

# Research and Worldwide Urban Transportation

WILBUR S. SMITH, Wilbur Smith and Associates, New Haven, Connecticut

•SINCE COMMERCE, and therefore traffic, are both essential ingredients of national and regional growth, and since these expanding activities are generally tending to strangle the world's urban complexes, it is essential that transport research flourish and that the findings be disseminated as widely as possible. In looking around the world, rapid increases in motor vehicle registrations can be observed, and much of their use is in cities.

Every urban area has problems of transportation. These are relative, and the extent of severity varies widely. On the other hand, public officials throughout the world have realized the importance of convenient and efficient urban transportation and have taken steps to provide it. By so doing, they have produced data and developed research results which are valuable to others as well as to themselves.

Since Americans have done much in the manufacturing, purchase, and use of motor vehicles, people in the United States have been required to deal with many transportation problems which are only now emerging in many other cities around the world. In the past two decades, research efforts on a worldwide scale have been very successful, but often they have not been known, understood, or appreciated. On the one hand, many officials in the United States look elsewhere for research results, while others concurrently look to America for applicable findings. As a result, the desirable international exchange of research ideas and their applications in separate urban areas is now being accomplished by many agencies, individuals, and private concerns.

## DISCUSSION LIMITED TO URBAN TRAFFIC

In looking internationally at research in fields of highway transportation, noteworthy developments and contributions are found in all corners of the world. Reviewing processes of road construction would show how new techniques and the results of special studies and researches spanning many centuries have collectively produced the methods and materials which are so effectively used today, in a rather uniform way throughout the world.

The results of studies of driver behavior and driver performance under varying types of urban traffic conditions have indicated that human beings perform about the same wherever they live. The capabilities and fundamental characteristics of automobile drivers are not substantially different in most parts of the world. There is perhaps less variance in the attitudes and skills between a typical city driver of the United States and a typical city driver of Australia or India than there is between a taxi driver in New York and a typical city driver of a smaller American city. Studies which have been aimed at measuring attitudes, abilities, and actual performance characteristics of drivers have been far-reaching; results of such investigations overseas, particularly in England, have been outstanding.

It is not the purpose of this paper to deal with highway construction and maintenance, nor with fundamental characteristics of driver and vehicles, but rather to present a relatively narrow scope of urban transportation. This is further narrowed by limiting it largely to a review of data and findings from studies which have been completed by our firm in the past several years in typical overseas cities and in the United States.

## DIVERSE TRANSPORTATION PROBLEMS

There are interesting variances in urban travel facilities and practices. To illustrate: In Athens, motor bus volumes alone amounted to 13,000 vehicles per day in 1962 on principal central streets, while 2.4 million persons were passengers on all transit vehicles each day. In addition, one section of Amalias Street carried about 73,000 vehicles per day, yet there are only about 68,000 vehicles registered in all of Greater Athens. Crossing the Hooghly River in Calcutta on a typical weekday are 29,000 fast-moving vehicles, 15,000 slow-moving vehicles, a total of 510,000 persons, up to 1,000 herded animals and some 400 stray, unattended animals. In Hong Kong, the ferries between Kowloon on the mainland and Hong Kong Island carry an average of 560,000 passengers each day. Moreover, street trams, bullock and donkey carts, tricycle cabs, hand carts, and even left-hand drive create diversity.

After observing the many differences in magnitude and modes of travel in different cities of the world, one is immediately concerned with numerous questions: To what extent do facts and research findings gathered in one country have applications in others? Are trends which have been observed in transportation in one place indicative of the way transportation practices will occur in other places? Are there correlations between urban transportation and urban economy? How can projections of transportation be related to projections of population and land uses?

Development of techniques to answer such questions have been evolved by engineers and scientists—too often, however, in isolation. From simple studies of traffic movements, to intense examinations of psychological processes involved in trip motivation, researchers have found study methods and results which have been, or can be, applied worldwide. In tests to date, there has been much satisfaction in the application of study techniques and data for the international exchange of knowledge, but more is needed.

## TRAFFIC OPERATIONS

One of the most obvious areas of interchange of investigations and experiences is in the field of traffic regulations and controls. Similarity in the control of urban traffic has become relatively commonplace throughout the world. Nearly every motorist who must travel city streets recognizes that traffic has to be restricted so that the many components of the traffic stream can coexist. Most of the controls familiar to American drivers are also found in Europe, Africa, Asia, Australia, and elsewhere. This situation comes primarily as a result of many reciprocal international applications by traffic engineers.

Signs, signals, pavement markings, and other devices, ranging from simple and complex traffic controls to symbolic traffic messages and electronic surveillance gear, are generally similar in both style and application, thus achieving a high degree of international uniformity.

Applications of other well-known control devices achieve a degree of uniformity. Parking meters, reflectorized pavement paint, barricades, channelization islands, and other tools of the traffic engineer are found to be highly alike throughout the world. This results, in part, from many manufacturing companies and engineering concerns assisting in the spread of technology. Most important, the flow of information and knowledge is two-way.

## TRANSPORTATION STUDIES

The goal of urban transportation researchers has been the development of techniques that will be applicable, under a variety of conditions, with only minor modifications. For example, the comprehensive home interview travel survey, developed originally by the U. S. Bureau of Public Roads, is found to be totally acceptable from city to city within the United States. More recently, the technique has been used in other countries.

The essential transportation elements, such as trip purposes, trip lengths, distribution rates, and modal choices, can be accurately defined. In addition, trip attraction and generation values, based on unit areas of land use, or on household units, can be developed and made applicable from city to city. This would make it possible to

economize on the cost of comprehensive urban transportation surveys through greater synthesis of data.

Through the work of our firm, we now have available recent data on travel demands and travel characteristics in such diverse places as Baltimore and Boston; London, England; Athens, Greece; Bombay, India; Hobart and Brisbane, Australia; and Skopje, Yugoslavia. Basic facts about these cities are shown in Table 1.

Consistencies in travel characteristics are found in these places, as shown by the results of the surveys. Although perhaps not exactly the same values, many of the same trends and ranges are visible.

Variations in conditions must be taken into consideration in the projection of total travel demands. Nevertheless, standard survey and analysis techniques were found to be compatible in determining recommended transportation systems in these diverse areas.

### URBAN AREA CHARACTERISTICS

The trended patterns for population, motor vehicle registrations and annual transit riding in four widely-separated urban areas are shown in Figure 1. In the more developed cities of Brisbane and Baltimore, vehicles and populations show increases, while transit patronage decreases substantially. In the lesser-developed areas, typified by Athens and Bombay, all three factors are still increasing, with vehicle registrations expanding very rapidly in the recent six-year span.

These trends illustrate how different the growth in the cities has been in recent years, but when separated into relatively similar categories (such as individual trip purposes or modes) urban area characteristics show surprising consistency from place to place.

Trip purposes were examined for seven cities (Fig. 2). Basic trip purposes for car drivers show that approximately 30 to 40 percent of daily trips are made for the purpose of getting to and from work. Approximately 10 percent are trips for social-recreation purposes, and a somewhat varying proportion of them are for shopping. It is essential to remember that car drivers in some of these cities represent a special segment of the population, since availability of a vehicle reflects a relatively high income.

Similar to the distribution of the trip purposes for car drivers, the purposes for segments of those urban residents using public transportation are shown in Figure 3. There is considerable variation from city to city with high work-trip percentages in both Skopje and London. In the Australian cities of Brisbane and Hobart approximately 40 percent of the transit trips are made for the purpose of work, which is also the case in Baltimore.

Since trip lengths for car-driver journeys are generally dependent upon the size of the city and the breadth of its development, the lengths of journeys were examined for individual purposes (Fig. 4). Again, the consistency of characteristics is apparent despite diverse urban conditions. It is also interesting to note that in those cities in excess of one half million population, the average car-driver trip length, for all pur-

TABLE 1  
BACKGROUND DATA FOR SURVEYED CITIES

City	Study Year	Population	Survey Area (sq mi)	Vehicle Registration	Persons per Vehicle	Total Person Trips (internal)	Percent by Transit	Household Interview Sample (%)
Hobart	1963	125,400	78	36,900	3.4	238,000	27	5.4
Skopje	1965	220,000	42	10,600	20.8	163,200	74	6.4
Brisbane	1960	593,668	375	151,560	3.9	1,011,200	45	5.0
Baltimore	1962	1,600,810	780	437,540	3.7	2,604,463	14.2	5.0
Athens	1962	1,900,000	206	67,700	28	3,200,000	65	0.33
Boston	1962	3,584,420	2,300	1,168,200	3.1	7,851,000	18	4.2
Bombay	1962	4,345,202	328	62,200	70	2,700,000	70	0.40
London	1961	8,826,620	941	1,454,000	6.1	14,396,000	54	1.7

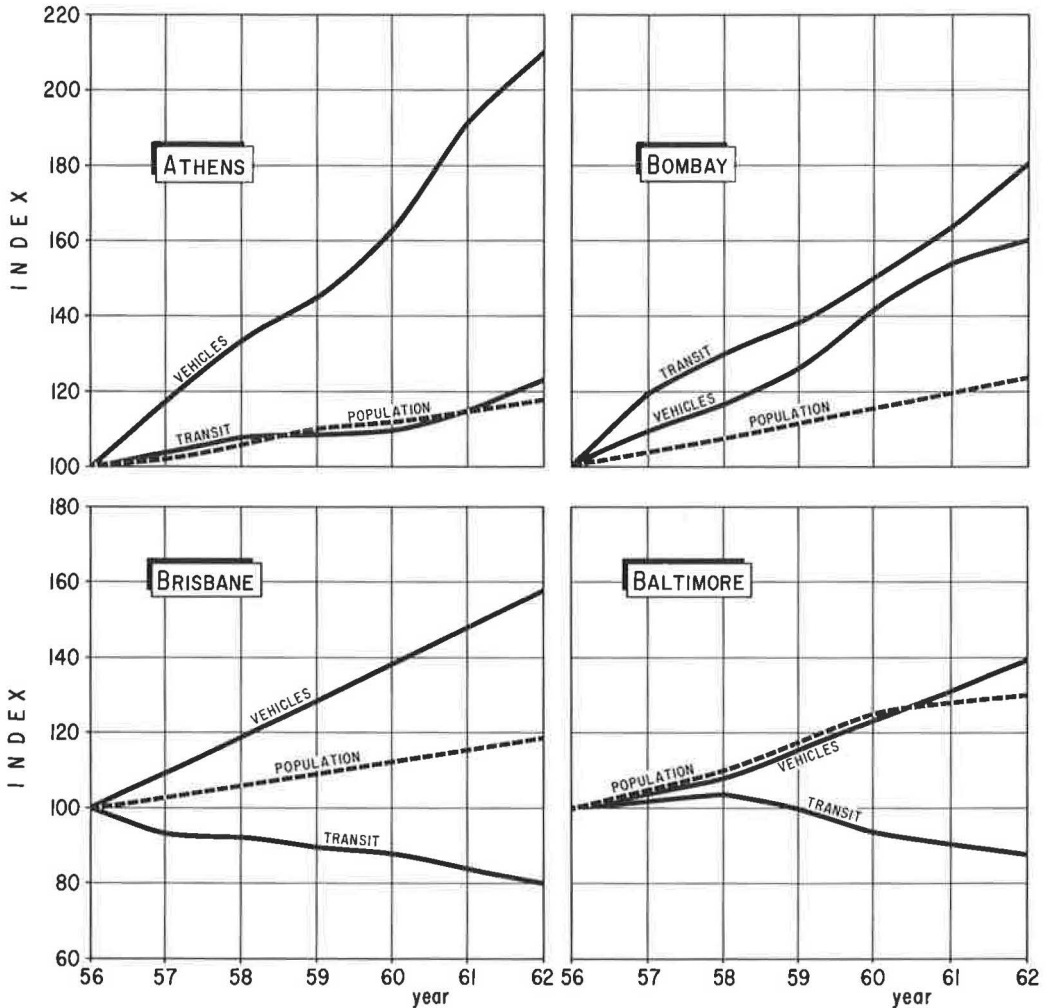


Figure 1. Population, vehicle registration and transit passenger trends, four cities.

poses combined, was stable, amounting to approximately 12 minutes. This general consistency also applied to shopping trips in foreign cities, but not to work trips which are probably more dependent upon employment locations and population density.

Investigating the mode of travel to work for several cities reveals that the choice is dependent, in part, upon car ownership (Fig. 5). As the number of passenger cars owned per household increases from 0.06 in Athens to approximately 1.0 in Baltimore, Boston, and Hobart, the usage of public transportation declines from 90 to 15 percent of the total trips made on a typical weekday. At the same time, car-driver trips increased from 10 percent to 85 percent of the total.

In the less-developed countries, many person trips on a typical weekday are performed on foot. As indicated in Table 2, Londoners made 18 percent of their work trips on foot. One third of the work trips in Skopje and 44 percent of all person trips were made by walking, whereas more than half of the person trips for work in Bombay and 25 percent of those in Athens were on foot. In the motorized countries, typified by Baltimore, only seven percent of the total work trips were made by walkers.

Given the same economic and social opportunities, trip productions tend to be generally consistent, changing primarily in relationship to car ownership. Figure 6

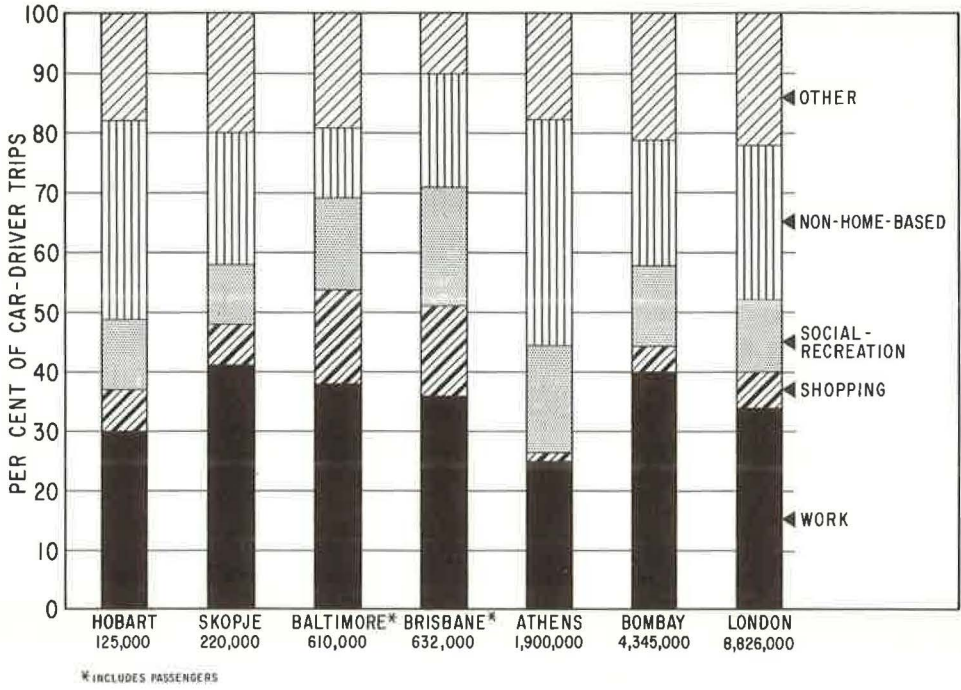


Figure 2. Car-driver trip purposes, seven cities.

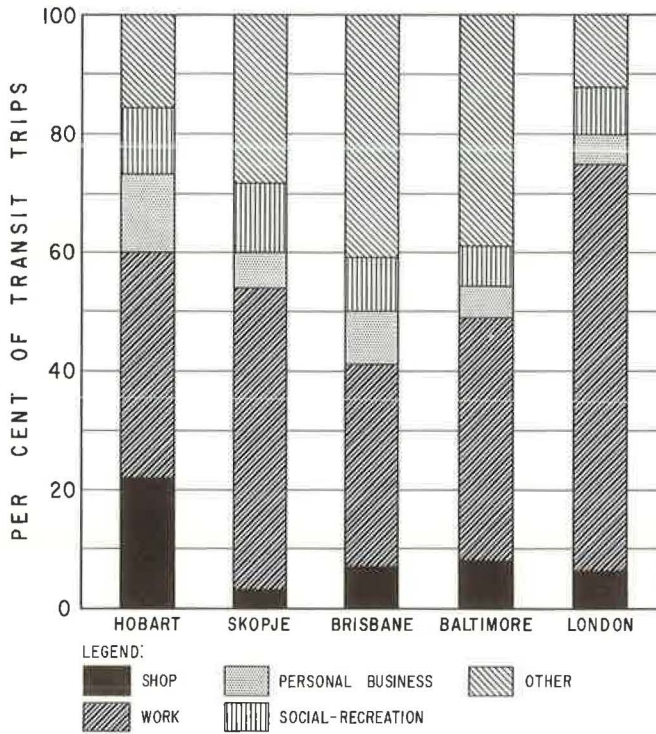


Figure 3. Transit trip purposes, five cities.

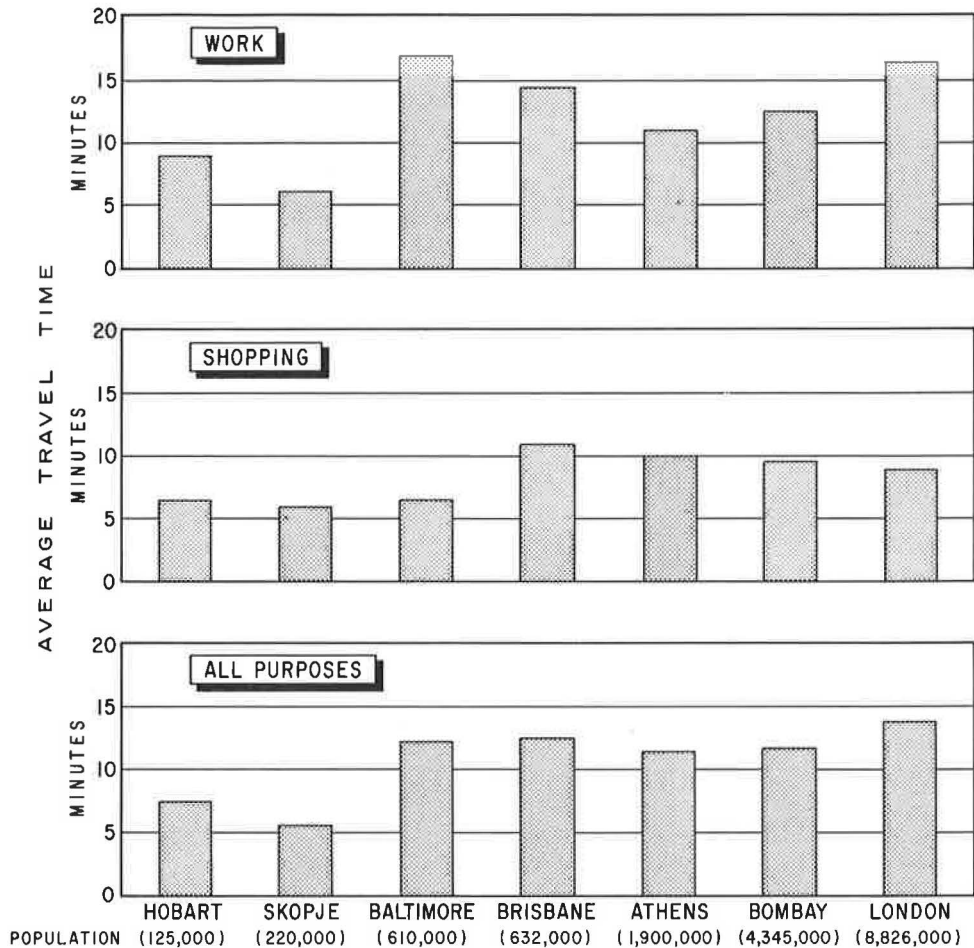


Figure 4. Car-driver trip lengths for selected purposes, seven cities.

shows trip generation, increasing with car ownership from approximately two trips per day in non-car-owning households to more than ten trips per day in those households owning three automobiles. Trends are quite similar in all the cities plotted; however, multi-car households are almost nonexistent in Skopje and Athens.

Figure 6 also shows that public transportation trips decrease with additional levels of car availability. In Baltimore, this decrease is quite sharp, but in overseas cities the general decrease is not as strong. This is probably due to the fact that the number of multi-car households is not large and the service afforded by public transportation remains relatively high despite rising ownership levels. For instance, a person may own two automobiles, yet prefer to use public transportation to and from work, as is often the case in Australia.

As one of the important parameters in modal split calculations, the average number of passengers occupying motor vehicles is determined from the origin-destination surveys. From those values can be determined, by purpose, the number of car drivers and car passengers from the number of projected total automobile trips. Table 3 indicates that the ratio of car occupancy for work-trips ranges from 1.08 in Boston to a maximum of 1.67 in Athens. For all purposes combined, the range of occupancy is from 1.43 in London to 2.16 in Athens. Those larger values reflect the fact that such trip purposes as shopping, recreation, and social journeys tend to produce greater car occupancies.

## CITY CARS/HOUSEHOLD

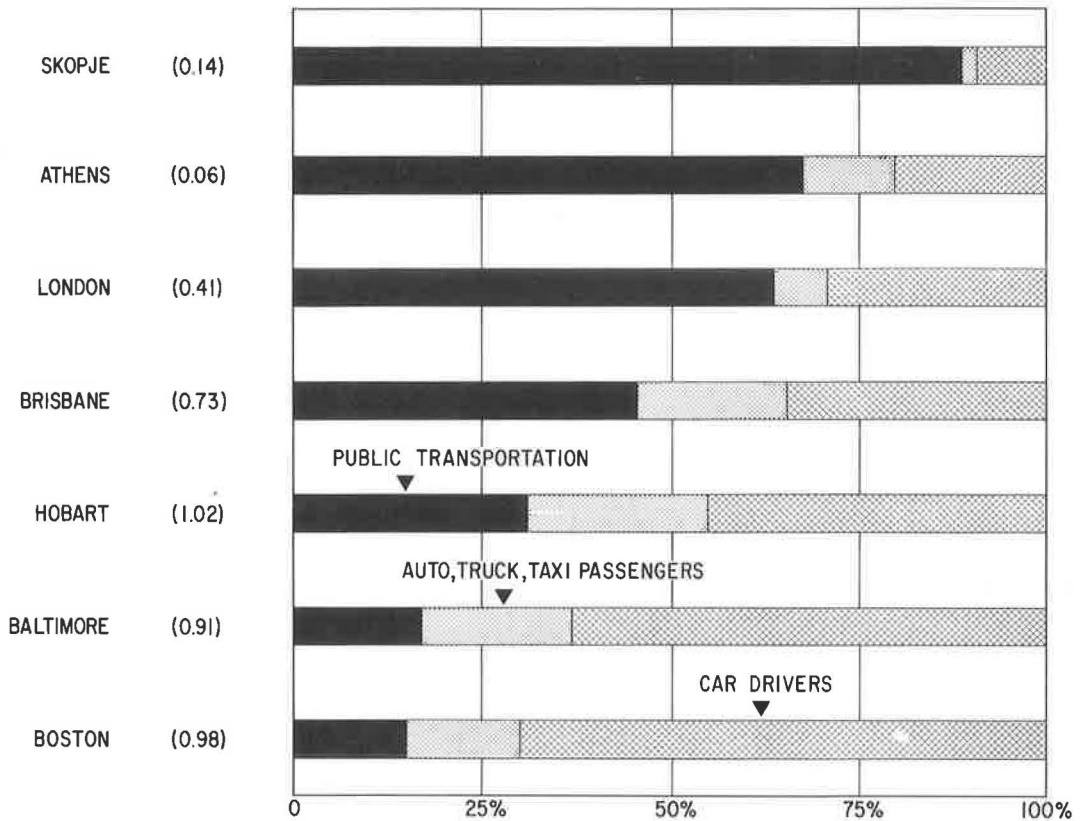


Figure 5. Modal choice for work trips, seven cities.

Comprehensive parking studies have been conducted in a number of overseas central areas. Some facts produced are shown in Table 4. In addition to the cities already cited, such surveys were conducted in Ipswich, a suburb of Brisbane with a population of approximately 52,000 people, and in Melbourne, with about two million residents. For reference, similar parking studies were conducted in Knoxville and New Orleans.

The data show that the average walking distance from the place of parking to the primary destination ranged from 314 feet in Ipswich, the smallest city, to about 500 feet in Athens and Knoxville, a relatively small difference.

TABLE 2  
PERCENTAGE OF TRIPS BY WALKING

City	Walk Trips	
	As Percent of All Work Trips	As Percent of Total Trips
Skopje	33	44
Bombay	51	—
Athens	25	34
London	18	—
Baltimore	7	—

The average parking duration for passenger cars, developed from records of time of entering or leaving a parking space, ranged from just over one hour in the city of Hobart to a total of 2 hours, 43 minutes in Knoxville, which, unlike the other cities, has a substantial number of off-street parking spaces. Parking at the curb is generally for a shorter duration and therefore the overall average is reduced for the overseas areas. In Australia, also, there is relatively intense usage of the curbside spaces. In Athens, only 6 percent of the parkers were there for

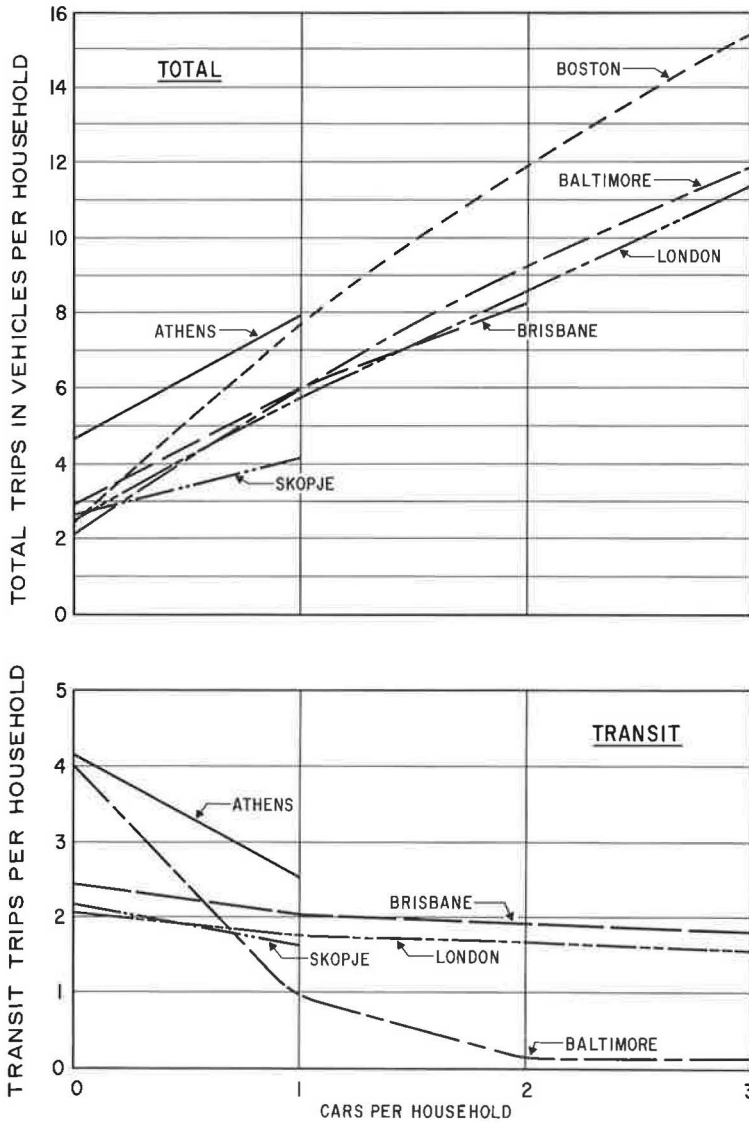


Figure 6. Daily trip generation, selected cities.

TABLE 3  
AVERAGE PASSENGER CAR OCCUPANCY<sup>a</sup>

City	Work	All Purposes
Bombay	1.61	1.82
Brisbane	1.33	1.58
London	1.16	1.43
Athens	1.67	2.16
Hobart	1.47	1.74
Boston	1.08	1.51
Baltimore	1.14	1.48
Skopje	1.54	1.60

<sup>a</sup>Internal-area trips, including driver.

shopping, whereas in Ipswich, 27 percent of the motorists parked to shop. Alternatively, 56 percent of the parkers in Athens were there for work purposes while the general average is approximately 18 to 20 percent of all the parkers for working.

#### APPRAISAL OF METHODS

In discussing urban transportation planning studies with technicians abroad, they frequently raise questions as to the need for as much detail as now attempted in the United States, even though it can be



TABLE 4  
SELECTED PARKING CHARACTERISTICS IN CENTRAL CITY

City	Average Walking Distance (ft)	Average Parking Duration (hr:min)	Trip Purpose	
			Percent Work	Percent Shop
Athens	500	2:06	56	6
Hobart	327	1:04	19	23
Adelaide	495	1:22	18	18
Brisbane	416	1:14	20	16
Ipswich	314	1:19	18	27
Knoxville	507	2:43	24	24
New Orleans	478	2:36	32	12
Melbourne	495	1:28	27	17

demonstrated that travel motivations are similar. They are apt to point out that traffic, generated by the movement of people and goods, is only one of the factors influencing the development of an urban area. They feel that sometimes a lighter study, easily applicable to various development plans, might give results as good as the very detailed analyses based on long and expensive surveys.

Up to the recent past, very few large-scale surveys on urban travel demands, like those conducted in the United States, had been performed in continental Europe. Travel demands had been based on surveys limited to small samples of households, with results compared to data collected on a larger scale. Forecasts of trips per capita were made and used as the basis for estimating travel demands between the vital parts of the urban areas.

It is likely to be further pointed out that, since in large U.S. transportation studies many assumptions have to be made all along the way, it seems that the accuracy obtained by the detailed surveys may sometimes be superfluous and not consistent with the many assumptions. Further, it might be felt that since their results are based on so many hypotheses, transportation studies should really be used comparatively instead of absolutely. In some countries it is thought that they should serve only to compare plans and solutions proposed for the overall development instead of giving the unique solution. These factors must be weighed seriously in the total urban planning process.

## OVERVIEWS

The data presented and the examples cited are too limited to permit drawing conclusive results. However, there are some strong indications of significant similarities and correlations. In addition, it is possible to generalize about the significance of the reported findings.

The interchange of urban transportation planning knowledge among nations is valuable, practicable, and essential. Techniques and ideas promulgated in one area, under one set of conditions, will often have applications elsewhere. As nations continue to develop, these interchangeable methods and data will become more valuable.

As urbanization continues rampant, to a point that within the next two decades 80 percent of Americans will live in cities, emphasis will focus increasingly on transportation problems of cities throughout the world.

The consistency in data discussed tends to support the argument that, given the same social and economic opportunities—as reflected in car ownership—personal desires for travel are consistent, regardless of geographic locations.

Additional data stratifications would show the same type of consistency for trip purposes of public transport users. However, these generally represent lower-income groups and would be heavily oriented to work trips.

The consistency in basic urban travel motivations suggests that many of the data which are collected at considerable expense in modern urban studies could be reduced

or simplified with acceptable accuracy by making greater use of both data presently available and proven techniques in synthesizing future travel needs.

Although there is a significant difference between the problems associated with the more developed nations and those associated with lesser-developed nations, the consistency among such population segments as auto-drivers is important. Projected car ownership seems to be an all-important link in transportation planning. Where countries are nearly equal in the degree of development, vehicle ownership, and thus overall transportation demands, tend to be the same.

Many of the aspects of this research are oriented directly toward long-range planning of facilities. It is essential that these research efforts be coordinated with other urban and regional planning. It is more significant that all of these research efforts in transportation can be, and are, interchanged through such agencies as the Highway Research Board. Other organizations, such as the research laboratories of the British Commonwealth nations, the International Road Federation, and the Australian Road Research Board are also making significant contributions. In addition, the personal contacts through student exchange programs are vital in this international cooperative atmosphere. The actual research program, the publication of findings and dissemination of reports, and the application of research are among the factors which will do much to foster sound urban transportation planning throughout the entire world.