\text{-}2_{Operators}}$	A measure of operating employees' productivity.
D_{ti}-3	Annual vehicle miles - per employee - per operating employee		$\frac{B_t\text{-}8}{D_t\text{-}2}$	A measure of the agency's labor productivity.
D_{ti}-4	Annual capacity miles - per employee - per operating employee		$\frac{B_{ti}\text{-}6}{D_t\text{-}2}$	A measure of the agency's labor productivity.
D_{ti}-5	Revenues/cost per vehicle-mile			
	- Annual total revenue		$\frac{D_t\text{-}3_{Total}}{B_t\text{-}8}$	
	- Annual total cost		$\frac{D_t\text{-}4_{Total}}{B_t\text{-}8}$	
	- Passenger revenue		$\frac{D_t\text{-}3_{Passenger\ fares}}{B_t\text{-}8}$	
	- Operating cost		$\frac{D_t\text{-}4_{Operating}}{B_t\text{-}8}$	

D_{ti} - Transit Organizational and Financial Indicators

Code	Item	CBD / Central city / Urban area	Derivation formula	Comments
$_{ti}$-6	Revenues/costs per capacity-mile			
	- Annual total revenue		$\frac{D_t\text{-}3_{Total}}{(B_t\text{-}8)(B_t\text{-}6)}$	
	- Annual total cost		$\frac{D_t\text{-}4_{Total}}{(B_t\text{-}8)(B_t\text{-}6)}$	
	- Passenger revenue		$\frac{D_t\text{-}3_{Passenger\ fares}}{(B_t\text{-}8)(B_t\text{-}6)}$	
	- Operating cost		$\frac{D_t\text{-}4_{Operating}}{(B_t\text{-}8)(B_t\text{-}6)}$	
$_{ti}$-7	*Revenues/costs per vehicle-hour*			
	- Annual total revenue		$\frac{D_t\text{-}3_{Total}}{B_t\text{-}9}$	
	- Annual total cost		$\frac{D_t\text{-}4_{Total}}{B_t\text{-}9}$	
	- Passenger revenue		$\frac{D_t\text{-}3_{Passenger\ fares}}{B_t\text{-}9}$	
	- Operating cost		$\frac{D_t\text{-}4_{Operating}}{B_t\text{-}9}$	

D_{ti}- Transit Organizational and Financial Indicators

Code	Item	CBD / Central city / Urban area	Derivation formula	Comments
D_{ti}-8	Revenues/cost per vehicle			
	- Annual total revenue		$\frac{D_{t-3\text{total}}}{B_{t-6}}$	
	- Annual total cost		$\frac{D_{t-4\text{total}}}{B_{t-6}}$	
	- Passenger revenue		$\frac{D_{t-3\text{passenger fares}}}{B_{t-6}}$	
	- Operating cost		$\frac{D_{t-4\text{operating}}}{B_{t-6}}$	
D_{ti}-9	Revenues/costs per passenger			
	- Annual total revenue		$\frac{D_{t-3\text{total}}}{C_{t-2}}$	
	- Annual total cost		$\frac{D_{t-4\text{total}}}{C_{t-2}}$	
	- Passenger revenue		$\frac{D_{t-3\text{passenger fares}}}{C_{t-2}}$	
	- Operating cost		$\frac{D_{t-4\text{operating}}}{C_{t-2}}$	
D_{ti}-10	Revenues/costs per passenger-mile		D_{ti}-9/C_{ti}-1	Choose the appropriate D_{ti}-9 for the appropriate calculation.
	- Annual total revenue			
	- Annual total cost			
	- Passenger revenue			
	- Operating cost			

D_h - Highway Organizations and Finances

Priority I

1 Code	2 Item	3 CBD	4 Central city	5 Urbanized area	6 Transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
D_h-1	Capital improvement projects annual cost - by functional class - by design type		✓	✓		SDOT		1977	2(A)	1	1	Classify costs by source of finances: federal, state or local.
D_h-2	Capital improvement projects - length of facilities		✓	✓		SDOT		1977	2(A)	1	1	
D_h-3	Annual costs - district SDOT dept. - Maintenance, admin., other misc. costs. - Bond interest		--			SDOT		1977	2(A)	1	2	
D_h-4	Estimated total expenditures of local governments for street and highway operations and maintenance		--			LGSD		1977	2(A)	1	2	

D_h - Highway Organizations and Finances

Priority II

1 Code	2 Item	3 CBD	4 Central city	5 Urbanized area	6 Transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
D_h-21	Estimated revenues earmarked for highway funding collected in the urban areas - gasoline taxes - vehicle licensing and registration fees - excise taxes - other					SDOT		1977	2(A)	5	4	

D_{hi}- Highway Organizational and Financial Indicators

Code	Item	CBD	Central city	Urban area	Derivation formula	Comments
D_{hi}-1	Capital projects - annual cost per lane mile		✓	✓	$\frac{D_h\text{-}1}{D_h\text{-}2}$	Divide for federal, state, and local shares. A measure of the costliness of highway capital improvement projects.
D_{hi}-2	Highway maintenance - annual cost per lane mile		--		$\frac{D_h\text{-}3}{B_h\text{-}2}$; $\frac{D_h\text{-}4}{B_h\text{-}2}$	Indicates the amount of money spent on maintaining one lane mile of street or highway.
D_{hi}-3	Annual public expenditure for operations and maintenance of highways per - annual VMT - annual person-mile - capita (urban area)				$\frac{(D_h\text{-}3) + (D_h\text{-}4)}{C_h\text{-}2,\ C_{hi}\text{-}3,\ A_2}$	Definition of public expenditures to be checked. Measures the payment the urban area has made for a unit of highway service it has demanded (VMT, person miles traveled). Reports the financial contribution of each resident for the highway service.

E.- Transportation Impacts

1 Code	2 Item	3 CBD	4 Central city	5 Urbanized area	6 Transit service area	7 Data collector	8 Data supplier	9 First report	10 Report interval	11 Availability	12 Reliability	13 Comment
E-1	*Annual energy consumption* - by transit buses* - by other highway vehicles - other transit			✓				1977	2	4	3	
E-2	Annual air pollutants produced - by transit buses* - by other highway vehicles - other transit**		✓	✓				1977	2	4	3	

* buses having internal combustion engines
**other transit vehicles (not buses) having internal combustion engines

E_i- Transportation Impact Indicators

Code	Item	CBD	Central city	Urban area	Derivation formula	Comments
E_i-1	Energy consumed per - VMT - person-mile traveled classified by mode			✓		Characterizes travel in regards to its unit energy requirements
E_i-2	Air pollution per - VMT - person-mile traveled classified by mode		✓	✓		Quantifies the effect that a unit of highway travel has on air pollution

DEFINITIONS, USES AND INSTRUCTIONS FOR THE DATA TABLE ITEMS

A. General Information

A-1 Land Area

Def: Size of the respective area in square miles.
Use: Shows spatial size. Required for computation of density indicators.
Inst: The data and respective maps should be supplied.

A-2 Population

Def: Number of residents in the respective area.
Use: Self-evident; also used to determine population densities.
Inst: The latest available count or estimate should be given.

A-3 Employment

Def: Number of persons employed in the respective area.
Use: Required to determine the number of people who must travel to work and their spatial concentration.
Inst: Supply the latest available data.

A-4 Vehicle registrations by class

Def: Vehicle registrations broken down into:
total, passenger cars, pick-up trucks and vans, other.
Use: Self-evident.
Inst: Obtain data from the state DOT.

A-21 Urban form and changes

Def: Pattern of land use in the respective areas.
Use: Determines present utilization of land, current and likely future changes in land use.
Inst: Brief descriptive statement required. If available, land use maps should be supplied.

A-22 Economic activity

Def: Types of major economic activities in the respective areas (banking, government, trade, manufacturing, etc.)
Use: Characterizes the employment sector of the area, thereby providing further identification of the community served by the urban transportation system.
Inst: Brief descriptive statement; include available data.

A-23 Topography and climate

Def: Terrain type, rivers, lakes and other components of the area's topography. Average rainfall and snowfall, average temperature, seasonal variations and other related features give an indication of the climate.
Use: Determine any special characteristics of the area that would have a special bearing on the urban transportation services.
Inst: Brief descriptive statement required. Maps should be provided if available.

A-24 Households

Def: Number of households in respective area.
Use: To further characterize population and residential patterns in respective area.
Inst: Supply the data.

A-25 Population by age, income, race, handicap

Def: Number of persons in respective area in the following groups:
Age: - elderly - 65 years and older
- young - under 18 years
Handicapped
Race: - White
- Black
- Other
Income: - below poverty level
- $10,000 to $14,999
- $15,000 to $24,999
- $25,000 to $49,999
- $50,000 and above
Use: To characterize the respective areas in terms of population groups.
Particularly significant are the groups which are captive transit users or requiring special services.
Inst: Supply the data.

A-26 Auto ownership and distribution by household

Def: Number of families in the respective areas which have 0, 1, 2, or 3 or more cars.
Use: To indicate auto availability.
Inst: Supply the data.

A-27 Office floor area

Def: Square footage of office space in the CBD.
Use: As a parameter for estimating work trips if correlation index is available.
Inst: Supply the data.

A-28 Retail floor area

Def: Square footage of retail space in the CBD.
Use: As a parameter for estimating shopping trips if correlation index is available.
Inst: Supply the data.

A-29 Crimes

Def: Number of crimes committed annually in the respective areas.
Use: Shows a condition in the city which strongly affects behavior of people and use of transit.
Inst: Data are not collected in the same way in all cities. Not recommended for use.

B. Urban Transportation Supply

B_t. Transit Facilities and Service

Routes and lines:

Transit route is a fixed path served by transit vehicles with a predetermined schedule. Lines are all streets or other rights-of-way on which transit operates. Individual lines may carry more than one route. Consequently, length of lines in a transit network can be equal to or smaller than total length of routes.

B_t-1 Number of routes - by mode

Def: See above.
Use: A measure of system size.
Inst: The number of different routes is to be reported classified by mode. The modes should be further subdivided into commuter and regular service. Commuter service refers to routes on which transit service is provided only during peak hours. Regular service refers to routes on which transit service is also during non-peak hours.

B_t-2 Length of routes - by mode

Def: The length of an individual route is the one-way distance between terminal points or once around a loop.
Use: Shows the extensiveness of the system.
Inst: The total length of routes for each mode should be reported.

B_t-3 Length of lines

Def: The sum of the actual physical length (one-way) of all streets, highways, and/or rights-of-way on which transit service is provided.
Use: In combination with the total length of routes gives a measure of the extent of duplication of service within the system, allowing greater numbers of no-transfer trips.
Inst: Provide the total length of lines by mode and by type of service in miles.

B_t-4 Area coverage - by mode

Def: The total area within 1/4 mile of a bus stop, 1/3 mile of a light rail or rapid rail station or 1/2 mile of a regional rail station, excluding overlaps.
Use: The area coverage divided by the total urbanized area yield percentage of area coverage (see Indicator B_{ti}-1).

Inst: First plot the area served by each station for each mode. Then compute the total coverage by each mode separately counting areas served by more than one station only once. Second, plot coverages by all modes on a single map and compute the total area served by all modes not counting any overlaps. For example, areas around rapid transit stations with bus feeders will count for each mode separately, but in the total area coverage they will count only once.

Bt-5 Population within area covered - by mode and total

Def: Population in the areas covered as defined in Bt-4.
Use: Determines the percentage of the total population served.
Inst: Use the maps with coverages (by modes and total) developed for Bt-4 and estimate population in each area covered by utilizing census data and other available sources.

Bt-6 Number, average age, and average capacity of vehicles owned - by mode

Def: Self-explanatory
Use: Shows fleet size, probable condition, and total fleet capacity.
Inst: Provide the number of vehicles by mode. Compute the average vehicle age and capacity by mode. Capacity refers to the number of seats; if standing in the vehicles is frequent, supply seating and total capacity, explaining each figure.

Bt-7 Maximum number of vehicles in peak service - by mode

Def: Maximum number of vehicles in service at one time.
Use: Provides a measure of the maximum capacity offered by the system. Also, along with data item Bt-22, provides a measure of vehicle utilization through the peak to base ratio.
Inst: Provide the data.

Bt-8 Annual vehicle miles of revenue service - by mode

Def: Sum of the miles of revenue service for all vehicles of each mode during the year.
Use: Provides a data base for operational costs as well as quantity of offered service.
Inst: Compute the total number of scheduled vehicle round trips from schedules for different days of the week and multiply by round trip length.

B_t-9 Annual vehicle hours of revenue service - by mode

Def: Sum of the hours of revenue service for all vehicles during the year.
Use: Provides a data base for operating costs as well as for computation of vehicle utilization.
Inst: Compute vehicle revenue hours from schedules for different days and multiply by the number of days per year. For operation of trains, compute vehicle-hours rather than train-hours.

B_t-10 Total capacity of park-and-ride lots at rail stations

Def: Number of parking spaces in facilities designated for transit users.
Use: Shows a contribution of transit system to reduction of auto driving in central city.
Inst: Supply the total number of legal parking spaces at all transit stations in the urban area.

B_t-11 Commercial speed - by mode

Def: Average speed of a transit vehicle travelling a round trip including layover time.
Use: Characterizes transit operations and allows conversion of vehicle miles to vehicle hours. Certain transit characteristics are more closely related to vehicle hours than miles, e.g. labor costs.
Inst: For the entire system divide the total vehicle miles of revenue service by the total vehicle hours of revenue service. Supply the data.

B_t-12 Average distance between stops and stations - by mode

Def: Self-explanatory.
Use: Gives indication of area coverage and operating speed.
Inst: Divide length of each route by the number of its stops minus one. Then compute the weighted average for all routes.

B_t-13 Operating speed - by mode

Def: Average speed of a transit vehicle while on its route.
Use: Characterizes transit operations and shows their ability to compete with other modes. It is an important feature of any service offered.
Inst: For the entire system divide the total vehicle miles of revenue service by the total vehicle hours of revenue service exclusive of all layover times.

B_t-21 Number of vehicles in base service

Def: Number of vehicles in service during the midday.
Use: In conjunction with the peak number of vehicles in service provides a measure of the peaking of demand for the equipment.
Inst: Supply the data.

B_h - Highway and Parking Facilities

Functional class and design type:

These terms define groups into which all highways in the urban area are classified. The functional class refers to service provided by the highway (arterial, collector, etc.); the design type refers to operational characteristics of the highway (freeways - including Interstate Highways; other highways (including expressways) with 4 or more lanes; and other highways with less than 4 lanes).(2) For complete definitions and procedures, see the following references:

- 1968 National Highway Functional Classification Manual
- Manual B - National Highway Functional Classification and Needs Study Manual (February 1970)

B_h-1 Route miles - by functional class - by design type

Def: Center line mileage of highways.
Use: Indicates extensiveness of highways in the urban area and in the central city.
Inst: Report the data by functional class and design type for both the central city and urbanized area.

B_h-2 Lane miles - by functional class - by design type- by jurisdiction

Def: The sum, for all sections, of the route miles of a section times the number of lanes for both directions in the section.
Use: Measures the size of the highway system.
Inst: Report the data by functional class and design type for both the central city and urbanized area.

B_h-3 Off-street parking spaces - by ownership

Def: Number of off-street parking spaces in CBD parking facilities grouped by type of ownership and user group.

Facility types

publicly owned - opened to the general public
privately owned - opened to the general public
privately owned - restricted to specific users.

Use: Gives the off-street parking capacity in the CBD.
Inst: Supply the data.

B_h-4 On-street parking spaces

Def: Number of legal on-street parking spaces in the CBD.
Use: Gives the on-street parking capacity in the CBD.
Inst: Supply the data.

B_h-11 Facility name

Def: Self-evident

B_h-12 Location

Def: The site of the facility in the urban area.
Use: Aids in the evaluation of the facility's role in the urban transportation system and impact on its utilization.
Inst: Supply a map showing the location of all toll facilities.

B_h-13 Number of lanes

Def: Total number of lanes and maximum number of lanes per direction if more than half.
Use: Gives an indication of the size and capacity of the facility.
Inst: Supply the data.

B_h-14 Toll rates

Def: Rates charged for use of the facility.
Use: Indicates user's cost. Amount at which these tolls are set influences a person's choice of mode of travel.
Inst: Supply the data.

B_h-21 Capacity miles - by functional class - by design type

Def: Maximum volume in car-miles which highway can serve guaranteeing specified level of service (3)
Use: Suggests a service volume potential of the highway system.
Inst: Report the data by functional class and design type for the urban area and central city. Capacity miles are the product of miles and one-way hourly capacity. To calculate capacity see 1965 Highway Capacity Manual.

B_h-22 Number of signalized intersections

Def: Number of intersections in central city controlled by traffic signals.
Use: Characterizes traffic control operations. Comparing the magnitudes of this data item for different cities improves its informativeness.
Inst: Supply the data.

B_h-23 Land area occupied by parking facilities

Def: Number of square miles of CBD area occupied by parking facilities.
Use: To compute percentage of CBD land area utilized by parking facilities (see B_{hi}-4).
Inst: Supply the data.

B_h-24 Parking rates

Def: Rates charged to users of parking facilities for following time periods: 1st hour, additional hours, daily and monthly.
Use: Gives a user's cost. Amount at which these rates are set influence a person's choice of mode of travel.
Inst: Supply the data for the given time periods.

B_h-25 Parking capacity at long distance transportation terminals

Def: Number of parking spaces at long distance transportation terminals.
Use: Helps to evaluate the effectiveness of these terminals as major transfer points.
Inst: Supply data for each of the major terminals in the urban area.

Definition sources:

2. U.S. Department of Transportation, 1974 National Transportation Study - Manual II: Procedures and Data Forms Volume I - Procedures, Washington, D.C., 1974.

3. Ibid.

C. Urban Transportation Usage

C_t - Transit Usage

C_t-1 Average daily total passengers - by mode

Def: The average number of passengers carried daily by each mode on weekdays, Saturdays, and on Sundays during the reporting year.

Use: Shows normal daily system demand. Needed to compute daily passenger-miles.

Inst: Supply the data on a per mode basis for weekdays, Saturdays, and Sunday/holidays. Average ridership for the latter part of the year should be used if there has been a marked change in patronage.

C_t-2 Annual revenue passengers - by mode

Def: Total number of fare-paying passengers per year.

Use: Measures total revenue load placed on the system.

Inst: The most common procedure for computation is based on fare box revenue and composition of passengers (break down on groups paying different types of fares), obtained through sample counts of passengers by fare category on typical days. If the total fare box revenue is R, different types of fares f_i, and the survey showed that the percentage of passengers paying fare f_i is p_i, then the total number of revenue passengers, P, on the system is:

$$P = \frac{R}{\sum_i f_i p_i}$$

C_t-3 Annual total passengers - by mode

Def: Total number of person-trips made on the transit system in one year.

Use: Indicates yearly demand for the system's services.

Inst: Compute the annual total passengers from daily total passengers.

C_t-4 Average trip length - by mode

Def: The average distance traveled by passengers on the system expressed in miles to one decimal place, i.e., 3.1, for each mode in the transit system.

Use: Required to determine daily and annual person-miles for each mode. Shows a characteristic of transit travel. It should be correlated with urban form.

Inst: A survey is usually necessary to determine this item. The surveyor registers the number of passengers, boarding and alighting at each stop or station. The product of the number of passengers on the vehicle between two consecutive stops or sections of route and the length of that section represents the number of passenger miles for that route segment. The

average passenger trip length or the vehicle being surveyed can then be determined by adding the passenger miles along the entire line and dividing by the total number of passengers who boarded the vehicle.

Ct-5 Peak hour passenger boardings - by mode

Def: Total number of passengers boarding vehicles during the peak hour on a typical weekday.
Use: Determines the maximum number of passengers using the system per one hour.
Inst: Make a survey during the peak hour to determine total number of passengers boarding.

Ct-21 Average number of routes used per passenger trip

Def: Self evident.
Use: Monitors the number of transfers required for passengers to complete trips. It also measures the extent to which the transit lines match the origin-destination patterns of the passengers.
Inst: Supply the data based on a survey.

C_h - Highway Usage

C_h-1 Daily vehicle miles

Def: Daily volume of travel on the highway system.
Use: Indicates travel demand. It is needed to compute a volume-to-capacity ration (see C_{hi}-1) and to characterize travel in the area. (see C_{hi}-2 - C_{hi}-9).
Inst: Report the data by functional class, design type, vehicle type and day of week for the central city and urbanized area. Data should be obtained from volume counts on highway sections or from traffic assignments made to future systems.

C_h-2 Annual vehicle miles

Def: Annual volume of travel on the highway system.
Use: Indicates travel demand. It is used to compute indicators that characterize travel in the area.
Inst: Report the data by functional class, design type and vehicle type for the central city and urbanized area. Annual values are computed by multiplication of average daily values by the numbers of respective days of week in a year.

C_h-3 Average vehicle occupancy

Def: The average number of persons traveling per vehicle.
Use: Characterizes travel and is used to compute indicators of person-miles and person-trips.
Inst: Report the data by vehicle type for the central city and urbanized area. The data should be obtained through surveys.

C_h-4 Average travel speeds

Def: Average speed on the highways for the peak and off-peak periods.
Use: Indicates the ability of the highway to serve the travel demand. Average travel speeds that are much lower than design speeds (or speed limits) are usually an indication of insufficient highway capacity.
Inst: Report the data by functional class and design type for the central city and urbanized area.

C_h-5 Number of highway accidents annually

Def: Number of accidents involving vehicles on the highway system in the urbanized area.
Use: To compute indicators that will show the level of safety on the highways.
Inst: Supply the data from the police records of state DOT.

C_h-6 Number of highway injuries annually

Def: Number of injuries to both passengers and pedestrians resulting from accidents involving highway vehicles.
Use: See C_h-5 - Use.
Inst: Supply the data. All highway injuries for the year are included in the count. There is no minimum level of severity that an injury must reach to be counted.

C_h-7 Number of highway fatalities annually

Def: Number of fatalities resulting from all vehicular accidents.
Use: See C_h-5 - Use.
Inst: Supply the data.

C_h-21 Daily vehicle trips

Def: Number of vehicle trips made daily on the highway system. Include all internal, through, and internal-external trips made by either residents or non-residents.
Use: Indicates travel demand and characterizes travel in the central city and urbanized area.
Inst: Report the data by functional class, design type and trip purpose for the central city and urbanized area. The data must be obtained through interview surveys.

C_h-22 Annual vehicle trips

Def: Number of vehicle trips made annually on the highway system. Include all trips (see C_h-21 - Def.).
Use: Characterizes travel in the central city and urbanized area.
Inst: Report the data by functional class, design type and trip purpose for the central city and urbanized area. Compute these data from C_h-21 in the manner explained for C_h-2.

C_h-23 Average trip length

Def: Average length in miles of trips grouped by trip purpose.
Use: Characterizes travel in the urban area.
Inst: Data must be obtained through interview surveys.

C_h-24 Travel time contours from CBD

Def: Outlines of areas that are defined by their travel times from the CBD for peak and off-peak periods.
Use: Measures efficiency of service provided by the highway system in the radial direction from CBD.
Inst: A map should be used to show travel time contours for the two time periods. Travel times are computed using the reported average speeds for respective time periods.

D. Organizational and Financial Data

D_t - Transit Organization and Finance

D_t-1 Type of agency

Def: Transit agency type can be either private or public. Public agencies can be municipal, district, authority or other type.
Use: Indicates the legal set-up of the transit agency.
Inst: Specify whether private or public, and if public, what type.

D_t-2 Number of employees (total and by categories)

Def: Total persons employed by the transit agency.
Use: Required to derive productivity measures.
Inst: Provide total number of agency personnel and its classification by the specified categories.

D_t-3 Annual revenue (total and by categories)

Def: Self-evident.
Use: Required to derive financial indicators and productivity measures.
Inst: Provide total annual revenue and its breakdown by specified categories.

D_t-4 Annual costs (total and by categories)

Def: Self-evident.
Use: Required to derive financial indicators and productivity measures.
Inst: Provide total annual cost and its breakdown by specified categories.

D_t-5 Base Fare

Def: Base fare charged for travel on the transit system.
Use: To identify the unit revenue source and to show the cost incurred by riders.
Inst: Report the cost amount.

D_t-6 Operator's wage rate

Def: The base hourly rate paid to transit operators.
Use: Identifies the unit cost which is basic to the operation of transit systems. Can help to evaluate reasons behind a system's costs and why it differs from costs of other systems.
Inst: Report the cost figure.

D_h - Highway Organizations and Finances

D_h-1 Capital improvement projects - annual cost

Def: Those costs incurred in projects for capital improvements on the urbanized area's highway system.

Use: Represents the cost of constructing a highway system that satisfies the needs of urban residents.

Inst: Costs for construction and all associated project activities should be included.

Report these costs upon completion of the entire project (facility put into service) regardless of when the cost was incurred. Projects that are constructed in stages should have the cost of each stage reported at the time of its opening to service.

D_h-2 Capital improvement projects - length of facilities

Def: Number of lane miles completed and in service as a result of capital improvement projects.

Use: Measures the size of the highway facility that was completed at the cost reported in D_h-1.

Inst: Report the number of lane miles in that period when they are opened to service.

D_h-3 Annual costs - SDOT local office (district, division or other)

Def: All those costs except capital costs which are incurred by the SDOT local office maintaining the state highways in the urbanized area.

Use: Represents the annual cost of performing maintenance and the associated activities on state highways in the urbanized area.

Inst: Divide annual costs into those for bond interest and those for all other department activities (administrative, maintenance operations, and miscellaneous non-capital costs).

D_h-4 Estimated total expenditures of local governments for street and highway operations and maintenance

Def: All those costs except capital costs which are incurred by the local government department responsible for maintaining local streets and highways in the area of its jurisdiction.

Use: Represents the annual cost of performing maintenance and the associated activities on local streets and highways under the jurisdiction of the respective local governments.

Inst: Supply the total sum for each local government.

D_h-21 Estimated revenues earmarked for highway funding collected in the urban area

Def: The amount of revenue paid annually to the state by urban area residents as gasoline taxes, excise taxes on vehicles and parts, vehicle licensing and registration fees, and other charges.

Use: Represents the urban area residents' payment for highway services and can be compared with the funds received by the urban area for highway construction and maintenance.

Inst: Report the total revenue in each of the specified sources and as the sum total of all sources.

E. Transportation Impacts

E-1 Annual energy consumption

Def: Amount of energy consumed annually by vehicles: gallons of fuel for internal combustion engine vehicles, Kwh. for electric transit vehicles.
Use: Self-explanatory.
Inst: Multiply respective vehicles miles of travel by unit energy consumption by each vehicle type.

E-2 Annual air pollution produced

Def: Volume of pollutants emitted by internal combustion engine vehicles.
Use: Measures the effect that transportation has on the air quality of the area.
Inst: Emissions should be calculated based upon the best data available and existing local factors. For one procedure see the following:

1974 National Transportation Study-Manual II Procedures and Data Forms. Volume 1 - Procedures, Item III.1.3, pg. III-9.

Section 4

TRANSIT SERVICE EVALUATION

Evaluation of transit service must include various measures of efficiency and productivity relating to the provision of service and to its use; it must also include the absolute measures of system operation and work, as well as indicators of service quantity and quality.

The great number and variety of indicators and absolute measures make the evaluation a very complex and often confusing task. To facilitate the evaluation, the following systematic classification of categories is proposed.

Evaluation categories

The different aspects of transit service can be viewed as seven basic categories:

A. Conditions under which transit service is operated: Potential for transit service.

B. Quantity and quality, or supply of service: Offered service.

C. Use of transit, or the purchase of offered service: Work performed.

D. Relationship of purchased and offered service (C and B): Service utilization.

E. Use of resources (money, labor, fleet) for provision of service: their amount and efficiency of use: Efficiencies of service and work.

F. Compensation obtained for services: Revenues.

G. Ratio of costs and compensation for the services (E and F): Financial efficiency.

These categories do not encompass all possible items for evaluation

which are derived and presented in Section 3 because of the following reasons:

1. The evaluation discussed here focuses on total transit service. Such indicators as operating employees/total employees, vehicle-miles/route-miles or many others are useful for evaluation of individual aspects of system management or operating characteristics of the system, but they are too detailed for this purpose;

2. To achieve practical use of this evaluation it is important that it is simple. This classification was made bearing in mind the needs of UMTA to have the ability to quickly assess many different cities and to eventually develop some guidelines for the evaluation of transit service.

3. The items used do not include trends (e. g. in ridership) because their inclusion in an overall evaluation would be incomplete without consideration of such factors as social changes, strikes, or special events.

4. Items relating to deficits and subsidy are not included because the purpose of this evaluation is to provide a basis for decisions on subsidy. Comparisons of subsidies are not items of system evaluation; they are post-facto considerations, following the distribution of funds.

It is specifically pointed out that such indicators as subsidy per capita are incorrect ones to use in any fund allocation. Allocation of funds should not be the same or similar among cities with different transit use. To illustrate this, another example is helpful. If the federal government wants to assist wheat growing, it will distribute the assistance funds on the basis of amount of its production, land used, or some similar item. A comparison of the amount of that assistance per capita in Vermont vs. Kansas would be meaningless. The fact that Kansas would get many times higher assistance per capita would be expected and logical. Consequently, equity of transit assistance distribution should be measured on the basis

of the number of transit passengers, passenger miles, or service offered, its utilization and efficiency, but not on a per capita basis.

A brief definition of each category, its meaning and the selected major data and indicators which characterize it are given here.

For an easy overview the categories, efficiency subcategories and indicators of each one are presented in a tabular form on the following page.

Definition and Selected Indicators for the Evaluation Categories

A. Potential for transit service encompasses the characteristics of the served area which influence transit operations and usage. These include city size, population, competing modes, etc., i. e. items not controlled by the transit operator.

Common indicators

Primary: Transit service area population
Population density

Secondary: CBD employment/Urban area employment
Lane miles/square mile for streets and freeways
Auto ownership
Parking availability and pricing

Notes on indicators

Although the secondary indicators would be very helpful, they are not at present easy to obtain. Parking in the CBD should be included whenever possible.

B. Offered service represents the supply of transit service, the product (service) offered to the public. Its characteristics are quantitative and qualitative, but the former are the only ones which can be precisely defined.

Common indicators

Primary: Operating speed
Capacity-miles/year
Capacity-miles/year/capita

Secondary: Vehicle-miles/year
Seat-miles/year
Seat-miles/year/capita

Table 1. Transit service efficiency subcategories and primary indicators

A. Potential for transit service		transit service area population population density
B. Offered service		operating speed capacity-miles/year capacity-miles/year/capita
C. Work performed		passenger-trips/year passenger-miles/year passenger trips/year/capita passenger miles/year/capita
D. Service utilization		passenger-miles/capacity mile
E. Efficiencies of service and work	E_1: Network efficiency	per cent of population covered
	E_2: Fleet productivity	vehicle-miles/year/vehicle
	E_3: Fleet utilization	maximum scheduled vehicle/total owned vehicles commercial speed/operating speed
	E_4: Labor productivity	capacity-miles/year/employee capacity-miles/year/operating employee
	E_5: Operating cost productivity	capacity-miles/dollar vehicle hours/dollar passenger miles/dollar passenger-trips/dollar
F. Revenue productivity	-	revenue dollars/capacity-mile revenue dollars/passenger-mile revenue dollars/passenger-trip
G. Financial efficiency	-	operating ratio (total cost/ total revenue)

Notes on indicators

Operating speed is very important for attracting ridership to the system. It reflects both operating practices and cooperation by the city (TSM).

The real product of the transit system is usable passenger space miles; referred to as capacity miles (seats plus standing spaces). Hence the choice of capacity-miles and not vehicle-miles (which give no indication of spaces per vehicle) or seat miles (which penalizes systems with heavy volumes, short trips, and few seats). It is important to consider both aggregate output as well as normalized output, hence both total capacity miles/year and capacity-miles/year/capita are included.

C. Work performed: passengers served and passenger-miles carried represent the purchased product or satisfied demand.

Common indicators

Primary: passenger-trips/year
passenger-miles/year
passenger-trips/year/capita
passenger-miles/year/capita

Secondary: none noted

Notes on indicators

It is important not only to monitor the number (passenger-trips) but also the distance (passenger-miles) in this category. The number of trips gives a measure of the degree to which the system is patronized, but without the distance traveled one has no idea of how much of the service provided is being utilized. If the system is vast, the passengers many, but the passenger-miles few, there will be a great deal of offered service which goes unused. As will be seen later, knowledge

of passenger-miles can be compared with capacity-miles offered to get the true measure of system utilization.

D. Service utilization is the ratio of performed work and offered service, or demand/supply. It reflects the efficiency of scheduling with respect to demand.

Common Indicators

Primary: passenger-miles/capacity-mile

Secondary: average passengers/vehicle/year
passenger-miles/seat-mile
passenger-trips/vehicle-mile

Notes on indicators

Here, as in the case of offered service, it is important to use the best measures of work performed and service offered and avoid duplication. Hence the obvious choice of passenger-miles (not passengers) and the choice of capacity miles for the same reason as in service offered.

E_1. Network Efficiency

Definition/Description: Indicates how well the routes of the system are tailored to the geographic area, population served and transit needs of the people.

Common indicators

Primary: % population covered

Secondary: line miles/square mile
route-miles/line-mile
capacity-miles/route-mile
vehicle-miles/line mile
passenger-miles/line-mile
passenger-miles/route-mile

Notes on indicators (E_1)

Although all the secondary indicators are interesting, if the service being provided goes to and from the wrong places, this will be evidenced by poor utilization (see D). Hence the primary concern under network efficiency is the degree to which it is available to the populace.

E_2. Fleet Productivity

Definition/Description: Shows the total service provided per unit of the major capital investment made by the transit agency - the vehicles.

Product:	seat-miles vehicle-miles capacity-miles vehicle-hours capacity-hours	Resource:	vehicles time

Common indicators

Primary:	vehicle-miles/year/vehicle
Secondary:	seat-miles/year/vehicle capacity-miles/year/vehicle vehicle-hours/year/vehicle capacity-hours/year/vehicle vehicle-miles/vehicle-hour (commercial speed)

Notes on indicators (E_2)

The simple, understandable indicator of vehicle-miles/year/vehicle is the most practical one since it expresses productivity of the fleet very well.

E_3. Fleet Utilization

Definition/Description: Shows how efficiently the rolling stock is being scheduled and how effectively it is being maintained. It also gives an indication as to whether or not there is a need for additional equipment.

Output: maximum scheduled vehicles, commercial speed

Input: total vehicles owned
base vehicles in service
operating speed

Common indicators

Primary: maximum scheduled vehicles/total owned vehicles
commercial speed/operating speed

Secondary: maximum scheduled vehicles/base scheduled vehicles (peak to base)

Notes on indicators (E_3)

The peak-to-base ratio, although important, may be an element of transit service over which the agency has little control except through peak fares. Hence penalization for a high peak-to-base ratio might not be fair. However, the higher this ratio is, the stronger is the indication that the agency should have less need for operating subsidy since it is only operating during the time periods when high load factors are achieved.

E_4. Labor Productivity

Definition/Description: Shows the offered service output per unit labor both of the actual operating employees and of the entire employees.

Products: vehicle-miles
seat-miles
capacity-miles
vehicle-hours
passenger-trips
passenger-miles

Resources: employees
operating employees
employee-hours
operating-employee-hour

Common indicators

Primary: capacity miles/year/employee
capacity miles/year/operating employee

Selected Secondary: seat-miles/employee
vehicle-miles/operating employee
capacity-miles/employee-hour
daily passengers/employee
annual passengers/employee

Notes on indicators

Because of the great number of different products and resources it may incorporate, labor productivity can be expressed by many different indicators.

The primary ones are selected to be capacity miles per units of resources because they represent the direct product, service supplied. Utilized product, i. e. passenger-miles, are a function of many other factors. Yet, the last two secondary indicators are also used for certain comparisons.

E_5. Operating Cost Productivity

Definition/Description: Shows the volume output of both offered service and work performed per unit of operating cost. This is the inverse of what is commonly referred to as costs per unit of output. To avoid confusion, both sets of indicators will be listed here.

Output: vehicle-miles
seat-miles
capacity-miles
vehicle-hours
passenger-miles
passenger-trips

Input: operating expenditures
total expenditures

Common indicators

Primary:	capacity miles/$ (total)	total cost/capacity-mile
	vehicle-hours/$ (total)	total cost/vehicle-hour
	passenger-miles/$ (total)	total cost/passenger-mile
	passenger-trips/$ (total)	total cost/passenger-trip

Selected secondary: operating cost/vehicle-mile
total cost/vehicle-mile
operating cost/vehicle-hour
operating cost/seat-mile
total cost/seat-mile

Notes on indicators

The indicators chosen as primary most closely reflect the direct cost of providing the service and performing the work. All of the

secondary indicators are important, but they represent specific subdivisions of the financial picture. They are useful for a detailed analysis to determine where costs are too high or out of proportion, but are not needed to determine if costs, overall, are too high.

F. Revenue Productivity represents the payments received for performed services. It depends mostly on the number of passengers, but it is also affected by the fare level and structure.

Product:		Resource:	
	revenues (total)		capacity-miles
	revenues (fare box)		seat-miles
			vehicle-miles
			passenger-miles
			passenger-trips

Common indicators

Primary:	capacity-miles/$ (revenue)
	passenger-miles/$ (revenue)
	passenger-trips/$ (revenue) [1/average fare]
Selected secondary:	vehicle miles/$ (fare-box revenue)
	seat-miles/$ (revenue)
	vehicle miles/$ (revenue)

Notes on indicators

The indicators most representing the actual service and work have again been chosen.

G. Financial Efficiency represents the main financial indicator of transit service: the relationship of cost of providing service and revenues obtained for it.

Output:	Input:
labor cost	total cost
operating cost	total revenue
maintenance cost	
total cost	

Common indicators

Primary:	Operating ratio	(total cost/total revenue)
Secondary:	Operating efficiency	(total revenue/total cost)
	% subsidy	((TC-rev)/TC)
	% labor cost	(labor cost/TC)
	% operating cost	(OP cost/TC)
	% maintenance cost	(maintenance cost/TC)

Notes on indicators

The secondary indicators, although extremely interesting, only show where the problem is or how the money is allocated. The operating ratio, on the other hand, shows how well the agency is doing overall. There is a slight preference for operating efficiency instead of operating ratio since numbers like 392%, 151%, 217%, etc. are harder to grasp than 25.5%, 66.2%, 46.2% which represent the former operating ratios in terms of their operating efficiencies. It also correlates very well with the manner in which most subsidies are judged, i. e. on the basis of what percentage of the total cost is borne by revenues and by subsidies.

Section 5

FORMAT FOR THE URBAN TRANSPORTATION STATISTICAL ANNUAL REPORT

It is recommended that the statistical material in the annual report be divided into three categories: national, by city size group, and individual cities.

The national section will contain totals and averages of different items for the nation as a whole. These data will be presented in tables or as bar graphs, charts or time series plots.

In some cases the averages may be supplemented by the standard deviation, high, and low values in order to show variance of the data.

Since the national section does not adequately show the correlation between city size and individual statistical items, totals and averages by city size groups will be presented in the second section. These data will allow a considerably greater depth of analysis of different urban characteristics and transit services because of a greater homogeneity of cities in individual groups. The data will again be presented in tables or different types of graphical displays.

The third section will tabulate city by city all the numerical data deemed of potential interest to users. The suggested format for these data is as shown in Figure 1. The cities will be subdivided into groups of approximately 40 cities. Each group will have its own set of headings and pages containing the tabulated information. The city names and numbers will be placed on side tabs. Thus it will be possible to quickly and easily cross-compare each data item, or review different data for each individual city. At either the front or back of the tabulations a cross reference from

alphabetical order of the cities to numerical order should be given. The numerical order should be based on city size. Thus the first 40 cities tabulated would be the 40 largest cities in the country.

The data items and indicators suggested to be included in the annual report are listed in Table 1. The Table columns, as numbered, contain the following data:

1. Designation of each item chosen from Section 3 for inclusion in the annual report;

2. Since the data items proposed in Section 3 do not correspond to those in the report of the TRB Advisory Committee on Urban Transportation Data Reporting Needs and Requirements, the items suggested here for inclusion in the annual report which were also included by the TRB Committee are indicated by a check mark in this column (many of the Committee's items however were intentionally omitted in Section 3 of this report because they were considered unnecessary or impractical);

3. Item designation;

4-5. These two columns show which of the items selected for the city category should also be introduced for the national and city size group categories;

6. Format of the item's presentation for the categories in columns 4 and 5. The format number given is from Figure 3, explained below.

7. Comments, self-explanatory.

It is suggested that the annual report extensively utilize graphical presentations (bar charts, graphs, diagrams, etc.) for greater clarity. To facilitate preparation of such presentations, 14 of the most common graphical forms are presented in Figure 3.

Figure 4 gives several examples of the commonly used items presented by different types of graphs.

Table 1. Items chosen for conclusion in the annual report. All items listed were chosen to appear in the individual cities section.

1 Code	2 TRB	3 Item	4 National	5 Size groups	6 Format (see Figure 2)	7 Comment (letters refer to footnotes)
A-1	✓	Land area	-	-		transit service area only
A-2	✓	Population	✓	✓	2	transit service area
A-3	✓	Employment	-	-		CBD only
A-4	✓	Vehicle registration	-	-		passenger vehicles only
A-5		Persons daily incoming to CBD	-	-		
A-6		Number of transit agencies	-	-		
A-24	✓	Number of households..	-	-		
A-27		Office floor area	-	-		
A-28		Retail floor area	-	-		
A_i-1		Population density	-	-		
A_i-3		Auto ownership per capita	✓	✓	1	
B_t-1		Number of routes - by mode	-	-	1	
B_t-2		Length of routes - by mode	-	-	1	
B_t-3	✓	Length of lines - by mode	✓	✓	6,4	a, plot with B_h-1
B_t-6	✓	Statistics on vehicles	✓	✓	1	Number and average age
B_t-8	✓	Annual revenue vehicle miles - by mode	✓	✓		
B_t-10		Total capacity at P&R stations	-	-		
B_t-11	✓	Commercial speed - by mode	-	-		
B_t-12		Average distance between stops - by mode	—	✓	1	average for size group
B_t-21		Number of vehicles in base service	-	-		
B_{ti}-3	✓	Percent of population served	✓	✓	3p	Percent of transit service area population. Percent area can serve as temporary substitute.
B_{ti}-4		Peak vehicles/total vehicles	-	-		
B_{ti}-5		Peak to base ratio for vehicles	-	-		

Table 1 (continued)

1 Code	2 TRB	3 Item	4 National	5 Size group	6 Format (see Figure 2)	7 Comment (letters refer to footnotes)
B_{ti}-6		Annual capacity-miles	✓	✓	2	b
B_h-1	✓	Highway route-miles	✓	✓	4,6	b,plot with B_t-3
B_h-2	✓	Highway lane-miles	✓	✓	2	b
B_h-3		Off-street parking in CBD	-	✓	1	Subgroup data - average
B_{hi}-1	✓	Lane-mile density	-	-		
B_{hi}-4		Percent of CBD area used for parking	✓	✓	9	
C_t-2	✓	Annual revenue passengers-by mode	✓	✓	4,6	b
C_t-3		Annual total passengers-by mode	✓	✓	4,6	b
C_t-4		Average trip length-by mode	-	✓	1	c,d
C_{ti}-2	✓	Annual passenger miles - by mode	✓	✓	4,5	b , plot with C_{hi}-3
C_{ti}-3		Offered capacity utilization ratio - by mode				
C_{ti}-7	✓	Annual passenger miles/capita	-	-		
C_h-2	✓	Annual vehicle miles	✓	✓	2	b
C_h-7		Number of annual highway fatalities	✓	✓	2	b
C_{hi}-3	✓	Annual person-miles	✓	✓	4,5	b , plot with C_{ti}-2
C_{hi}-7	✓	Annual person-miles/capita	-	-		
D_t-2	✓	Number of employees, total only	✓	✓	2,10	b
D_t-3	✓	Annual revenue, total only	✓	✓	4,10	b , plot with D_t-4
D_t-4	✓	Annual cost, total only	✓	✓	4,10	b , plot with D_t-3
D_t-5		Base fare	-	-		
D_t-6		Operator's wage rate	✓	✓	3	e
D_{ti}-1		Operating ratio	-	-		the inverse, revenue/cost, is suggested
D_{ti}-4		Annual capacity-miles/employee	✓	✓	2	e, total employees only
D_{ti}-6	✓	Revenues and costs per capacity-mile	-	-		costs only
D_{ti}-7	✓	Revenues and costs per vehicle-hour	-	-		costs only

Table 1 (continued)

1 Code	2 TRB	3 Item	4 National	5 Size group	6 Format (See Figure 2)	7 Comment (letters refer to footnotes)
D_{ti}-10	✓	Revenues and costs per passenger-mile	✓	✓	4,6	e, plot with D_{hi}-3
D_h-1		Capital improvement projects - annual cost	✓	✓		
D_{hi}-2		Maintenance cost/lane-mile	✓	✓	1	
D_{hi}-3		Highway operation, public cost/ person-mile	✓	✓	4,6	Plot with D_{ti}-10
E_i-1	✓	Annual energy consumption/person-mile	✓	✓	4,6	c,f
E_i-2	✓	Annual pollutants/person-mile	✓	✓	4,6	c,f

Detailed comments on Table 1.

a. The data for both regular and commuter service should be given.
b. The national presentation for this item should show the national total and could include a comparison of the average for each city size group. The city size group presentation probably only needs to show the average value.
c. The national and city-size group presentations need only give the averages (national or city size group respectively).
d. May at first be difficult to get, but the data are important.
e. The national and city-size group presentations should only show the averages. It is, however, suggested that the national presentation also show how the average value changes with the city-size group.
f. Categorized by transit bus, other transit modes, and others. The total amount should be eliminated from the presentations since it is meaningless.

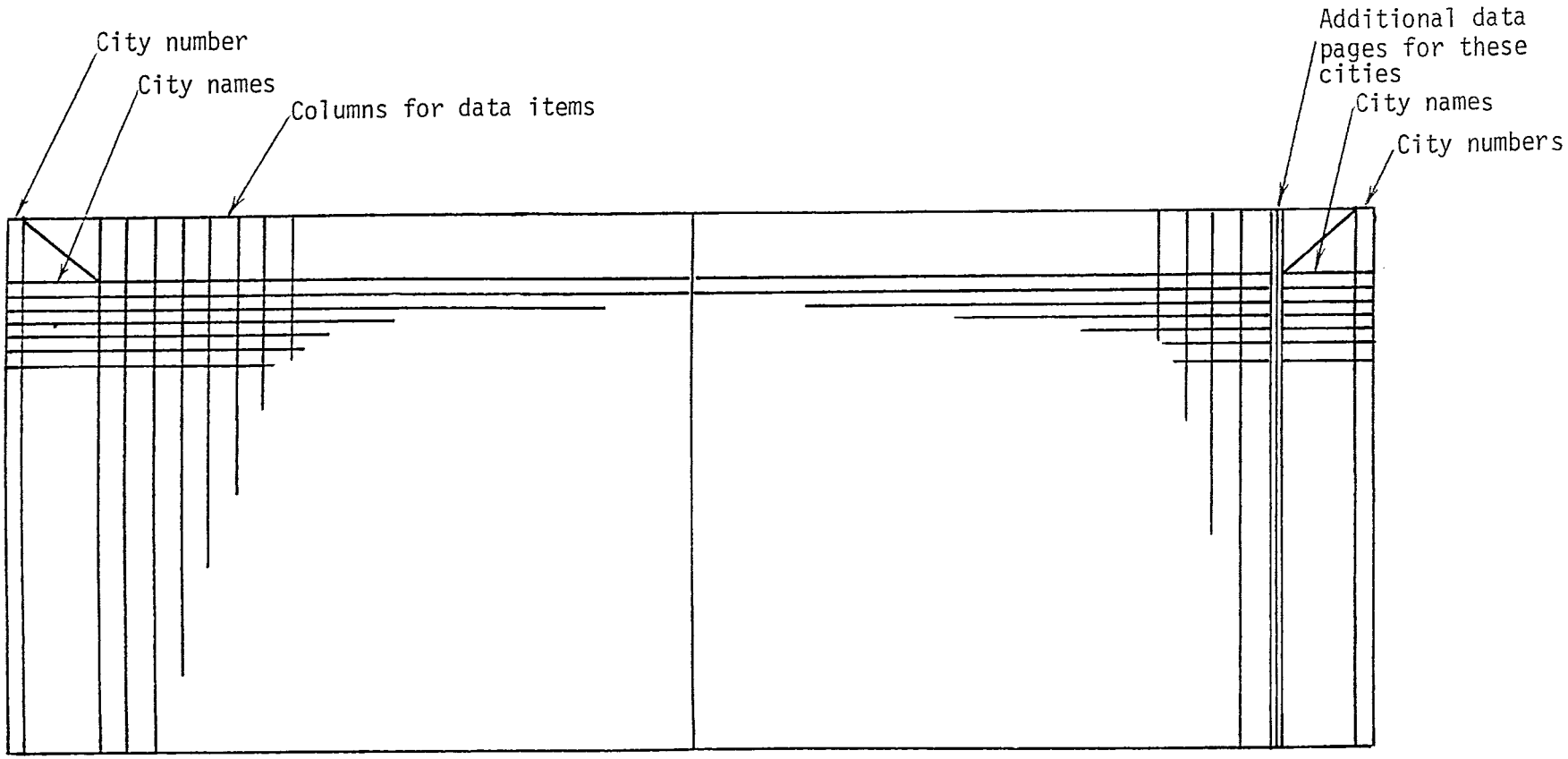
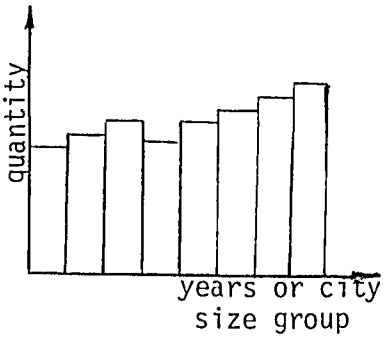


Figure 1: Page format for the numerical presentation of the data in the individual cities section of the annual report. Allowing the pages to open lengthwise minimizes the number of pages required to present the data.

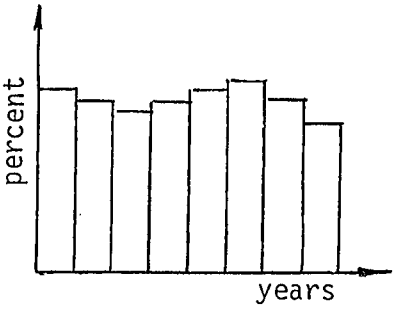
Figure 2: Formats for presentation of the national and city group data

1. Tabulation of the numerical data only

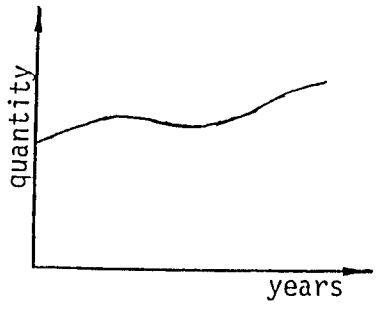
2.



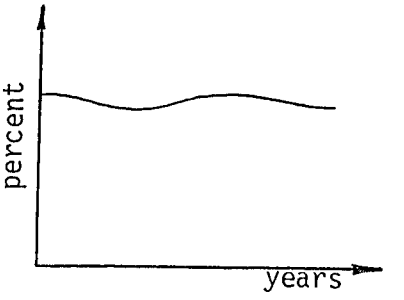
2p.



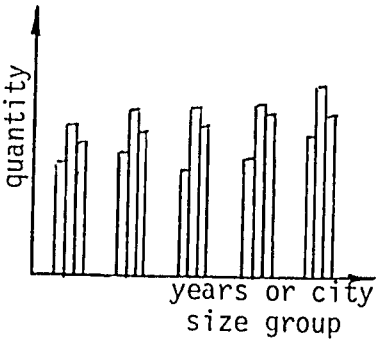
3.



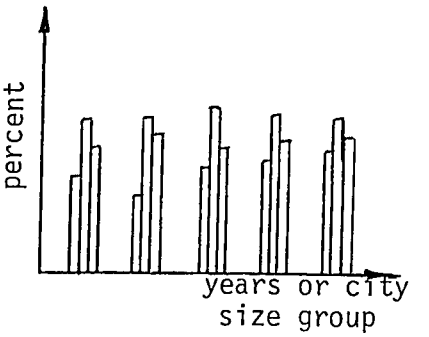
3p.



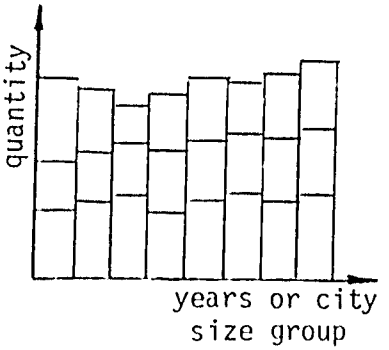
4.



4p.



5.



5p.

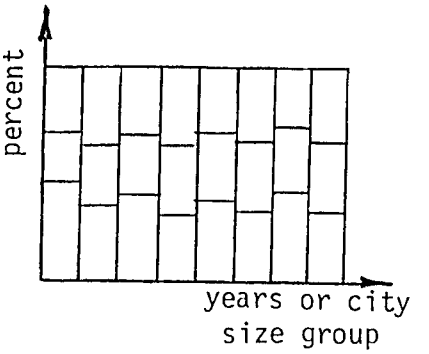
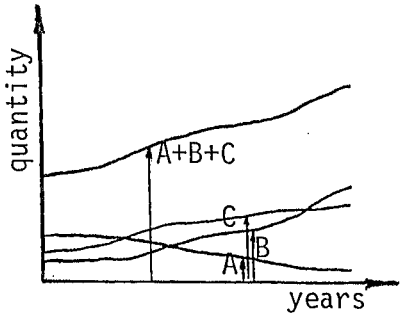
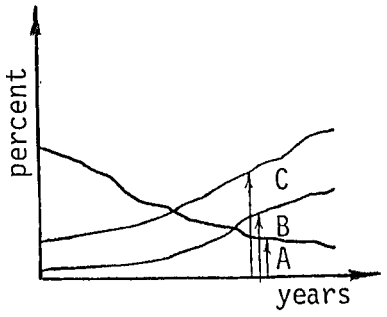


Figure 2 (continued)

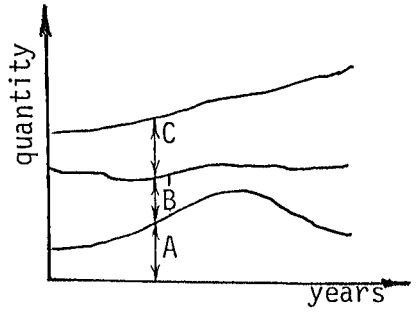
6.



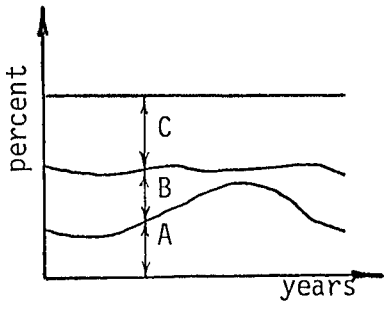
6p.



7.

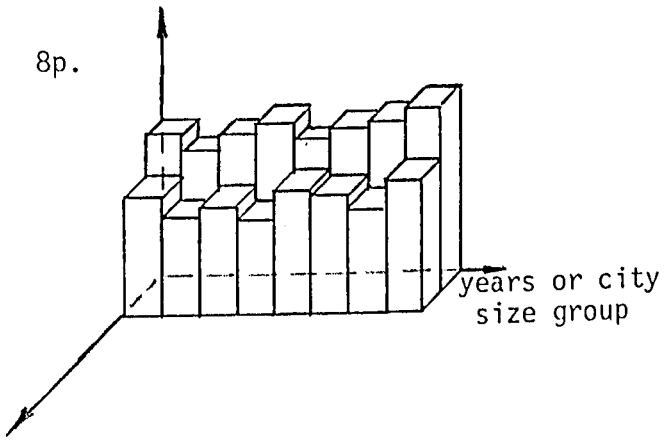


7p.

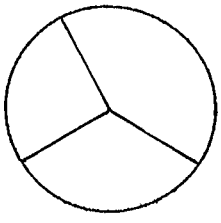


8. The height of each block shows the amount or percentage for that item. This is a variation of format 4 or 4p.

8p.

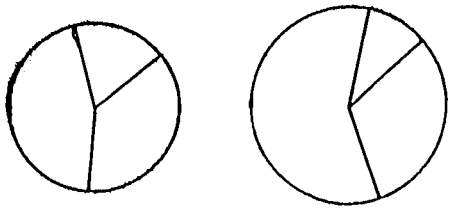


9.



Note: Sections show the percentages for each

10.



Note: Circle size shows total amount while sections show the percentage for each

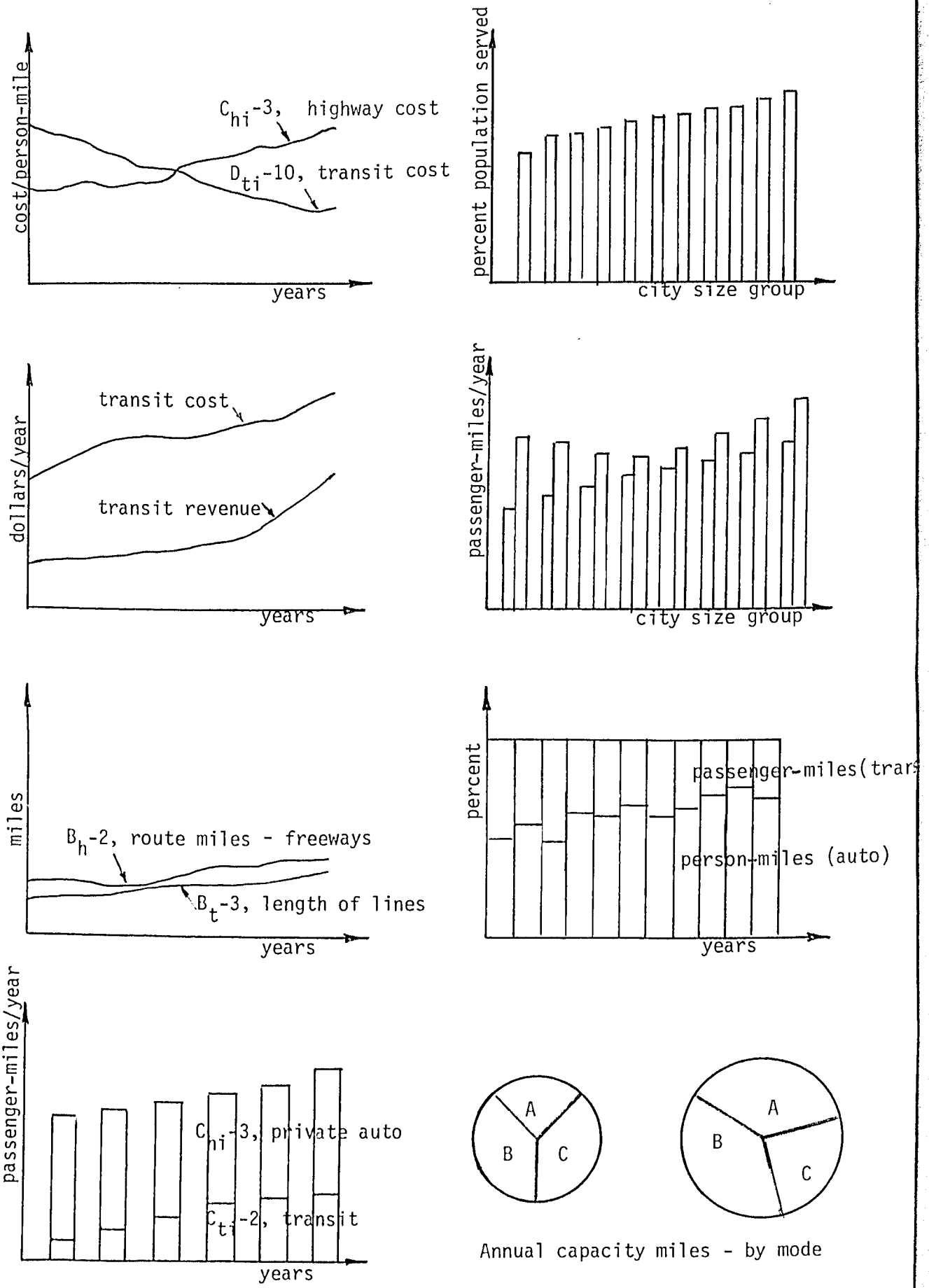


Figure 3: Example graphical data presentations for the national and city size group sections.