THE UNIVERSITY OF NOTTINGHAM
DEPARTMENT OF URBAN PLANNING

THE IMPACTS OF THE RESIDENTIAL LOCATION ON TRANSPORT ENERGY USE:
A case study from Ankara

By

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PAGE

NUMBERING

AS ORIGINAL

To my aunt Nihal.

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ABSTRACT

Efficient use of energy is one of the key elements of sustainability. Energy consumption through transport has been increasing, not because transport has become less energy efficient but rather because the overall travel demand has been increasing so rapidly. An increasing number of trips by motorised modes as well as increasing travel distance are two main indicators of this trend.

In order to lower the energy used by transport, consideration must be given not only to the policies directly related to transport, but also to those related to urban development. It may be possible to reduce the amount of energy use in an urban environment through these policies. Thus, one of the objectives of planning activity is the realisation of cities which promote short distance trips with more energy efficient transport modes.

The main concern of this research is to examine the possibilities of having more energy efficient travel demand patterns and to find out under what circumstances, the spatial structure of an urban area allows for a reduction in the energy used by transport.

Urban residential developments that tend to move out of the city are especially good example of development that might result in more energy intensive travel demand patterns. In terms of its relation both to the inner city and in itself, the overall travel demand characteristics of a city can easily be changed by residential choice. New housing developments, especially the out-of-city ones, may lead residents either to travel for longer distances, or to use cars widely, or both. But, it could stimulate them to travel for shorter distances or to use motorised modes less, or both. The spatial structure of a new development and its connection and relation to other facilities (such as work places, schools, shopping areas, recreational places and so forth), shape travel demand patterns.

This research has attempted to define the travel demand patterns of the inner and out-of city residents of Ankara and to discuss the factors affecting them. Beside this comparative analysis, there was an attempt to discover what the out-of city residents would do if they were living in the inner city districts. The possibilities of having more energy efficient travel demand patterns in the selected districts of Ankara were examined.

It is evident from the survey results that transport energy use changes due to the location of a residence relative to the CBD. Living in an out-of city area means travelling for longer distances and a wider use of motorised modes. Living near to the central facilities encourages walking trips. Trips by motorised modes also have a considerable share, but the travel distance is not as long as in the out-of city case. Additionally, dependence on cars has been accelerating through the increasing distance of residence from the central inner city facilities. Following the assumption that the previous residence of out-of city residents was the inner city, the comparison of previous and actual travel demand patterns indicates that they used to have less energy intensive travel demand patterns.

The main reason behind the urban decentralisation policy was to reduce the air pollution level in Ankara. Research findings, however, confirms that increasing travel demand together with transport energy consumption are negative outcomes of this policy. These developments are contributing the environmental problems through wider use of motorised modes and long distance trips and air pollution created by huge volume of traffic coming into the inner city. Thus, it is out of question whether the planning objectives have been reached or not through the urban decentralisation measures or what should be the additional measures or policies to contribute sustainable urban development process.

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PART ONE: INTRODUCTION

CHAPTER ONE : INTRODUCTION

I.1. Research Background : Sustainable Urban Development

> "Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (World Commission on Environment and Development, 1987; p 42).

Sustainability covers a wide range of areas including interrelated aspects such as political willingness, institutional and legal frame, technological improvements, participation, integration of ecological factors into decision-making process. It does not draw limits but limits are drawn by human activities and their impacts on the Earth. While fulfilling people's aspirations for a better living conditions, it is necessary to be aware of the impacts of today's life on future generation. Thus, sustainability implies an equity among people and between generations and the way we use the non-renewable resources is an important issue.

One important aspect of sustainability is a clear focus on conservation and efficient use of energy. One of the key elements of sustainability in terms of energy use is "energy efficiency and conservation measures" (World Commission on Environment and Development, 1987; p 169). These measures should help to satisfy both the present generation's needs and the requirements of future generations. As Redclift (1987) mentioned, we need to consider to what extent we use energy efficiently for the benefit of both generations. We also need to control the growing demand for energy.

Transport has a considerable share in overall energy consumption, and thus plays an important role in sustainable development. In order to lower the energy used by transport, consideration must be given not only to the policies directly related to transport, but also to those related to urban development which encourage better use of energy for transport (or reduce the energy consumption for transport). Thus, urbanisation has a direct influence on the growth of energy demand.

Beside all efforts to reduce the energy consumed in transport, such as technological improvements, research to find cheaper sources of energy, and so on, urban development is a fundamental instrument for the control of the energy use within an urban area.

Most studies about the interaction between urban development patterns and transport attempt to solve the transport problem from its supply side. They usually concentrate on the improvement of an existing system or try to introduce new systems co-ordinated with proposed urban development schemes. There are also various efforts to define this interaction from the other side. The possibilities of manipulating travel demand through land use planning and urban form decisions while concentrating on the demand side of problem are also important.

Policies of sustainable urban development should lead to the development of energy efficient cities in terms of their form and energy. The form and size of the city should be appropriate for energy conservation and efficient use of resources and services. In addition, changing distribution of activities and their densities should lead to better use of natural resources (Elkin et al., 1991).

Policies for new developments in terms of their location, density, and relation with similar and different land uses can be channelled for reducing energy use in transport activity. This research, then, asks "how far the energy used by urban transport can be minimised through urban planning decisions which will, in turn, provide better utilisation of resources" (World Commission on Environment and Development, 1987).

I.2. Scope of the Research

Transport, industry and housing (domestic use) are the sectors that account for the highest share in overall energy consumption within urban areas. In Turkey, the transport sector accounts for 20 percent of total energy consumption (Ministry of Energy and Natural Resources, 1991) and road transport accounts for more than 50 percent of energy use within the transport sector (Baker, 1981).

Increasing energy consumption for passenger transport has also been raising. For example in Italy it rose by 32 per cent between 1970 and 1989 whereas during same period it rose by 77 per cent in UK. In all OECD countries, the transport share in total energy consumption increased from 24 per cent by 1970 to 31 per cent by 1991 while energy consumed for road transport increased by 65 per cent over same period (OECD, 1995).

Energy consumption through transport has been increasing, not because transport has become less energy efficient but rather because the overall travel demand has been increasing so rapidly. An increasing number of trips as well as increasing travel distance are two main indicators of this trend.

Two of the reasons for the rise in the number of trips and travel distance are the high rate of urbanisation and the physical separation of urban areas. They either directly or indirectly result in changing travel demand patterns in a city. If physical separation is not accompanied by the public transport network, then private cars may begin to be used more widely. This also means higher energy consumption.

In recent years, in most of the world's big cities, an increasing tendency in overall travel demand can be observed together with high levels of private car use (see Kenworthy and Newman, 1989a for details). Half of the energy consumption of road transport is wasted by private motorised modes (Baker, 1981) which means that 25 percent of overall transport energy is consumed by cars. While rising car ownership causes wider use, physical separation of urban areas generates more trips by car and dependency on cars increases. Long distance trips, together with higher levels of car ownership and use, make the problem much more serious.

As mentioned in most existing research, the distance travelled and the mode used are important from the energy conservation point of view. These two issues of travel demand result from various demographic, social and economic factors such as lifestyle changes, ageing, and so forth (Banister et al., 1990). Additionally, some structural factors, that is the land development characteristics of cities, are among the most important; because they affect travel demand in terms of mode use, travel distance and number of trips.

One of the objectives of planning activity is the realisation of cities which promote short distance trips with more energy efficient transport modes. Urban areas are not only places where concentration of energy use takes place, but they are also potential instruments for energy conservation, if planned. It may be possible to reduce the amount of energy use in an urban environment through urban land use differentiation.

Urban residential developments that tend to move out of the city are especially good example of development that might result in more energy intensive travel demand patterns. In terms of its relation both to the inner city and in itself, the overall travel demand characteristics of a city can easily be changed by residential choice. Depending on residential location and activities within or near the residential area (such as local centres, primary schools and so forth), travel distance, dependence on private modes and number of trips are reorganised by residents.

The main concern of this research is to examine the possibilities of having more energy efficient travel demand patterns and to find out under what circumstances, the spatial structure of an urban area allows for a reduction in the energy used by transport.

The distribution of activities, that is the physical separation and/or agglomeration of activities, influences the amount of energy used through transport. First of all, the locations of different type of activities, as places of origin and destinations of trips, determine the possible combinations of trips among them in numbers and distance travelled. Secondly, the densities of different activities, particularly population and job densities define these commuting relations (Kenworthy and Newman, 1989a). Thirdly, the mixture of different or similar land uses, that is, the level of physical agglomeration or separation has a considerable effect on the travel demand. Clustering similar and/or dissimilar land uses can either reduce or increase travel distances.

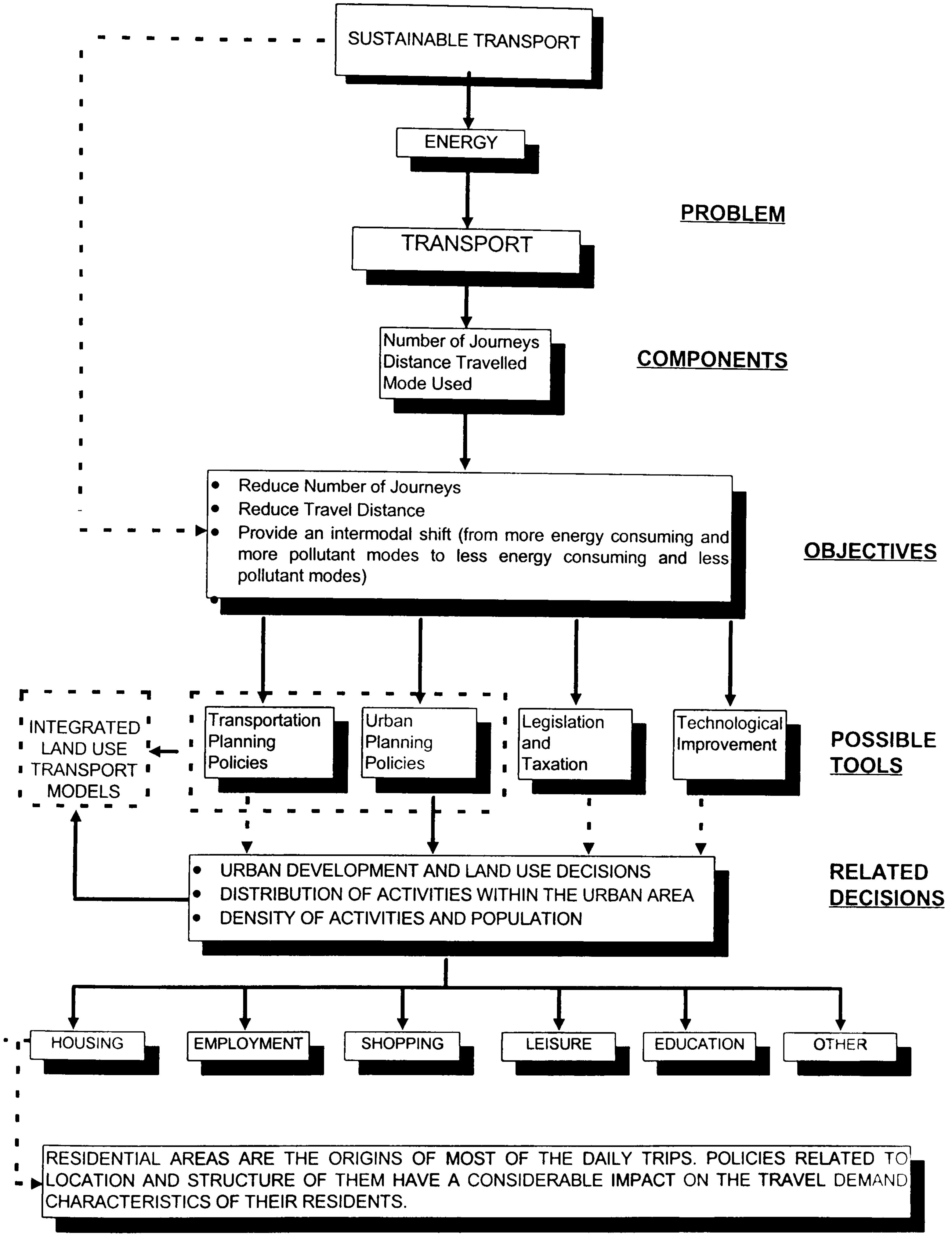
Policies of sustainable urban development should be directed to produce energy efficient cities where the amount of travel and the travel distance can be minimised and the use of more energy efficient transport modes be ensured. If the lowest possible energy consumption can be achieved through certain residential locations and land use patterns, then planning activity will contribute to sustainable development.

Planning policies for new housing development areas, therefore, affect the pollution levels and energy costs of the urban environment due to their influences on the travel demand characteristics of the residents. The intra-urban migration caused by new housing developments, especially the out-of-city ones, leads residents either to travel for longer distances, or to use cars widely, or both. But, it could stimulate them to travel for shorter distances or to use motorised modes less, or both. The spatial structure of a new development and its connection and relation to other facilities (such as work places, schools, shopping areas, recreational places and so forth), shape travel demand patterns. Two of the fundamental questions for planners to be asked then are:

> "What policies should be implemented to provide an energy efficient form for the city? What kind of residential developments will help to reduce the energy cost of transport?"

Having these questions in mind, the approach of this study is summarised in Figure 1.1. This chart also shows the framework and method of the research. If reducing the amount of travel and travel distance, and providing an intermodal shift from more energy intensive modes to less energy intensive ones are the objectives of planning activity, then residential areas, as origins of most of the daily trips, become more important for managing travel demand.

Figure 1.1. An Approach to the Study



I.3. Significance of the Research

In Turkey, the number of private cars have increased to 1.9 million during the 1980's. Table 1.1 shows that this represents a growth of 154 per cent compared with a growth of 18 per cent in the USA, which is the lowest among all sampled countries. In Italy and Spain this growth was comparatively moderate with 48 per cent and 59 per cent respectively. Among all selected countries, the growth of average annual energy consumption between 1980-1993 has the highest value in Turkey. The change in energy consumption of road transport between 1980-1989 is also relatively high, whereas road density is the lowest of the countries shown.

Table 1.1. International Comparison of Some Indicators

	Average Annual Growth of GNP Per Capita !980-1993 (%)	Average Annual Growth Rate of Population 1980-93 (%)	Average Annual Growth Rate of Urban Population 1980-93 (%)	Average Annual Growth Rate of Energy Consumption 1980-1993 (%)	Changes in Number of Private Cars 1980-1990 (%)	Road Density (km per Million Person) 1992	Changes in Energy Consumption of Road Transport 1980-89 (%)
Turkey	2.4	2.3	5.4	5.1	154	5514	60.01
Canada	1.4	1.2	1.3	1.5	25	11451	-3.41
USA	1.7	1.0	1.2	1.4	18	14453	14.52
France	1.6	0.5	0.4	2.0	22	13008	27.37
Italy	2.1	0.1	0.1	1.5	48	5283	37.40
Spain	2.7	0.4	0.7	2.9	59	8540	62.02
UK	2.3	0.2	0.3	1.0	NA	6224	36.19
Japan	3.4	0.5	0.6	2.5	NA	6426	38.24
Denmark	2.0	0.1	0.2	0.7	NA	13741	28.27
Australia	1.6	1.5	1.4	2.3	NA	16221	29.68

Sources: World Bank (1995) and OECD (1991)

In the case of Turkish cities, the number of cars and distances covered by public transport have increased together with a high rate of urbanisation, during last 10 years (Table 1.2). The number of daily trips per person has also been increasing together with a doubling of car use in most Turkish cities. The number of daily trips per capita was 0.72 in Istanbul in 1982 and this increased to 1.14 in 1987; in Ankara, these figures were calculated as 1.57 and 1.72 for 1980 and 1985 respectively.

Table 1.2. Urbanisation and Some Transport Indicators in Turkish Cities[1]

Cities	Urbanisation Ratio (1990)[a]	Number of Motor Vehicles[2] (1992)[b]	Annual Increase in Distance (km) Covered by Municipal Bus Services (1980-1988)[c]
Istanbul	92.40	566 969	13.8%
Ankara	87.64	304 057	4.7%
Izmir	79.22	172 647	4.7%
Bursa	72.22	77 151	NA
Adana	69.78	70 946	NA

Sources [a] Calculated from SIS (1990a)
[b] Automotive Manufacturers Association (1993)
[c] Calculated from SPO (1991; p 53)

In the case of Ankara, the capital city of Turkey, a high level of car ownership and use has been observed for more than the last 15 years. Urban development policies for decentralised urban form were supported by the municipality to reduce air pollution. Since the late 1980's, the west corridor of the city has been developed rapidly, particularly in terms of new housing estates (see chapter IV).

[1] Provincial centers where urban population exceeds 1 million in 1990 are included.
[2] Figures represent number of registered cars within a province.

During this development process there is little or no evidence that urban development and transport policies took into account travel demand and energy use. It is obvious that the city benefits from decentralisation both in terms of lower air pollution levels and better opportunities for housing; but a reduction in travel demand or encouraging extensive use of public modes and walking do not require these benefits to be rejected. They would not conflict with air pollution reduction. This research tries to figure out, if sustainable urban development is one of the objectives of planning activity, whether or not land use arrangements might be helpful in controlling or managing travel demand. If this is so, it would also assist better and more efficient use of non-renewable energy resources for the benefit of both today's and future generations.

Consideration of energy conservation as a target in each stage of the planning process is necessary for a pleasant living environment with the least possible air pollution, noise and congestion. In Ankara, new out-of city residential areas usually offer peaceful and pleasant living conditions, but if the residents continue to use inner city facilities regularly, then they have to commute between two places on an everyday basis. This signifies long distance trips, usually by motorised modes. If they have access to a car, then they become more dependent on cars. Under these circumstances, it is difficult to calculate their net contribution to the inner-city air pollution problem. It is also difficult to say that these areas are contributing to the sustainable urban development, since they might be causing high energy consumption by transport.

This research addresses to answer the following questions in order to understand and explain the facts:

1. What are the possible impacts of the location of residences on the travel demand characteristics?

2. Why does transport energy use differs from one district to another and among people?

3. Why do certain residential developments, presumably out-of city ones, generate more energy intensive travel demand patterns than others?

4. What would the out-of city residents do if they were living in the inner city?

5. What kind of residential developments will help to reduce the energy cost of transport?

6. What are the policies that can be used as instruments to control/manage the travel demand and hence to contribute to sustainable development through reducing the energy cost of travel?

In order to establish the facts, a comparative study of the travel demand patterns of inner and out-of city residents was carried out in Ankara. This research aims to investigate the energy utilisation impacts of the changing travel demand patterns due to expanding the city. There is no other study of travel demand variation due to recent out-of city developments in Ankara. There is also no related data collected on a regular basis and necessary data for a comparative analysis was therefore obtained through a field survey conducted in Ankara. By filling this lacuna in knowledge about these urban developments, this research will also provide a perspective on how the energy use of transport changes through such developments. It also shows whether out-of city residents continue to use inner city facilities, if they are more dependent on motorised modes than inner city residents, and if it is so, why. By doing this, it is hoped that it will contribute to the urban development policy framework for Ankara.

I.4. Structure of the Thesis

Following this introductory chapter, the thesis is divided into four main parts. Part one which includes two chapters is about literature related to the subject. Chapter II gives a review of energy considerations in transport. The main objective of this chapter is to summarise the energy issues with reference to certain travel demand patterns. Chapter III discusses the literature on the impacts of spatial structure on travel demand. Within the framework provided in Chapter II, it includes explanations about different urban land developments and their possible resulting travel demand patterns.

Part two outlines the research framework. Chapter IV provides a general description of the city of Ankara and reviews the urban development policies and processes in Ankara while explaining the existing structure. Chapter V explains the research design in the case of Ankara. It also describes procedures for data collecting and the techniques used for analysis.

Part three is concerned with the results and main findings. Chapter VI provides research findings in terms of the spatial structure of selected districts and the socio-economic characteristics of selected populations. Chapter VII presents travel demand patterns of the inner and out-of city districts in the light of chapter VI. These two chapters provide a comparative analysis of the research findings. Chapter VIII analyses travel demand patterns from the energy consumption point of view. It also discusses the possible contribution to the energy consumption of transport of living in the out-of city districts of Ankara.

Part four discusses the research findings. The question of why the out-of city residents have different travel demand patterns from the inner city residents, is dealt with in chapter IX. The implications of the research findings for planning policies, and suggestions for further research about the subject are also included in this part.

PART TWO: ENERGY CONSIDERATION OF TRAVEL DEMAND PATTERNS - AN OVERVIEW

CHAPTER TWO : ENERGY CONSIDERATION IN TRANSPORT-THEORETICAL BACKGROUND

This chapter concentrates on urban travel demand, particularly that for passenger transport. The purpose of this chapter is not to provide a comprehensive summary of the literature, but rather to focus on the energy consumption aspects of the subject.

II.1. Introduction: Energy Consumption of Transport

Transport is one of the main sectors to contribute a considerable share in overall energy consumption. Research results indicate that the contribution of the transport sector to total energy demand has been increasing. For example, the growth of energy consumption in transport was around 9,69 per cent for the period 1986-1988 in the UK (Elkin et al., 1991) and in all OECD countries, the transport share in total energy consumption increased from 24 per cent by 1970 to 31 per cent by 1991 (OECD, 1995).

Road transport has the lion's share of energy consumption within the sector. Energy consumed for road transport increased by 65 per cent from 1970 to 1991 in all OECD countries (OECD, 1995).

As has been observed from many of the world's big cities, transport energy use rose between 1970 and 1980 (Table 2.1). The rate of this growth differs from one city to another. In some cities, such as Los Angeles, New York, Copenhagen and Tokyo it was below 10 per cent but it exceeded 50 per cent in the cases of Paris, Sydney and Hong Kong. The reasons behind these changes also vary from one city to another due to their transport structure and changing travel demand patterns.

Table 2.1 Transport Energy Consumption in the World's Cities

CITIES	Transport Energy Consumption[1] 1970	1980	Change (%) 1970-1980
BOSTON	$1.2636*10^{17}$	$1.7747*10^{17}$	40.45
L. ANGELES	$4.4155*10^{17}$	$4.8506*10^{17}$	9.85
NEW YORK	$8.7587*10^{17}$	$8.9990*10^{17}$	2.74
WASHINGTON	$1.1869*10^{17}$	$1.5945*10^{17}$	25.56
MELBOURNE	$6.3349*10^{16}$	$9.5447*10^{16}$	50.67
SYDNEY	$7.5983*10^{16}$	$1.1149*10^{17}$	75.99
AMSTERDAM	$6.726*10^{15}$	$7.830*10^{15}$	16.41
COPENHAGEN	$2.6372*10^{16}$	$2.8103*10^{16}$	6.56
LONDON	$9.5162*10^{16}$	$1.1813*10^{17}$	24.14
PARIS	$1.0836*10^{17}$	$1.9124*10^{17}$	76.49
HONG KONG	$1.0743*10^{16}$	$2.2697*10^{16}$	111.27
TOKYO	$1.6864*10^{17}$	$1.8396*10^{17}$	9.08

Source : Newman and Kenworthy (1989a)

In terms of energy consumption per person per annum, there are large inequalities among countries. Overall energy consumption in countries like China or India or Bangladesh is more than fifteen times lower than those in USA (Whitelegg, 1993). Considering these differences and their transport structure, it can be said that the third world countries has considerably lower energy consumption for transport. The dependence on walking and cycling, obviously, contributes to the sustainability. Nevertheless, there has been an

[1]Total fuel consumption (joules)

increasing car ownership in these countries which might change the energy consumption figures and car dependency.

The figures in Table 2.1 show energy consumption of transport operation; but, transport does not only use energy for the operation of vehicles. Any increase in travel demand inevitably means further increase in energy consumption throughout the system.

> "The demand for transport results in ... the demand for manufacture of vehicles and its components; the demand for associated raw material manufacture; demand for maintenance of vehicles; the demand for transport infrastructure; the demand for generation of energy. Each of these demands results in the consumption of energy." (Transnet, 1991; p 1).

II.2. Indicators of Urban Transport Demand and Its Energy Consumption

The demand for transport is usually represented by the traffic volume at different levels of cost. For passenger transport, it is usually expressed by the number of passenger trips between two locations in an urban area during the average week day.

Travel is a derived demand, that is it is derived from the demand for other social and economical activities. People use the roads or transport modes to consume or to use other things. Therefore urban travel demand is usually expressed as a function of land use. People have an enormous number of choices to make when considering the possible combination of location, modes and routes. All these, either alone or together make up the travel demand.

> "Transport's demand for energy can be analysed as the product of two components: the amount of energy required to move 1 passenger (or

one unit of freight) 1 kilometre multiplied by the number of kilometres driven." (Transnet, 1991; p 19).

The amount of energy required for travel activity varies in relation to the travel demand pattern. The amount of travel itself might indicate the amount of energy consumed for transport. Newman and Kenworthy (1989a) pointed out an increasing amount of travel by motorised modes usually means more fuel consumption (Table 2.2). For example, energy use of transport is highest in Los Angeles where distance travelled is the highest. In Hong Kong, energy use is lowest together with lowest travel distance. Although their findings show a high correlation between energy use and amount of motorised trips, factors such as technology or occupancy of a vehicle affects energy use of transport.

Table 2.2. Passenger kms per Capita by Fuel Use in the World's Cities

CITY	Passenger kms per Capita (Public Transport + Private Car)	Energy Use (MJ per capita)
BOSTON	13088	54185
L.ANGELES	14249	58474
NEW YORK	9141	44033
WASHINGTON	12286	51241
MELBOURNE	10907	29104
SYDNEY	10961	27988
AMSTERDAM	6242	9171
COPENHAGEN	7888	11106
LONDON	6169	12426
PARIS	6026	14091
HONG KONG	2658	1987
TOKYO	8184	8488

Source : Newman and Kenworthy (1989a; p. 36)

The amount of travel can be expressed in different ways such as trip generation rate (number of passenger trips per capita) or travel distance (passenger kilometres per capita).

The amount of travel in either term might be the function of a number of variables such as demographic forces (age structure and sex composition), lifestyle (number of working people, students, women at work), personal circumstances (education, occupation), economic structure (income level, car ownership), technological improvements (telecommunication), or settlement patterns (location and intensity of activities). Besides all these external forces, developments within the transport sector play an important role. Price changes, the availability of means of transport and travel demand management all affect the travel demand.

These forces influence both the daily number of trips and the distance travelled. The transport system (network and service maintenance) itself and the settlement pattern (land use pattern, location of origin and destination areas) are the most powerful factors influencing travel distance.

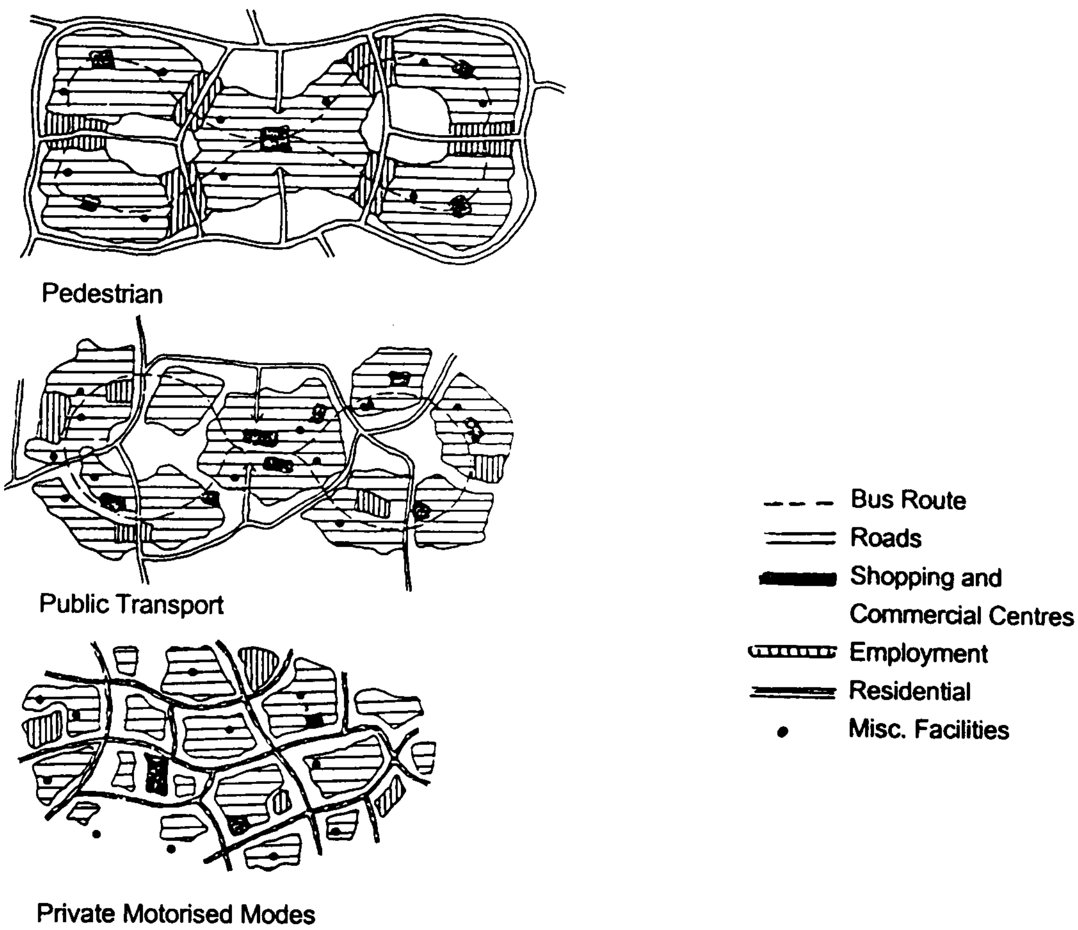
In the case of passenger transport, modal choice (that is public transport modes versus private transport modes, or motorised modes versus non-motorised modes) is an important component affecting energy use. Besides all other components (like the spatial structure of a settlement, social preferences, supply of transport facilities or transport policies), modal choice and distance travelled directly influence energy use.

II.3. Energy Use Variations by Modal Split

Banister et al. (1990) discuss how all demographic, economic, social and structural factors contribute to the demand for travel. For example, any rise in living standards, in car ownership levels, owner occupation, leisure time, number of women at work or growth in the service sector and technologically based industries, demographic factors such as ageing, single parent families and reduction in average household size, or increasing housing stock and physical separation of urban areas, any of them, either directly or indirectly, can result in an increase in the amount and distance of travel.

All these factors can affect people's modal choice. For example, women may use public transport because they have less access to cars in comparison to men; or most of the work trips might be made by public transport; or high income people and those who have access to cars may use private cars more widely. These impacts on modal choice inevitably affect energy use. In addition to people's modal preferences, different settlement patterns suit different transport modes. As shown in Figure 2.1, "public transport requires a concentration of generators and facilities to maximise the number of people and activities within easy reach of the transport route and thus induce a high level of use.... private transport requires a dispersal of generators and facilities to achieve maximum vehicle accessibility at low capital cost" (Jamieson et al., 1967; p 202).

Figure 2.1. Optimal Settlement Structure for Different Transport Modes



Source: Potter (1982) quoted in Stedman (1983; p 39)

Certain settlement patterns may be suitable for more efficient operation of a particular mode. Nevertheless, most the scholars agree that public transport is the most energy-efficient of all forms of motorised modes.

> "Public transport comprises many different types of vehicles, but most commonly the term refers to buses and trains. Buses take many forms, from minibuses to double-length vehicles with pivoting centres. Rail services fall into four major categories: rapid rail which operates on exclusive right-of-way in tunnels or elevated tracks; streetcar (or trams), which move with other traffic on regular streets; light rail which are quieter, more modern versions of streetcar, and can run either on exclusive right-of-way or with other traffic; and suburban or regional trains, which connect the city with surrounding areas."(Lowe, 1991; p 12).

Their energy requirements vary in accordance with their design and the number of passengers they take. Table 2.3 gives an example of energy requirements for different modes of transport in the case of the US cities. From this example it can be seen that among all buses and trains require less fuel per passenger for each kilometre of travelled, but for this to be true it is of course necessary to guarantee a reasonable number of passengers (Lowe, 1990; p 13).

Table: 2.3. Energy Requirements of Motorised Transport Modes, USA

Mode	Number of Passengers per Vehicle	Energy Intensity (Btu[2] per passenger-km)
Intercity rail	80	442
Intercity bus	40	477
Light rail	55	639
City bus	45	691
Rapid rail	60	752
Car pool	4	1144
Automobile	1	4576

Source : Lowe (1990,p 13)

Cars have the greatest share of road transport energy consumption (nearly 50 per cent) because they are the least energy efficient. As can be seen from Table 2.3, a car with one occupant uses nearly 7 times more fuel per passenger-km than a city bus with 45 passengers.

Vehicles with low loads have the highest energy requirements. Thus, buses and rail transit have substantially lower requirements.

Rail transit is the most energy efficient of all modes in terms of operating energy per passenger mile; but it may be the least efficient when construction and station energy are considered, and even less efficient when mode of access

[2] Btu: British Thermal Unit.

and circuity (that is number of trips between residence and station) are included.

Energy conservation measures could concentrate on minimisation of energy use for people's movement. Although mass transit is the most energy efficient among all motorised forms of transport, when the energy requirement of non-motorised modes is added to the table, bicycles consume less energy than any other form of transport including walking. Their energy source -food- is renewable. Lowe (1989) provides figures for the energy intensities of walking and bicycling at 100 and 35 calories per passenger km respectively.

Newman and Hogan (1987) claim that transport energy consumption is positively correlated with car ownership whereas it is negatively correlated with public transport utilisation (Table 2.4). Their findings confirm the inverse relationship between public transport use and car ownership. Thus, high car ownership encourages less use of public transport while causing more energy consumption through private car use. They categorise cities as automobile cities, public transport cities and walking cities (see Table 2.4). The automobile city is the least energy efficient in terms of transport, whereas the walking city is the most energy efficient one. As will be addressed in chapter III, besides all other external and internal factors influencing the energy used by transport, settlement pattern is an important due to the advantages/disadvantages that it offers for an efficient use of non-renewable energy resources by transport.

Table 2.4. Relationship Between Energy Consumption, Car Ownership and Public Transport Utilisation

City Type	Car Ownership (cars per 1000)	Energy Consumption (annual kg per capita)	Public Transport Utilisation (annual pass. trips per capita)
Automobile City	High - approximately 400	Very high - approximately 870	Low - approximately 90
Public Transport City	Middle - approximately 170	Medium - approximately 220	High - approximately 310
Walking City	Low - approximately 60	Low - approximately 60	Medium - approximately 180

Source : Newman and Hogan (1987) quoted in Newman and Kenworthy (1989a)

There can be several factors affecting people's choices of transport mode in their daily trips. In the case of public transport, lower fares, safety, comfort, speed and frequency of services are important. If these are improved, public transport might attract more users.

Private cars, on the other hand, offer considerable benefits in terms of enhancing mobility and affording greater flexibility in personal travel behaviour but are often seen as "being environmentally intrusive and harmful for resources consumption from both the points of view of the cost of using the vehicle and of the resources used in the manufacturing process" (Banister and Button, 1993, p 3).

In the case of bicycles, that are the most environmentally friendly modes of transport, the main obstacle is the absence of a suitable environment for riding.

II.4. Transport Objectives and Related Policies

There have been several attempts to adjust transport objectives so that "they give a structure within which the success and failure of transport policies and programmes can be accurately assessed" (Buchan, 1992; p 15). These objectives are called "quality of life objectives for transport" by Buchan. They are accessibility, environment, economic development, fairness and choice, safety and security, energy and efficiency, accountability and flexibility.

For accessibility, the main concerns of transport policies are to provide a transport system that enables people to travel from one place to another and to integrate it with land use and economic developments while encouraging people to travel less. Accessibility can be met at the lowest possible resource cost in favour of energy and efficiency (Buchan, 1992; pp 15-16).

These two objectives for transport (accessibility and energy and efficiency) refer to the following questions:

* How can travel demand be reduced while providing access to all facilities?
* How can energy use of transport be lowered?

II.4.1. Intermodal Shift

Changing travel mode, particularly switching from the use of private cars to public transport and, more preferably, from use of finite energy resources to human energy as a source of power can result in more efficient use of transport energy.

Hillman and Whalley (1983) specify the measures necessary to maintain a shift away from a high energy input mode to a low energy input one as follows:

* to maintain efficient and cheap mass transit services;
* to introduce a range of traffic restraint and improved enforcement methods;
* to create safe and attractive environments for walking and cycling.

Most of transport planning policies have been directed towards the minimisation of car dependence by introducing series of measures directly or indirectly related to car use. Lowe (1991) considers the change of transport methods in favour of public transport and "putting the car back into its useful place as a servant" as a prerequisite for having a sustainable transport system: "With a shift in priorities, cars can be part of a broad, balanced system in which public transport, cycling, and walking are all viable options" (Lowe, 1991; p 12).

II.4.2. Measures for Intermodal Shift

One of the main obstacles for intermodal shift is high dependence upon the private car which is the least environmentally friendly mode of transport. In most of the world's major cities, there exists a high level of car ownership which results in the wider use of cars and a higher consumption of non-renewable sources of energy (see Table 2.4). Car users consume the share of others because they carry one passenger with 7 units of fuel in stead of the possible greater amount of passengers in 7 buses (7*45=325 person) using only 1 unit of fuel per bus. Meanwhile cars contribute more to air pollution and noise problems than all other modes (see Lowe, 1990). Those who consume others' share in common goods like road and natural resources should be asked to pay for it. If they were paying, people's choices for transport methods would seem more moderate and realistic than the actual situation.

> "All transport tax, investment, subsidies and transfer payments should be reviewed and amended to encourage environmentally and socially benign modes of travel, and penalize other modes in relation to the damage they cause." (James and Pharoah, 1992; p 85).

The outcome of such a review would include a number of measures to reduce both car ownership and use, while supporting alternative modes. The initial objectives of taxes, incentives and subsidies are economic. Nevertheless, they have several consequences for the modal split of transport. These policies might further effect the amount of energy consumed, pollution, noise level caused by transport and safety, etc.

II.4.2.1. Discouraging Car Use and Ownership

It is necessary to ensure that full costs of transport are taken into account while arranging fiscal measures. The prices paid by users should include not only the costs of making an extra trip by specific mode, particularly by car within a given transport system, but also the costs of any impacts "on other relevant competing activities and on human and natural environment" caused by making this trip (Hanna and Modridge, 1992; p 103).

The fiscal policy regarding car travel can be manifested as either vehicle taxes (for ownership) or fuel taxes, parking fees and road pricing (for usage).

> "Policies to limit traffic should be aimed first of all at regular longer-distance car trips, and car commuting trips to inner and central city locations... The least damaging category of car trip might be the occasional short journey for which no reasonable alternative is possible.... Higher car purchase tax and/or other disincentives to multiple car ownership are required.... Alternative types of access to cars that offer the potential to reduce car ownership, including short-term local car rental, should be the subject of research and experimentation... Comprehensive controls over parking provision and enforcement are required.... Incentives and taxation should be designed to reduce current over-provision, especially at office and commercial locations." (James and Pharoah, 1992; pp 86-87).

II.4.2.2. Encouraging the Use of Energy Efficient - Environmentally Friendly - Modes

Other policies usually have a supportive role for the more intensive use of public transport, walking and cycling.

Policies to encourage the use of a specific mode are usually supported by price subsidies such as lowering the price of public transport, reducing oil prices, or infrastructure investments. It is difficult to predict the possible impacts of these policies, but public transport subsidies will result in benefit to its users whereas most of the benefits of road building are for people who can travel by car.

Revenue from charging road users can be used to finance public transport improvements. Along with the public transport subsidies, routing schemes, establishing new transport structure or extending and improving the existing system make the public transport mode more attractive for its users.

> "There should be heavy investments in the quality of public transport, coupled with disincentives to use private transport. The priority should be the improvement of intra- rather than inter-urban public transport. There should be a substantial shift of expenditure priorities away from provision of road capacity to investment in alternative methods of travel, and away from inter-urban to urban transport.... Interchanges, vehicles and other transport facilities should be developed as a means of encouraging multi-modal transport... Combined transport should be promoted with environmental objectives for .... passenger journeys." (James and Pharoah, 1992; p 86).

Cycling and walking can be made more useable and attractive by providing safe, proper and pleasant environments. Routing schemes and physical planning arrangements are the necessary tools for governments in achieving the intermodal shift from motorised to non-motorised modes of transport.

II.5. Summary

> "Transport is a cost not a benefit... Society will be more energy efficient if the amount of travel can be reduced." (James and Pharoah, 1992; p 76).

If promoting the use of less energy intensive and damaging modes of transport in daily trips is one of the primary goals of transport policies, then it is quite impossible to consider these policy measures separately from each other, due to the fact that alone neither can satisfy the necessary conditions for the intermodal shift.

It is necessary to consider the transport policies which affect the modal split within a wider framework. The policies should cover "the environmental, quality-of-life and other objectives, rather than simply [be] left to market forces of supply, demand and price" (Hanna and Modridge, 1992; p 102). At the same time, making transport more sustainable depends on more than the existence of the above measures. It is also necessary to integrate them with urban development policies for a city which is not car-oriented while encouraging public transport and providing a better environment for cyclists and pedestrians.

The minimisation of travel demand does not mean reaching a point where the demand is zero, but rather reaching a point where the least possible damage to the environment is sustained while people's demand or need for travel is met. Similarly, intermodal shift does not mean the elimination of private cars from urban areas but rather, to locate it in its right place within an integrated transport system.

Stuttgart provides a good example of such a policy. Here car traffic is restrained, while public transport services are extended and improved, and the centre is largely designed for pedestrians. The results of these measures are a dramatic reduction in the share of car trips, and an increase in the proportion of trips on foot, by bicycle and by public transport. Similar to Stuttgart, Copenhagen has become a city of bicycles due to a series of traffic restraint policies, improved public transport and pedestrian areas. In the case of Vienna, where car ownership is high, the use of car and public transport has declined in favour of walking (Sherlock, 1991; pp 167-170).

Although urban transport plans are effective means of ensuring better co-ordination among different transport policies and actions, they are contributors rather than enablers. Planning measures can best serve a better urban transport system if they contribute sustainable urban development by ensuring that people's needs are met by the least damaging forms of transport.

On the other hand, policies might need to be directed to reduce the need for travel as well as the distance travelled. These in turn might reduce the energy consumption of transport. One problem for planners is to find out whether or not there exists any settlement patterns which provide a shift from car-dependent travel demand pattern into a wider use of public transport, walking and cycling.

The policies of urban development which will be discussed in next chapter set up a tool for the realisation of cities which ensure short distance trips with more energy efficient transport modes.

CHAPTER THREE : THE IMPACTS OF SPATIAL STRUCTURE ON TRAVEL DEMAND

The influences on transport energy consumption of the spatial structure of cities are the main concern of this chapter. Relevant literature about the spatial structure of cities which might affect travel demand patterns and energy consumption of transport is surveyed.

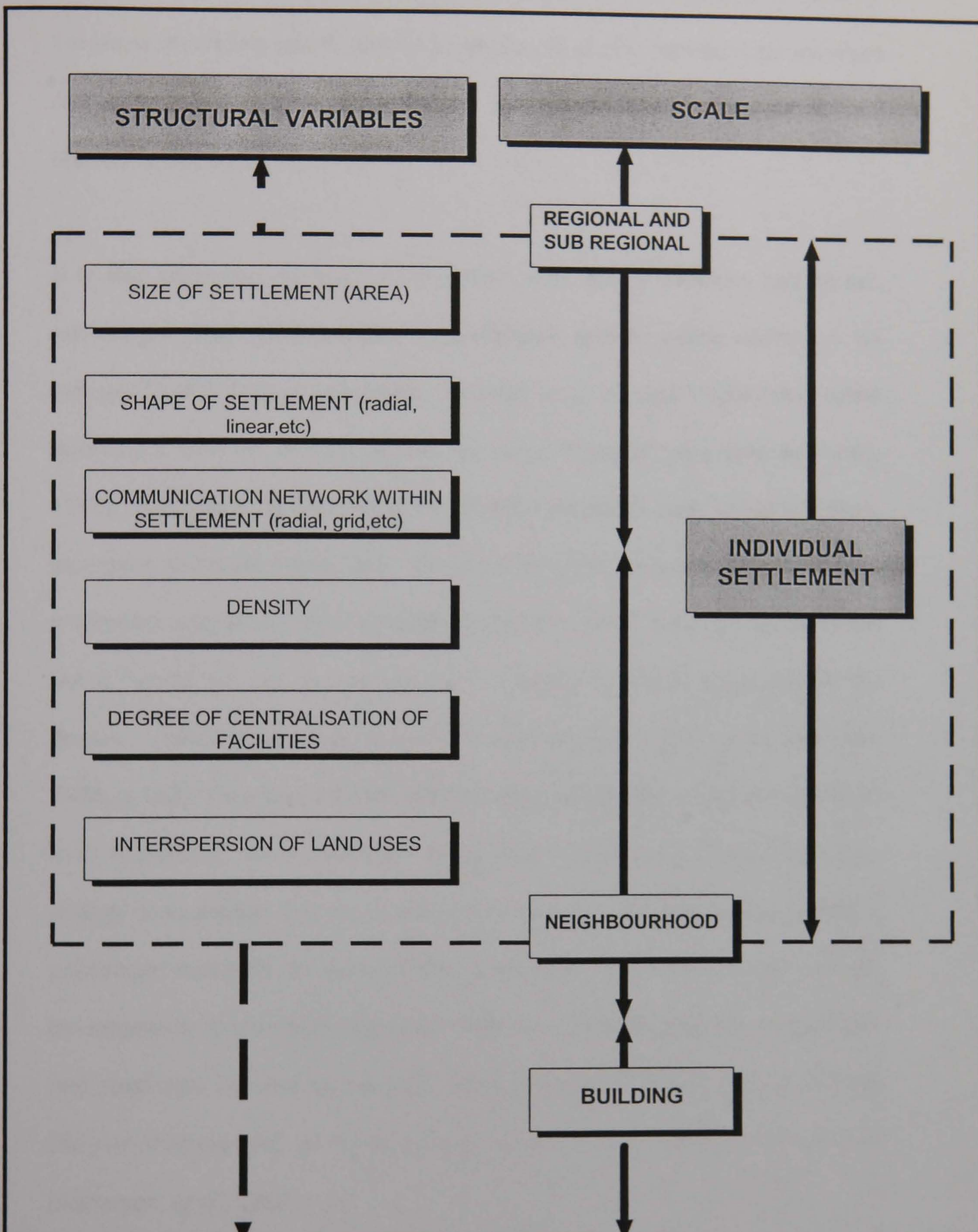
III.1. Introduction

Apart from an acceptance that there is an interaction between physical structure and travel demand patterns, there is little or no agreement as to which settlement patterns might be relatively more energy efficient than others. The results of various studies indicate that some urban forms might have considerable advantages for energy efficient travel demand patterns. They might enable and encourage people to travel less often, for shorter distances, and to use less energy intensive modes.

It is difficult to establish a one-to-one correlation between spatial structure and its resulting energy consumption due to the diversity of structural elements of an area. Owens (1984; p 219) recommends a list of structural variables at different scales ranging from region to community level (Figure 3.1).

In this chapter, variables at an individual settlement level will be reviewed through their possible influences on travel demand.

Figure 3.1. Structural Variables at Individual Settlement Scale



Source: Owens (1984; p 219)

These variables can not be isolated from each other due to the existence of a close relationship among them and the complexity of this relationship. Most of the research shows that to ensure an existence of one condition, for example restricting the size of a settlement, is not sufficient to produce an energy efficient travel demand pattern.

It is also necessary to keep in mind that each spatial structure has certain advantages and disadvantages. A settlement pattern which seems to be energy-efficient from a passenger transport point of view might have some drawbacks in terms of energy used for cargo transport (see Vale and Vale, 1996), or it might cause other environmental problems such as air pollution, increasing domestic energy use. Vale and Vale (1996) argue that, for example, a compact urban form might be energy efficient in terms of passenger transport but it "would not be an easy place for people to grow vegetables in the garden.... which would suggest traditional suburban densities" (Vale and Vale, 1996; p 143). They support their idea by an argument that in order to carry all food necessities for a household living in a compact city results in higher energy consumption and air pollution by transport than the energy saved in passenger transport. In spite of this suggestion, dispersed or low density developments might negatively affect water quality due to the use of fertilisers and pesticides, as well as the solid waste generated. It might also imply the transfer of areas such as farms, or ecologically sensitive areas to urban uses (Anderson, et al., 1996; p 9).

III.2. Possibilities for an Ideal Settlement Size for Energy Efficiency

Debates on reducing travel demand and transport energy requirement have tended to be dominated by city size which is usually measured by population size. As Gilbert and Dajani (1974; p 271) state "city size is a factor which should be included in any analysis of alternative urban forms and their resulting energy consumption of transport.".

Similar to other structural elements, most of the studies use only journey-to-work data showing this relationship. For example, Lynch (1981) provides an example of the positive correlation between travel time to work and city size as an indicator of this relationship. It might not be possible to identify an ideal size of urban area which results in energy efficient travel demand patterns:

> "No one size is an optimum size, even for a single city, but there are a series of thresholds at which certain major benefits and costs are encountered, as growth crosses those limits. These costs then level off as growth rises toward the next threshold of size..... Knowing these thresholds, policy should try to keep just below them, or, if growth cannot be restrained, to jump over them rapidly and by a wide margin." (Lynch, 1981; p 243).

This argument by Lynch can be accepted to a certain extent, but it is necessary to keep in mind that non-work trips still have the lion's share, so patterns and their modal split should be given highest priority in all research on urban transport energy use.

In spite of the multiplicity of components affecting this relationship between energy use and settlement size, most of the data related to the subject indicate that small size urban areas have a smaller amount of travel and energy use (see Maltby et al., 1978 quoted in Owens, 1986; pp 29-30).

Stone (1973) provides a theoretical example for this interaction indicating that average travel cost per person is lower in settlements for 50.000 than in those for 100.000, and higher in settlements for 250.000.

Despite the fact that many factors might influence this relationship, it is worth noting that "travel requirements would probably be lower in relatively small self-sufficient settlements whose inhabitants were content to use the facilities available locally" (Owens, 1986; p 31). There might be some thresholds for a settlement size in which a reduction in the travel requirements for specific facilities, walking and cycling are possible.

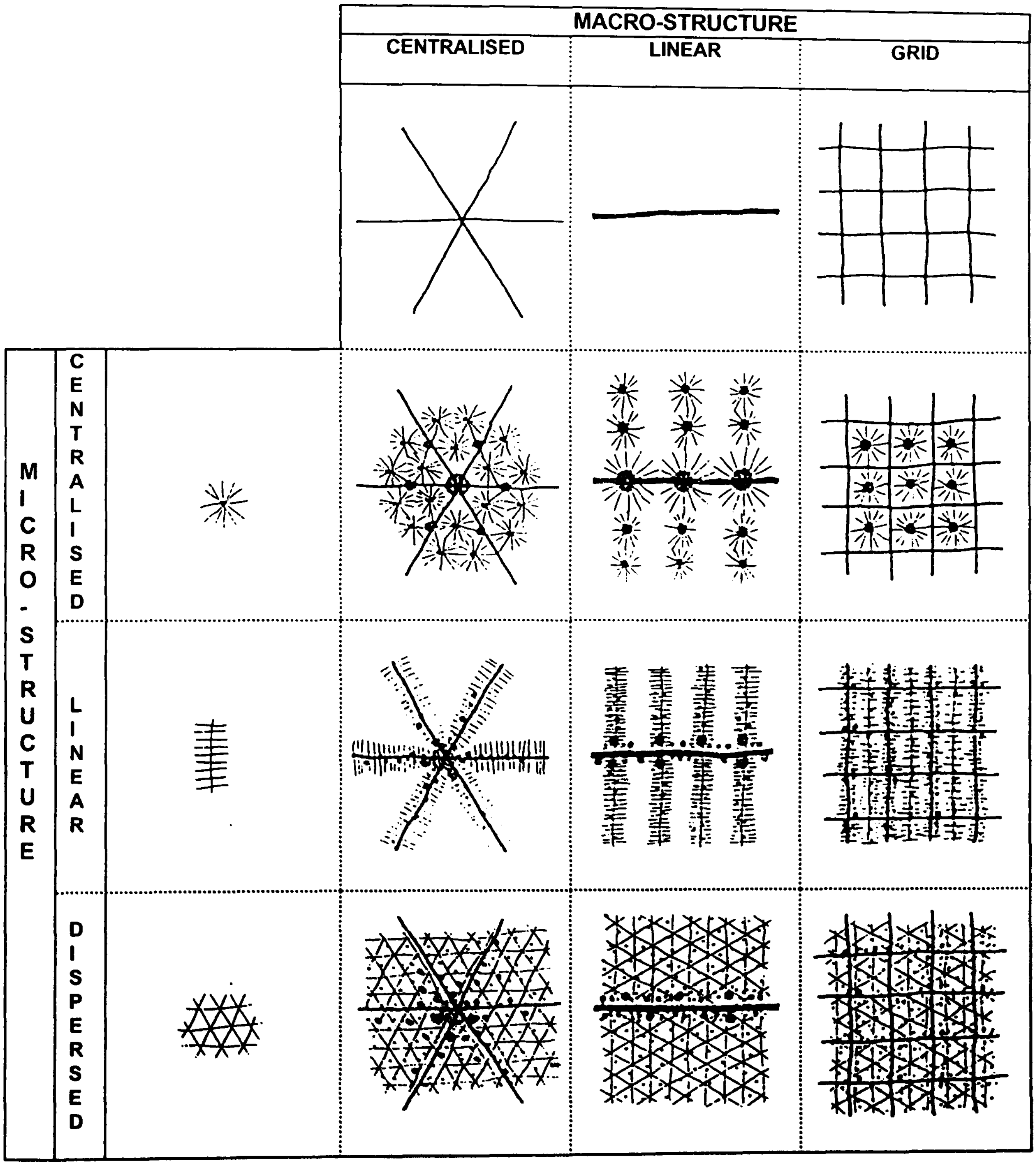
III.3. The Shape of General Pattern of Land Development and Resulting Travel Demand

The shape of the urban development structure is usually named according to the main communication network. There can be different combinations at macro and micro level. (Figure 3.2).

Discussions and research findings about the travel demand patterns of different urban forms focus on three of the land development patterns described by Lynch (1981), namely linear, satellite (multi-nucleated) and radial (Table 3.1).

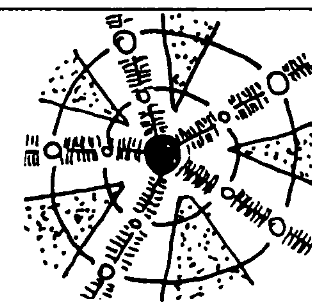
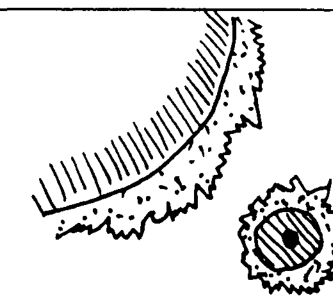
These urban forms might have different versions depending on the level of concentration of facilities and population, or size, or density.

Figure 3.2. Matrix of Possible Micro- and Macro- Urban Structures



Source: Quoted in Stedman (1983; p 22)

Table 3.1. Patterns of City Form

STRUCTURAL VARIABLES	LINEAR CITIES	RADIAL CITIES	SATELLITE (MULTI-NUCLEATED) CITIES
SHAPE	LINEAR CITIES	RADIAL CITIES	SATELLITE (MULTI-NUCLEATED) CITIES
DENSITY	High density along a linear line.	High density along the radials; less intensive uses farther back from them.	Limited, preferably low densities both in main city and satellites.
COMMUNICATION NETWORK	Continuos transport line, equal access to facilities; mass transit; at smaller scale walking and cycling possible.	Radial lines outward from the centre; concentric highway linking radial lines together.	Daily commuting within the satellites and linked to main city.
SIZE	Preferably small scale.	From moderate to large scales.	Limited certain size both for the centre and satellites.
INTERSPERSION OF LAND USES	Concentration along the line and less intensive uses while moving away from the line and no dominant centre.	Mixed use, particularly along the radial axes; single dominant centre at the junction of the radial lines where secondary centres located.	Each satellite has its own centre and local facilities; dominant centre at the main city and local sub-centres at satellites.
EXAMPLE	Madrid	Moscow, Copenhagen	Stockholm
FIGURE			

III.3.1. Linear Urban Form

Linear structures develop along one single line. Linear forms might result in low transport energy requirements if a high concentration of population and activities along the linear corridor are sustained (Edwards and Schofer, 1977; Elkin et al., 1991; p 42). Linear urban forms are usually considered the most suitable for public transport since they require a concentration of generators and facilities. On the other hand, "a fairly even and congested flow can be expected along the canalised public transport route" (Stedman, 1983; p 20) where the distances are long for non-motorised modes.

A linear urban form along which residential, industrial and commercial areas are all located and where public transport operates, promotes the lowest travel time to work and assists the minimisation of travel demand (Jamieson et al., 1967; Gilbert and Dajani, 1974).

Lynch (1981) and Stone (1973) stress that linear forms have more advantages at smaller scales. If the concentration along the linear corridor is on a larger scale, "concentrated-linear configuration is the least efficient option for fuel conservation, because of the traffic congestion due to the concentration of trips along the main axis" (Rickaby, 1987; p 214) and it might also lead to long distance travelling and a less accessible living environment.

In stead of having a large concentration along a linear corridor at a larger scale, a dispersed-linear pattern where a certain degree of integration of land uses is achieved by concentrating the origins and destinations of trips into a small number of routes can be an ideal form for the operation of public transport (March, 1967; Rickaby, 1987; Owens, 1987). Shorter trip length is another advantage of dispersed-linear configuration. While sustaining a certain level of energy efficient travel demand patterns (that is motorised trips by public transport and possibilities for walking due to short travel distances), a high level of accessibility can also be achieved.

III.3.2. Radial (Star-shape - Cartwheel) Cities

"Star-shape or radial or cartwheel" forms have a single dominant centre and secondary sub-centres along radials (for various alternatives see Figure 3.2). Basic land uses are distributed along the radial routes and radial ring routes. Jamieson et al. (1967) named this type of urban form "cartwheel" form of urban development where there is a concentration of population and jobs within the inner ring.

The transport network consists of a smaller number of major routes that extend out from the central business districts (CBD). Trips between different parts of the urban area are usually made by way of the CBD.

This form is usually supported by concentric roads which might become more important as the outer areas diverge further from the centre. If the whole becomes very large, it may be difficult to relate the outer developments with the dominant centre along a linear route which may carry heavy traffic.

Theoretically, there should be local sub-centres along the main axes and mixed land uses along the corridors together with high densities. At moderate scales, it might provide some advantages for in saving transport energy through a wider use of public transport and walking as well as shortened travel distances.

III.3.3. Satellite (Multi-nucleated) Cities

Although fringe and satellite developments are generally known as accelerators of per capita energy consumption, satellite developments may cause lower transport energy use. Since they are self-contained, most of the trips generated are short distance internal trips to the sub-centres. Nevertheless, there might be some degree of dependence on the main city:

> "..., Since satellites lack the diversity of the larger metropolis, especially during their establishment phase, a significant number of long external trips are generated and received from the metropolis. Such trips will consume significant quantities of energy. Furthermore, public transport will be lacking during the formative stage of the satellites, thus most internal and external trips will be by the more energy intensive private transport mode.....Inner suburbs, on the other hand, with high population densities lead to a decrease in total energy use due to the shorter average trip length while leading to an increasing traffic congestion and an increase in the use of public transport. These effects tend to compensate each other in terms of energy consumption." (Sharpe, 1978; pp 133-134).

Lowe (1990) provides an example of a satellite city which has been planned to achieve an energy saving in transport. In Stockholm there are mixed land uses and integrated development with transport and railway routes being well-linked to the urban motor ways. Settlements are located close to stations which provide easy access to jobs both in the city centre and in other settlements. The urban form has discouraged unnecessary driving and parking in the city centre.

Satellite cities can be planned and designed as a combination of dispersed and centralised patterns so that they might contribute to lowering the energy consumption of travel demand. Dispersal of the settlements will favour public transport, while self-contained settlement units can provide better opportunities for walking and cycling at a micro level. This is also the main idea behind the "decentralised concentration" proposed by Danish planners.

III.4. Structural Characteristics of Urban Form and Energy Efficient Travel Demand

Clark (1976) uses the term "structural characteristics of urban form" to denote both form and structure which have two dimensions of measurement:

> "The form dimension ranges from an extreme of concentration of physical structure (and hence activities) to an extreme of dispersion over landscape. The structure dimension is measured on a scale of integration of the various specialised activities and functions." (Clark, 1976; p 12).

Having these definitions, this section will address the impacts of spatial structure on travel demand from these two dimensions of measurement.

III.4.1. Centralised Urban Form versus Sprawled Urban Form

Most of the remaining proposals for energy-efficient settlement patterns can be grouped into two: centralised versus decentralised urban forms, but it is difficult to discuss them separately.

III.4.1.1. Centralised Urban Forms

It appears from most of the studies (see, for example, Gilbert and Dajani, 1974; Sharpe, 1980; Rickaby, 1987; Edwards and Schofer, 1977; Owens, 1978; Hillman, 1984; Sherlock, 1991) that a concentration of activities might result in more energy efficient travel demand patterns.

Centralised urban forms are likely to be energy efficient because they reduce travel distances and maximise prospects for public transport. There are also some radical views like solving urban development problems within the boundaries of existing urban areas while avoiding sprawl.

Concentration of development is associated with an improved accessibility and might assist energy saving in transport by reducing trip lengths, while providing better opportunities for walking and cycling. Also, it reduces car usage. Dantzing and Saaty (1973; pp 80-83) recorded total energy savings of 15 per cent due to the reduction in car usage in a centralised urban form.

The reduction in average travel time is usually mentioned as another advantage of this form (Stedman, 1983; pp 18-19, Jamieson et al., 1967; p 216). Dantzing and Saaty (1973) analysed the travel time saving for the working population in a centralised form and found that it can vary from one to three hours per day.

Besides these advantages, the transport system may not operate at maximum efficiency because of traffic congestion at central areas and peaking of demand. If, for example, the proportion of employment in the city centre is high, then the traffic problems become more severe because of increasing congestion. It is thus, necessary to avoid "over-centralisation" as in the case of Hong Kong (Hillman, 1984), while maintaining the small scale concentration which may eliminate most of the disadvantages of centralisation.

Beyond a certain level of concentration within the existing city, it might be better to locate new developments outside but near to the existing city. Thus, "proximity" between the new development concentrations and the existing urban areas should be arranged in such a way that it will not cause any congestion. If the new development centres are relatively far away from the main centre, then energy savings might be lost due to the increasing length of the trips to those activities which remain in main centre. However, it is obvious that the concentration of new developments into smaller centres outside the existing urban areas might save less energy than concentrating them into an urban area. Rickaby's (1981) comparative analysis of six settlements' patterns stresses the need to locate the concentrated development as near as possible to the existing centre:

> "It appears that modest concentration of development into local centres within the hinterland of the existing city both saves fuel in transport and improves accessibility." (Rickaby, 1987; p 214).

Breheny and Rookwood (1993) criticises all radical views supporting "centralised-compact city" due to the urban decentralisation which has been experienced and "dominant trend" in the big cities of developed countries since 1945. They argue that energy saving achieved by centralised-compact cities is very modest and might be achieved after many years.

III.4.1.2. Dispersed Urban Forms

Hillman and Whalley (1983) argue that a dispersion of living patterns can easily lead to an increasing cost of transport, as a result of extending travel distance and increasing use of private modes, while providing some economies through reducing the total number of daily trips.

Dispersed structures, whether the overall land development pattern is in the form of a grid or radial or linear (see Figure 3.2), are usually considered to be one of the most energy-intensive urban forms and are thus undesirable from energy conservation aspects (Hanson,1992). Origin and destination areas are too dispersed making them potentially unsuitable for an efficient public transport operation. In addition, distances are likely to be too long for walking and cycling. In contrast to the centralised urban form, dispersal might result in long distance commuting, usually by cars, and increasing travel times.

The importance of proximity both at micro and macro levels has been mentioned in the preceding section. An example, the case of Melbourne provided by Sharpe (1980), also supports this idea while indicating that the residents of outer areas might have higher per capita energy consumption rates. That is to say they might make more trips to inner areas than the inner residents make to outer areas of the city. Sharpe (1980; p 209) noted that 20 percent of total energy consumption of transport is within a circle of 10 km diameter in Melbourne city where the density of traffic and degree of congestion is highest.

An increasing distance from the centre might not be the only reason behind high energy consumption. Modridge (1985) also obtained a high correlation between dispersal and energy use by comparing the data for London and Paris, two very different strongly centralised European cities which have been decentralising over the last few decades. He argues, however, that the main reason behind the high energy consumption of transport in dispersed patterns is not dispersal but rather the high level of car ownership. Regardless of the strong correlation between car ownership and urban sprawl, if the dependence on the inner city areas can be lowered by providing necessary local facilities, and if the number trips to the inner city by those living in outer areas can be minimised through traffic restriction measures, then there might be some possibilities for maintaining energy efficient travel demand patterns within sprawling urban patterns.

There are also views that decentralised forms may provide many advantages for energy saving and sustainability since it is a return to "rural values" (see Owens, 1991 and Vale and Vale, 1996 for example). Breheny and Rookwood (1995) consider this approach "unrealistic" since people would not stop travelling if they grow their vegetables and use telecommunication facilities at home.

One of the most important prerequisites for an energy-efficient dispersed pattern might be sustaining a small scale integration of land uses in an arrangement of almost self-sufficient settlements (see section III.1.1.3.). The dispersal of "compact, small-size, and self contained" settlements at macro level may provide the backbone for a better transit system while introducing better opportunities for walking and cycling at micro level.

Although energy efficient urban development form can not be standardised, both centralisation and decentralisation might be energy efficient.

Owens (1992a) mentions the possibilities of having decentralised land uses which are related to the residential areas "either within a single large urban area, or to form free standing settlements which may or may not retain links with the original centre." (Owens, 1992a; p 90). This type of decentralisation is called as "decentralised concentration which is usually regarded as energy efficient since people tend to use jobs and services close to them. It is a combination of centralised and decentralised urban forms and assumed that they are self-contained.

III.4.2. The Effect of Land Use Pattern on Travel Demand

The degree of integration of various specialised activities and functions can provide another way of measuring the impacts of spatial structure on transport energy use. The location of activities themselves, and their position relative to others, determine the traffic generated by each different land use.

> "Urban form is the physical arrangement of residences, work places, etc. Urban structure is the pattern formed by the connection of these elements in the daily activities of the area's residents.... Given a physical pattern of places, the connections between them -from home to work, from home to shopping centre, etc.- must be established... Urban form describes the static, physical setting itself and that urban structure describes the dynamics of a particular physical setting." (Hemmens, 1967; p 32).

People's modal choices, the distances they need to travel, and the frequency of their trips are determined and shaped by the land use pattern within a city. Additionally, land use shapes the transport system within a city by regulating whether a new or an existing transport system can attract enough users to operate efficiently. Regardless of the Hemmens's (1967; p 38) argument, that "evaluation of alternative land-use patterns may be considered without reference to particular transport systems" the location of activities can be arranged in a way that reduces the need to travel and dependence on private motorised modes.

The spatial linkage between different types of activities in urban areas can be arranged in a way that will help to control the amount of energy consumed in transport and the overall travel demand. A decision related to each of the activities, such as place of work, residence or shopping, is restricted or conditioned by the place of the others. For example, residential choice might affect the decisions about where to go for shopping. After choosing the place of an activity in a specific district and neighbourhood, choice of transport mode, either public or private transport or both, is accordingly made (de la Barra and Rickaby, 1987).

III.4.2.1. Mixed Land Uses in Residential Areas

> ".... Land use changes alone will not guarantee transport energy saving, but the smaller the physical separation, the lower travel needs are likely to be and the more feasible it is to meet them by energy-efficient and environmentally friendly modes such as walking and cycling." (Owens, 1991; p 24).

To achieve less transport energy consumption, it might be necessary to promote an urban form which combines jobs, homes and services. These facilities can be located near to a public transport network, preferably rail and other non-private motorised modes. Additionally, the provision of the car infrastructure can be restrained (Lowe, 1990).

Watt and Ayers (1974) argue that urban travel demands are not affected by mixed land uses but most other researchers agree that mixed land uses and concentrations of different facilities near to residential areas result in changing travel demand patterns. These changes are usually characterised by minimisation of total amount of travel and transport energy use. Most scholars (see for example Longmore and Musgrove, 1983; Elkin et al., 1991; Lowe, 1990; Newman and Kenworthy, 1989a) recommend the mixed-use development which offers several possibilities for energy saving. Empirical findings also support these ideas: Markovitz's (1971) comparative study about clustered and non-clustered residential and non-residential land uses shows that a concentration of different land uses, both non-residential and residential, lowers the travel demand by as much as a 65 per cent in trip generation rates. In the 1990's, the effects of mixed land use on travel might not lower trip generation rates due to increasing car ownership, changing life style, etc. Additionally, in countries like Denmark and Netherlands, there has been an increasing cycling in daily trips.

Traditionally, the object of planning in most of the industrial countries, is to segregate residential areas from jobs, shops and other centres of activity and to protect public health by excluding heavy industrial areas from residential areas. Most developing countries have imported the industrial world's experience and zoning laws, the consequence of which is an excessive isolation of activities by creating distances too long for walking or a bicycle rides (Potter, 1984). A more rational approach may be to integrate residences not only with a workplace but with other amenities, so that they are easily accessible by walking, cycling, or public transport. Homes, jobs and services can be brought into a relatively compact urban centre so that a high level of accessibility with little need for movement can be achieved. It might be possible, for example, to reduce the distance of travel to work by changing the place of residence or place of employment. As Clark (1976) mentions, minimum increases in total travel might be achieved if new employment areas are located near to the developing population concentration.

The location of residence and workplace relative to each other is not the only factor affecting travel demand, since work is not usually the primary journey purpose. For example, in the UK 35,7 per cent of trips per person per week were work trips in 1965, and in 1985 the share was 23,3 per cent. On the other hand, social entertainment journeys had shares of 20,7 per cent and 25,1 per cent respectively (Banister et al., 1990; p 8).

Location decisions by households, on the other hand, have become more complex. Many decisions might not be constrained by work place, as assumed in most of the transport analyses, due to changing life style, fluctuations in the housing market, the increasing number of working people within the household, or the quality of facilities and living environment.

Car ownership and use are other important factors controlling changes in land use patterns. "Increasing car ownership makes almost every location more accessible by car, and long distance commuting now seems attractive" (Banister et al., 1990; pp 52-53). The growing mobility of much of the population due to a high level of car ownership adds more to the tendency to have more widely spread land use patterns, as was the case before the oil crises of the 1970's. Increasing physical separation of homes, jobs and other facilities that are not served by public transport or do not provide an environment for walking and cycling, further encourages car use. These arguments illustrate the vicious circle between car ownership, car use and sprawling land use pattern.

Public policy also influences the provision and location of homes and other facilities generating travel, and people's decisions about where to live and which facilities to use.

> "It is necessary to guide, accommodate and sometimes constrain changes in land use arising from continually evolving patterns of living, working, shopping and leisure activities....The distribution of people and jobs has been shifting together with increasing population trends towards decentralisation from major urban areas. Travel and transport developments have permitted and interacted with major land use changes. The overall result has been the evaluation of more energy-intensive land use and activity patterns." (Owens, 1991; p 12).

Policies related to land use and transport have different effects upon different social groups, which will in turn may create different patterns of travel demand. It is necessary to consider each of the different land uses and their locations as either "energy producer" or "energy consumer", because the

> "relative role of housing areas, places of employment, leisure destinations are directly affecting distances and accessibility when new development occurs, and indirectly affecting distance travelled and ownership and use of cars." (Hillman and Whalley, 1983; pp 108-109).

If we are talking about a new housing development, it is apparent that its location leads to new patterns of home-based and non-home-based trips.

III.4.2.2. Agglomeration and Dispersal of Facilities: Local Accessibility versus Out-of-Town Developments

Depending on the proposed and existing land-use pattern, planners also encourage or define the way in which basic facilities like health services, hospitals, schools and shopping areas should be located. All these facilities either together or alone might set up a centre. In most of the discussions about energy efficient cities, there is a general agreement that city centres should be designed to achieve a

> "hierarchical model in which there is one dominant centre, including all the highest , most intense, most specialised activities. At a distance from this centre, there should be a number of essentially equivalent sub-centres, of lesser size, serving only a portion of community, and containing less important, less intense, or less specialised activities, many of which will "feed into" the uses of the main centre...... The star shape city, satellite concept, and the neighbourhood idea, are all married to this hierarchic notion." (Lynch, 1981; p 389).

Centres may contain a concentration of distinct activities which should be separated in space: it is possible to talk about a commercial centre, or an office centre, or an education centre, etc. The quantity demanded from each of these facilities defines its size. As Hemmens (1967) mentioned, the location of employment and commercial facilities might be one of the most important elements affecting travel requirements, since they are the destinations of most daily trips. It is obvious, on the other hand, that people's daily activity pattern has changed and as many scholars argued (see for example Banister et al., 1990) people have a variety of reasons to travel in 1990's.

There is an increasing tendency to concentrate facilities in space. In addition to economic and social benefits, centralisation of facilities with high levels of specialisation creates certain use conflicts, such as service congestion, noise, etc. Out-of-town shopping centres, which are widely seen in most developed countries, highly centralised hospitals and -off- centre campus locations for universities or business parks, have many drawbacks, even though Gilbert and Dajani (1974) argue that concentration of activities results in the reduction of amount of travel to those activities due to low level of accessibility.

Because of an increasing car use, this might not be true. The experience with out-of-town shopping centres shows that:

> "As such centres depend on large numbers of people driving substantial distances to reach them, they are highly questionable in sustainability terms." (Hall, 1993; p 9).

Not only in terms of out-of-town shopping centres, but for all facilities, the domination of a single land use, if not well supported by public transport services, might lead to long distance travelling by car. These out-of-town developments, e.g., business parks, located on the edge of cities with ready access to a motorway or other major highways, are accessible only by car (Gossop and Webb, 1993).

Padmore (1992) provides one example of an out-of-town retail development and its consequences in Nottingham:

> "traffic congestion caused by redirecting traffic to a specific network and to a particular area is one of the drawbacks of out-of-town developments. New development proposals, especially for basic facilities out-side the inner city area, influence the amount of traffic generated for it. Depending on its location, it initiates a redistribution of traffic while causing a negligible increase in total trips. The main characteristic of the patterns of travel demand is longer travel distance by motorised modes." (Padmore, 1992).

Although out-of-town developments are usually considered as a cure for the access and parking problems of city centres, by reducing the number of cars driven to city centre, they in fact usually serve one party only: car owners, whereas one of the aims of planning activity is to provide equal opportunities and equal access for all.

Elkin et al. (1991) address the need to encourage and improve local facilities. If reducing the amount of travel and distance travelled, and a providing shift away from car-oriented cities are the main concerns, then out-of-town developments might not help. Moreover, they might create additional negative consequences, namely an increase in car dependent travel demand patterns (Hillman, 1984).

All the arguments about out-of-town shopping centres are valid for other out-of-town developments, such as schools, hospitals or sports facilities. For example, over-centralisation of education facilities outside the city and larger schools, will lead pupils to travel further and therefore adopt motorised travel (Elkin et al., 1991; p 69).

Like schools, "the transfer of offices from the city to the periphery raises car use by 10-40 per cent and reduces travel by public transport and bicycle by 4-8 per cent" (Gossop and Webb, 1993; p 116). Similarly, in the case of larger centralised health facilities which are in off-centre campus location:

> "gains in operational efficiency are likely to be made at the expense of user accessibility, which reinforces dependence on the car creates much hardship for those forced to depend on an increasingly uncertain and expensive bus services. Research from the Netherlands has shown that the relocation of two of Amsterdam's inner city hospitals led to 116% increase in the total number of car-kilometres travelled." (Hall, 1993; p 9).

Instead of having specialised and centralised, often campus-style larger facilities, it might be preferable if more and smaller units were available. There is no doubt that there are certain agglomeration economies due to concentration of the same type of activities in a specific area. There is a general expectation that out-of-town shopping centres and dispersed communities would lead a better life for everyone; but there can be some diseconomies. It is obvious that:

> "no one is going to benefit in the long run from the combined effects of shops being bigger, fewer and further away... Much more significant in the long term, however, is the fact that out-of-town-centre retailing encourages low-density residential development which increases travel and dependence on the car which, in turn, will lead eventually to California-style suburban congestion, a deteriorating physical environment and a dangerous level of atmospheric pollution." (Sherlock, 1991; p 177).

III.4.3. Population Density : High Density versus Low Density

Another structural variable in discussions about urban form and transport energy requirements is density. The same shaped urban forms may have varying energy requirements as a result of differing densities (see Edwards and Schofer, 1977), and these effects can be observed both in the inner and outer areas of cities.

There appears to be a general agreement that low densities militate against energy efficiency. Low density urban forms with dispersed activities might be convenient to spread traffic volume over the widest areas possible. Yet, many disadvantages have been experienced:

> "The low-density development means that the population served by local facilities is small and only basic services such as a shop or two, a school, playing fields, and a community hall, are within walking distance of the home... Such an urban structure means that a high proportion of journeys are required to be by motorised forms of travel." (Potter, 1984; p 12).

Low urban densities and dependence on the car go hand-in-hand. A study of the world's 32 major cities also shows a high correlation between low urban densities and high level of private car use. (Table 3.2).

In the US and Australian cities where land use density is low, private car use is relatively high and the shares of public transport use, walking and cycling are low. For example, in Boston where the land use density is 18 persons and jobs per hectare, 74 per cent of all trips by workers are made by private cars, whereas the shares of walking and public transport rides are 10 and 16 per cent respectively. On the contrary, in most of the European cities having higher population densities, public transport use is higher than the US and Australian cities. In Paris, public transport has the highest share (40 per cent) among all modes including walking and cycling, while the land use density is 70 persons and jobs per hectare.

Table 3.2. Urban Densities and Modal Split of Travel Demand by Workers,1980

	LAND USE DENSITY (population+jobs/ ha)	PRIVATE CAR (%)	PUBLIC TRANSPORT (%)	WALKING CYCLING (%)
BOSTON	18	74	16	10
L. ANGELES	31	88	8	10
NEW YORK	29	64	28	8
WASHINGTON	21	81	14	5
MELBOURNE	23	74	20	6
SYDNEY	25	65	30	5
AMSTERDAM	74	58	14	28
COPENHAGEN	47	37	31	32
LONDON	86	38	39	23
PARIS	70	36	40	24
HONG KONG	403	3	62	35
TOKYO	171	16	59	25

Source : Kenworthy and Newman (1989a)

"The strong negative correlation between oil use (or private car use) and the urban density" (see Newman and Kenworthy, 1989b) can also be observed within an urban area. Differentiation of population densities within the urban area also confirms that the more intensive the population distribution, the less will be the energy consumption of transport. For example in New York's Metropolitan Areas, where the outer area New York is the least dense urban area within the Metropolitan boundaries and has the highest energy use. On the other hand, in the inner area energy use reduces while urban density increases. The average oil consumption is the smallest in the central city which has the highest urban density within the Metropolitan boundaries.(Table 3.3).

Table 3.3. Petrol Use and Urban Density by City Region in New York,1980

AREA	PETROL USE (MJ per capita)	URBAN DENSITY (person per ha.)
Outer Area New York	59590	13
Whole City (N.Y. Tri State Metropolitan)	44033	20
Inner Area (City of New York)	20120	207
Central City (New York County + Manhattan)	11860	251

Source : Newman and Kenworthy, 1991; p 263

Newman and Kenworthy (1991) suggest that there is a threshold level of urban density (30 to 40 people per hectare) below which reliance on the car rises. It is apparent from their findings that even moderate density changes cause a shift in the energy consumption of transport. For example, a 60 per cent decrease in density corresponds with a 285 per cent increase in petrol use per person (Newman and Kenworthy, 1989a).

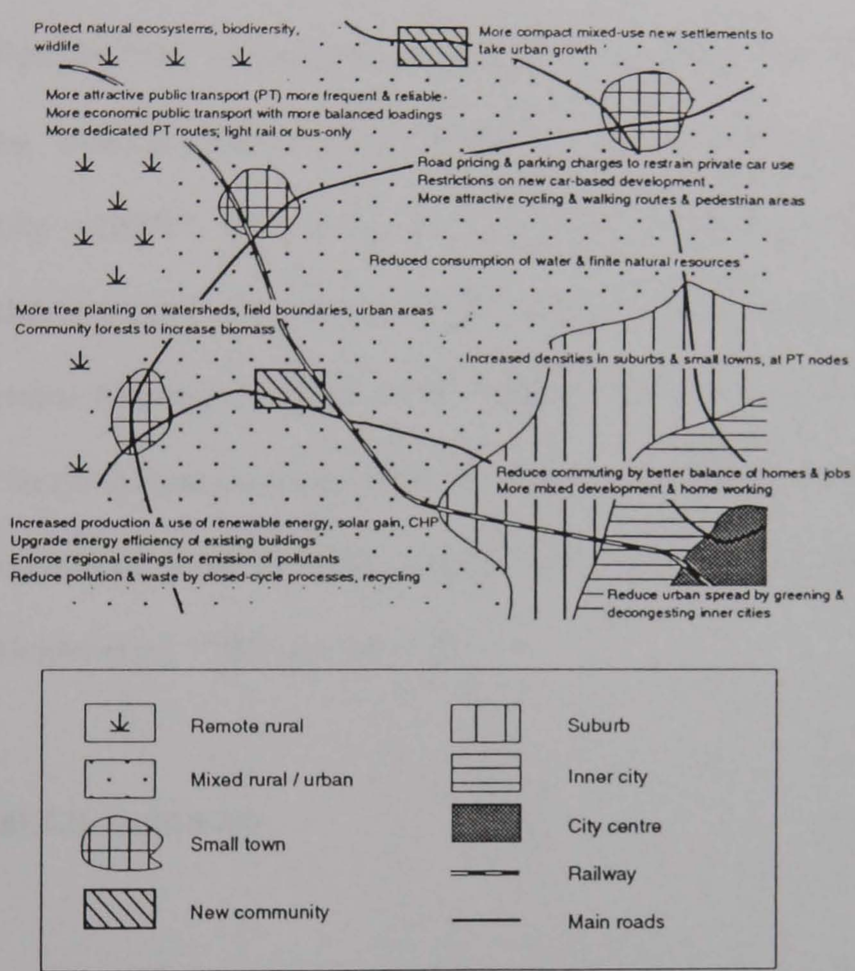
Whatever the other structural characteristics are, sustaining a certain level of density might support better transport services, lower travel demand patterns and use of more energy efficient transport modes. Nevertheless, besides density, the clustering of different activities might be more effective in some cases. Newman and Kenworthy (1989) try to investigate the correlation between overall urban density and transport energy use, but there may be other factors such as income, car ownership or dispersion of different activities which should also be considered. It is clear that the density of an urban form may provide some kind of intermodal shift from private motorised modes to public transport and non-motorised ones. If car ownership is high, it is difficult, even impossible, to restrict its use, but it might be possible to enable people to use other modes. One way may be "..to encourage urban development that is dense enough to promote alternatives to cars" (Lowe, 1991; p 20). As many authors point out new development and redevelopment at high densities might reduce average trip lengths and hence reduce energy consumption, while leading to lower physical separation of activities (Clark, 1974; Roberts, 1975; Edwards and Schofer,1977; Sharpe, 1978; Owens, 1984).

III.4.4. Social City Region

The above discussions on the possible effects of land use patterns on travel demand concentrate on compact - high density - and decentralised - low density - urban development forms which Breheny (1993) regards as "unrealistic, impracticable and undesirable" from the sustainability point of view.

Instead of these two urban developments, Breheny (1993; p 72) suggests "the whole inter-dependent regional complex" which he calls a **"Social City Region"**. In this type of development pattern, policies can be formulated according to the diverging necessities of each part of the region. That is, the measures aiming at sustainability may differ among city centres, inner city areas, city suburbs, small towns and new communities, mixed urban rural areas, and remote rural areas (Figure 3.3). In order to meet differing conditions, a variety of approaches, each suiting one of these six settlement levels, should be determined (Breheny, 1993).

Figure 3.3. The Social City Region



Source: Breheny and Rookwood (1993; p 161)

Social city region, in fact, is a combination of all possible urban forms for an existing and future proposals for development. Thus, Breheny and Rookwood (1993) call this approach as "MultipliCity" approach to sustainability.

At each settlement levels, policies for sustainable urban development differs. The overall objectives related to land use and transport in such social city region are:

> "Shorter travel to work and for daily needs.
> Much higher proportion of trips by public transport.....
> More concentrated development served principally by public transport."
> (Breheny and Rookwood, 1993; p 158).

Policies then, should be directed to reduce urban decentralisation and dispersal by "making inner city housing more attractive, increasing average densities in city suburbs and small towns, using more concentrated forms for new development", to reduce travel distances by "more mixed developments and more housing in major employment centres", and to reduce road traffic by "locating new developments so as to reduce travel demands", to reduce private motorised trips by "using opportunities to reshape urban areas" (Breheny and Rookwood, 1993; pp 159-160).

III.4.5. Summary

In order to achieve more energy-efficient configurations, the possibilities seem to be "(either) to direct new development into the existing urban areas, thereby increasing its density, (or) to direct new development into small satellite centres within the city hinterland" (Rickaby, 1987; p 218). It might be necessary to promote changes with respect to the characteristics of each area at different scales and to define the solutions separately, instead of using the same prescription for all urban areas. Decentralisation of certain activities to suburban centres and increasing housing within and near to these central areas may contribute to reducing trip generation in city centres.

III.5. Summary

> **"The dream of living where you want and working where you want regardless of distance travelled becomes a nightmare when a large number of people try to realise it." (Sherlock, 1991; p 136).**

As Edwards and Schofer (1977) pointed out "the relationships among urban structure, transport networks, and energy consumption of passenger travel" need to be understood. Lower travel demand, shorter travel distance and wider use of less energy intensive transport modes than the actual situation, should be supported throughout the planning process.

Uncertainties about social preferences and future needs, on the other hand, complicate decisions on different types of physical arrangements in cities for energy saving: which combinations will provide more energy saving? "Linear or radial or spread cities", "centralised or decentralised urban forms", "separation or integration of different land uses", "high or low densities of population", or "dispersion or agglomeration of facilities"? Which will minimise the increase (or maximise the decrease) in the travel demand?. It is clearly apparent that there is no ideal land-use pattern which certifies the absolute conditions for maximum energy saving in transport, because several factors, spatial as well as non-spatial ones are involved.

Each settlement pattern might have certain positive and negative points for reducing transport energy consumption and accordingly be preferable on energy grounds. They might also have non-energy advantages and disadvantages that should be kept in mind. There might be some gains in terms of energy saving together with loss of other benefits or vice versa.

Public willingness to travel less, to shorten distances and to reduce car use is also important. Similarly, factors like socio-economic ones, rather than technology of transport and spatial structure, also shape travel demand and energy use.

PART THREE : PROBLEM DEFINITION IN TURKISH CITIES - THE CASE OF ANKARA

CHAPTER FOUR : DESCRIPTION OF STUDY AREA : ANKARA

This chapter outlines the characteristics of the study area, Ankara. It aims to provide broad background information about the city as a whole. Meanwhile, some of the factors affecting the travel demand characteristics of Ankara will be covered briefly within a historical overview.

The first section reviews the factors affecting the urban travel demand characteristics of Ankara. The factors included in this section have either direct or indirect influence over transport system and travel demand patterns. The second section summarises urban development policies as a whole at municipal level. It presents the urban form policies with reference to planning experiences in the past. The last section summarises the travel demand characteristics of the city, according to the results of the "Transportation Master Plan of Ankara" finalised in 1987 and updated in 1992.

IV.1. Factors Determining the Urban Travel Demand in Ankara

As a capital city, Ankara has been an attractive to migrants for last 50 years. It has been under the pressure of migratory movement both from urban and from rural areas. It therefore has dynamic population and employment structures, changing rapidly over time.

In addition to social and economic indicators, the spatial distributions of population and employment have also been changing. Other constraints, that are naturally given or are the products of changing social and economic structures, also shape the urban development process and travel demand pattern of the city. Beside national or regional circumstances, a city itself defines its urban development strategy, and limits this development according to its own dynamics. The following subsections discuss some of these dynamics under separate headings, but we should keep in mind that they are strictly interrelated.

IV.1.1. Natural Constraints

Natural constraints do not have a direct effect on the travel demand characteristics of city, but their influence on the urban development process indirectly affect them.

The topography of Ankara is a "U" shaped valley where the open end looks towards the western corridor. As a result of its topography and increasing population, rapid urban development in Ankara resulted in an increasing air pollution problem that reached very dangerous levels during the late 1970's and the 1980's.

Although natural constraints determine an urban form and can contribute to the urban development process, social and economic factors are sometimes much more effective as the determining force and this is the case for Ankara. Factors such as the land market, that is ownership and price, income level, migration and establishment of central governmental facilities, etc. are important elements in the formation of Ankara's urban macroform.

IV.1.2. Population and Employment Structure

IV.1.2.1. Population

In 1925, Ankara was only a small town of approximately 25.000 people. Twenty-five years later, it was the second largest city in Turkey with a population of 290.000, and it has the highest growth rate of the country's nine cities of 100.000 and over. From 1925 to 1950, the population of Ankara quadrupled. In 1927, 3.25 per cent of the total urban population lived in Ankara. This ratio reached 8.32 per cent during the 1950's because of the migration from rural areas. By the end of the 1960's, the urban population growth rate was higher than the national average. Correspondingly, Ankara is the second largest metropolitan area having 3.6 per cent of the urbanisation rate between 1980 and 1985. For the last 20 years this increasing tendency has continued and now 8 per cent of the total urban population lives in Ankara.

Like the population composition of Turkey, Ankara has young population, 30 per cent of which is below 14 and 65 per cent of which is aged between 15 and 64, with males comprising nearly 50 per cent of the total population.

Although migration from other provinces to Ankara now shows a decreasing tendency, it has a significant influence on population growth. In recent years, nearly 50 per cent of the population growth resulted from migration to the city, mainly from rural areas. (Tekeli and Guvenc, 1987; p 21).

The area of Ankara within municipal boundaries was 14.000 hectares in 1970. It expended to 27.000 hectares in 1985 and it was estimated that the size would be 34.000 hectares by 1990. (Altaban, 1987; p 147). In 1995, it reached 60.900 hectares.

The overall population density was 83 persons per hectare in 1985 and 52 in 1995.

IV.1.2.2. Employment

In 1990, 31 per cent of the total population of Ankara is economically active, while 44 per cent of the population aged 12 and over is either unemployed and seeking a job or employed. Most of the working population is employed in services. Although the percentage of males at work is greater than that for females, the percentage of women at work increased during the ten years from 1980 to 1990 (Table 4.1).

Table 4.1. Changes in Employment Structure (1980-1990)

	1980	1990
Percentage of Economically Active Population[1]	31.10	30.94
Percentage of Economically Active Population Employed in Service Sector	59.26	59.43
Percentage of Economically Active Population Employed in Manufacturing Industry	15.95	15.44
Percentage of Males Employed[2]	49.76	54.09
Percentage of Females Employed[2]	4.92	12.69

Source : SIS (1990b) and Turel (1987b)

As a capital city, the service sector is not only an effective factor in an economic growth of the city, but also one of the important determinants of the urban development and urban form, because of its distribution within the city.

The rate of industrialisation in Ankara is not as fast as its rate of urbanisation. Sixteen per cent of the economically active population is employed in industrial activities. Although Ankara is not an industrial city, one should accept that there have been significant industrial developments and its relative importance has been increasing in the last few years.

IV.1.3. Income Groups

Income differentiation reflects itself among the residential areas of Ankara. Six income categories were defined in 1980, by considering car ownership levels in each district of Ankara (Turel, 1987c)[3]. Higher income groups are concentrated

[1] Employed or unemployed person seeking a job.
[2] Aged 12 and over.
[3] Car ownership figures at district level range from 10 to 100 cars per thousands in 1980. The recent study done by EGO in 1992 shows that upper bound of car ownership level increased from 100 to 220 cars per thousand within the boundaries of a district.

around the southern part of the city centre and along the western corridor where new residential developments take place. Income groups are ranking outwards, like concentric zones around the CBD, from high to low. Lower income groups are usually settled in low cost housing areas which are quite far away from the CBD. In recent years, high and upper-middle income groups have tended to move out from the inner city to its outskirts, particularly in the vicinity of the Ankara-Eskisehir and Ankara-Istanbul motorways.

Income not only influences spatial distribution of residential areas, but also the transport structure of a city. In Ankara, the car ownership ratio has parallel tendencies with income level. It accelerates travel demand directly. It may further affect travel demand through decisions for residential location which are stimulated by income level.

IV.1.4. Housing

After the Founding of the Turkish Republic in 1923, there was an increasing need for housing to keep up with population growth. The government was involved in the housing market through the provision of credit and the construction of houses in order to meet this need.

In Ankara, housing developments originally took place near to the CBD. 1930 was one of the turning points for the housing market of Ankara. In this year government gave up housing construction and cut down on credit because of economic crises. These policies entailed housing shortage. This was the first time that squatter houses (known as *gecekondu* which means built at night time) were being built as a solution for low-income people's housing need in Ankara. Most of the high and middle income families' dwellings were single houses that were built individually.

During the 1950's, the government began to support housing projects by providing land with reasonable price and credit but, as a result of the high population growth rate, increasing housing needs together with rising land prices were added to the problem. In order to reduce land cost, the density in the built up areas was increased vertically by the construction of many of high-rise buildings. Because of increasing costs of construction, legal, institutional and spatial organisations were necessary.

From the beginning of the 1970's, cooperative (mass) housing projects were supported by providing credit and land. This was another important turning point in the housing market that led to the suburbanisation period in Ankara.

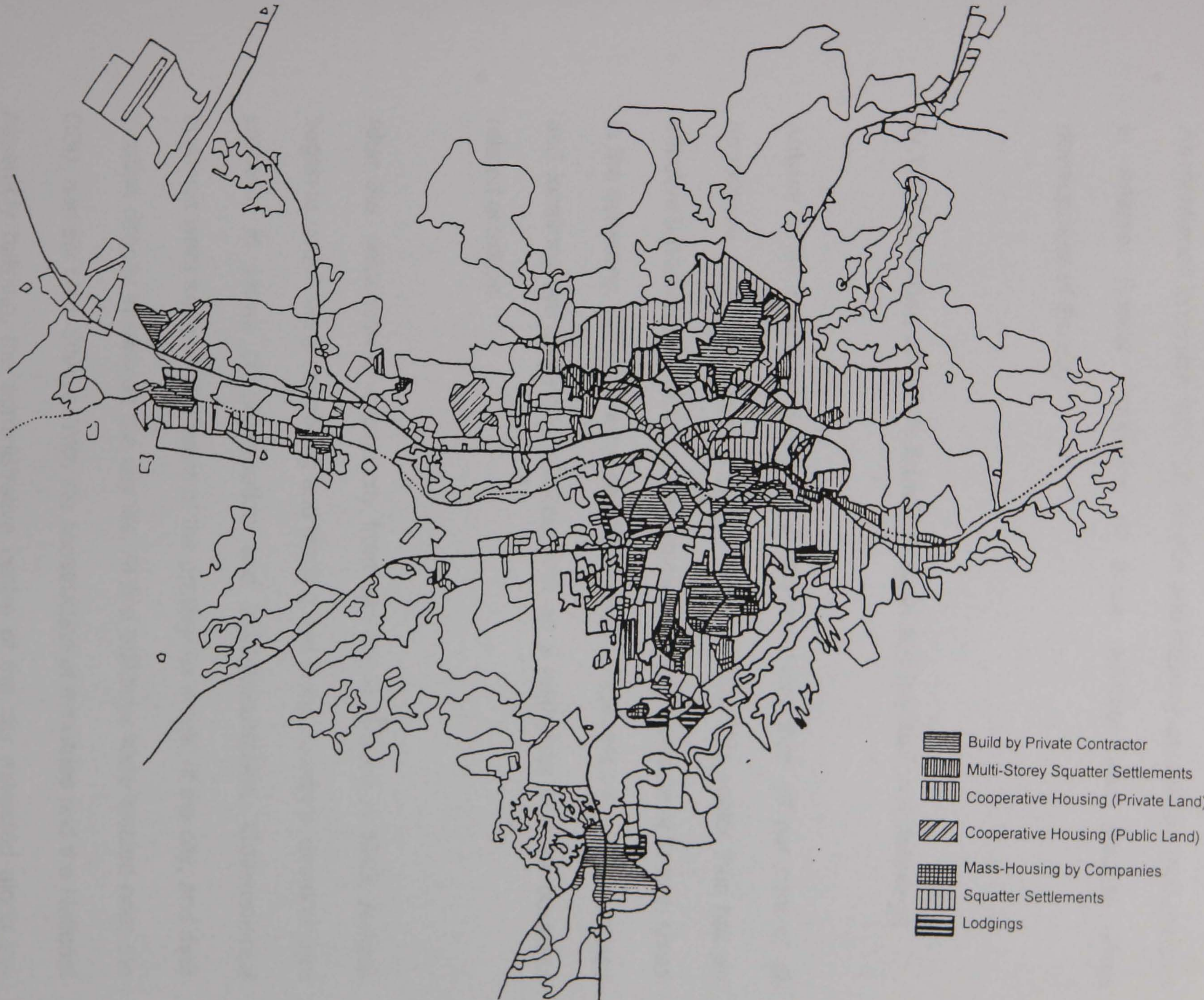
Unlike the suburbanisation process in developed countries, the process was characterised by the middle-income housing projects in Ankara. With the support of the municipality of Ankara which provided infrastructure, credit and assistance in organisation, middle-income groups moved out from the inner city and settled in the western corridor. Most of the houses in the suburbs were single houses due to the original cheap land costs. Besides, construction was undertaken by the housing cooperatives, which do not aim at making big profits, not by big companies as in the case of Western Europe countries and US cities (Turel, 1987a).

Today, individual entrepreneurs are constructing high-rise blocks within the inner city. In urban fringes both cooperatives and private companies are actively engaging in mass housing projects. They are again faced with increasing land prices. Even though suburbanisation was encouraged as a solution for the middle-income groups' housing problem, these areas have become the prestige zones for today's high income groups, particularly those around the western corridor of the city.

High and upper-middle income groups are living in the south and partially in the west corridor of Ankara. The northern and eastern parts of the city are the places where middle and upper-lower income group families are living. Squatter areas, where the low income groups are living, were first built within the old-city and around the Citadel and later surrounded the inner city. The municipality has been proposing a series of projects to improve (upgrade) these areas, and to prevent further such developments. Some housing estate areas are planned as alternative to *gecekondu* settlements, one of which is also situated along the western corridor.

Housing developments according to type (gecekondu, cooperative, private etc.) are shown on Map 4.1.

Map 4.1. Housing Developments According to Their Way of Organisation During the Construction Stage



Source: Turel (1987a; p 63)

IV.1.5. Workplace

As mentioned in section IV.1.2.2, service and industry are the two main sectors in Ankara. Spatial distribution of these activities also shapes urban development of the city.

IV.1.5.1. Location of Public Administration and Institutional Buildings

Ankara is the centre of public administration. More than 40 per cent of all employees work in this sector. (Turel, 1987b; p 28). This sector thus has an effective function in the urbanisation process, not only because of its high share in the economy, but also because of its location within the city. The buildings and locations are destination places both as a workplace and for business related activities.

After the relocation of capital city from Istanbul to Ankara in 1923, Ankara began to undertake a controlling and leading role in the country's development process, in terms of organisation and institutionalisation. Governmental buildings were seen as indicators of the prestigious image of the city, and their location directly influenced the city life. At first buildings were located near the CBD, namely *Ulus-Sihhiye*. With the construction of ministries and the National Assembly building, the administrative centre of the city extended along the main arterial road, *Ataturk Boulevard*, towards the southern part of the city. Later Cankaya, which is today's prestigious district in southern Ankara, was selected as location for the Presidential Palace. All these developments changed the traditional CBD by shifting it from *Ulus-Sihhiye* to *Sihhiye-Kizilay* while transforming its shape from compact to linear.

When we examine today's situation, most of the administrative buildings having more central functions are located near the CBD and along the *Ataturk Boulevard.* (Altaban, 1987; pp 31-44). Others can be grouped as campus type developments requiring larger amounts of land and usually situated along the western corridor. In recent years some of these facilities that were previously settled within the city, have moved out of the city and been located along the west corridor.

IV.1.5.2. Industrial Location

In 1980, 15 per cent of the working population was employed in industrial activities in Ankara. Although it is not a basic sector in Ankara, its share has been increasing in recent years. The location of industry affects an urban macroform.

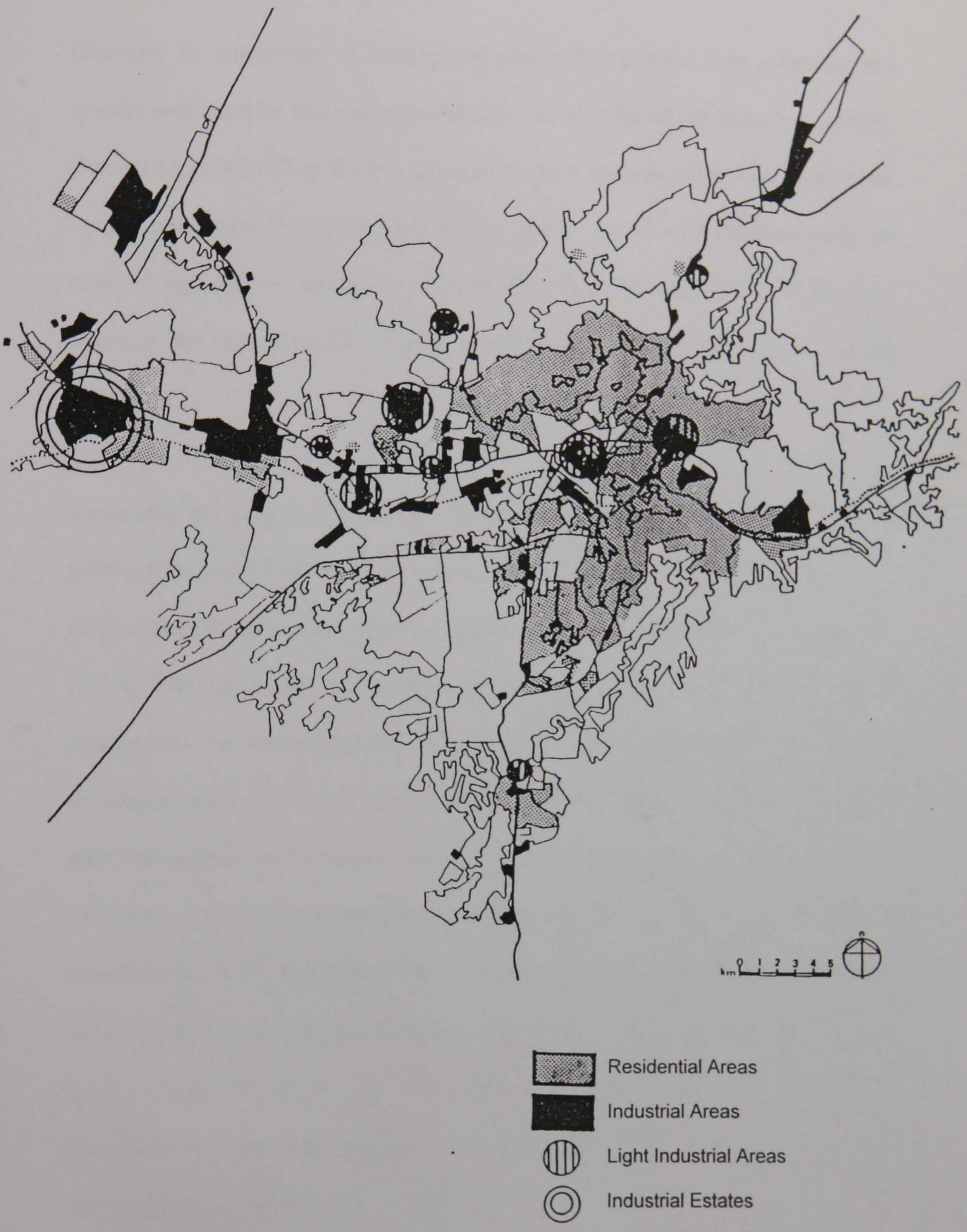
Bademli (1987) shows the processes of change connected with the establishment and location of industry in Ankara. Small-scale industries and workshops are located near the city centre.

Because of government intervention, the share of industry in the city's economy grew rapidly. One of these interventions, in 1963, was the decision to establish an industrial estate in the western part of Ankara, near Sincan. In spite of such advantages as tax reduction for companies settling there, industrial enterprises prefer places near to main motorways. This tendency has been observed since the 1970's (Bademli, 1987). They are mainly located along the east-west axis (see Map 4.2). This process is a result of the increasing importance or priority of highways rather than railways in site selection decisions. Proximity to residential areas and natural constraints such as topography and air pollution are the least important factors in determining industrial location in Ankara, the result of which is the decentralisation of industrial areas.

On the other hand, numbers of small-scale industrial estates have been supported since 1970. Most of them are located along or near the north-western axis, marked by the Istanbul-Ankara motorway. This corridor is the place where most recent new, middle-income housing developments are found. The inner-city small-scale industries and workshop areas in Ankara are, on the other hand, very near to the low-income squatter housing areas, residents of which are working there.

To sum up briefly, location of workplace, whether for service-based jobs, industry or workshop, has a significant influence on urban form changes.

Map 4.2. Industrial Areas in Ankara, 1985



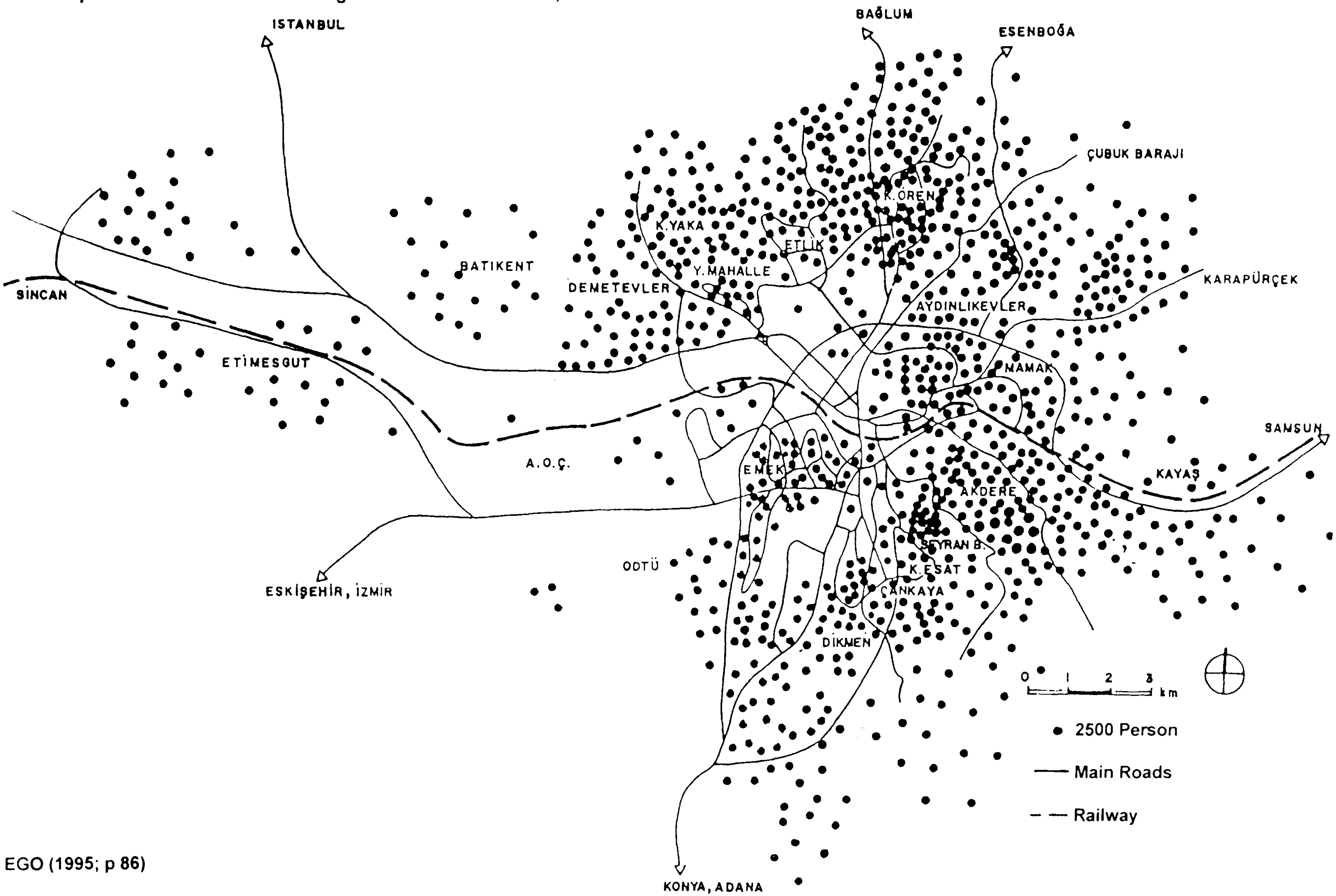
Source: Bademli (1987; p 53)

IV.1.6. Density

Changes in population or activity density within certain time intervals are usually explained by two variables; land prices and the urban transport system. If access to the CBD or to other parts of a city is well-supplied, land price goes up along the main axis. High land price leads to high density developments. In case of high car ownership the overall density in the city centre decreases, whereas the expansion (or sprawl) of residential areas outside the city gains momentum.

Cities are planned and an urban development procedure is the product of planning activity. In the case of Ankara, two procedures can be seen: planned and unplanned (squatter housing -*gecekondu*-) developments (see section IV.1.4). The study done by Tekeli and Guvenc (1987) indicates that the rate of increase in the net population density does not change during time, but it decreases when we move away from the CBD. Ankara has a compact form with high population densities, even 16 km distant from the city centre. From the 1960's until 1985, the population density in the city centre decreased. Tekeli and Guvenc (1987) argue that "reason behind this is not rapid suburbanisation as in the case of developed countries, but rather the high density development in the out-of city areas." (p 152). Map 4.3 shows the urban population distribution by residential areas which gives a general idea about density differentiation at spatial level.

Map 4.3. Urban Population Distribution According to Residential Locations, 1992



Source: EGO (1995; p 86)

IV.1.7. Urban Transport

Ankara has experienced a transformation from a city of 30.000 population with only 13 per cent of the total urban trips being motorised in 1930 to a city of 2,3 million population in 1985 where 81 per cent of the trips were made by motorised modes. (Tekeli, 1987; p 66).

Over 60 years of experience of urban transport in Ankara shows that the demand for motorised trips has increased faster than the population growth rate. Increasing travel demand is maintained by the public sector with limited resources, and by individual entrepreneurs in Ankara. Individual entrepreneurs operate on densely populated routes and at peak hours with a high level of profit. The public operator, that is the municipal bus service, operates along other routes during the day, including less profitable off-peak hours, sometimes showing a loss.

With the operation of "*dolmus*"[4] routes, the supply of services is designed according to demand. The main principle in supplying transport service was "first the settlement develops, and then the transport service is supplied". This area-wide supply system further encouraged high density concentric circular developments around the CBD. Afterwards, the city began to extend its

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[4]The world dolmus in Turkish means "full up". It is a semi-public mode operating like a shared taxi open to all members of the public. They are usually owned individually by small entrepreneurs as owner-drivers. It was originally a large car carrying up to seven passengers. It operates along specific routes which are defined by the Municipality. Numbers and fares were originally regulated by the municipality. With recent changes in the legal framework, fares are regulated by the Chambers of Dolmus Operators. It has a flexible service schedule. Today, they have turned into minibuses carrying more passengers.

boundaries around the CBD just like a drop of oil on paper. This form was modified later, through expansion along main corridors, eventually leading to a star-shaped urban form. Today, different types of transport modes owned by individual operators[5] are serving different social and economic groups located in different parts of Ankara.

Because of increasing travel demand, there has been much discussion of strengthening and improving public transport services and constructing a rail rapid transit system in Ankara. In 1987 it was decided to construct such rapid transit system, and the project was financially supported by the government and prepared by the municipality with its consultants. The Urban Transport Master Plan Project proposes public transport improvement together with rail rapid transit system. (see EGO, 1987, vol 5, p 164). The project proposes the construction of rail rapid transit system that was expected to start in 1988 and to be completed in 2012. The construction of this system began in mid 1989 and is still continuing.

The proposed rail rapid transit system will be serving five different axes. The first phase links Kizilay, at the south end of the CBD, to the north-western corridor of Ankara where the first suburban development took place together with small-scale industrial estates during the late 1970's. The second phase will connect the CBD to the western corridor along the Ankara-Eskisehir motorway where four University campuses are located and where upper-middle and high

[5]Municipal buses, private buses, minibuses (dolmuses), company buses or minibuses, school buses.

income people have been settling since the early 1980's. The third phase links the north of the city to the train station that is located near to the CBD and the fourth is between the southern parts of the city and the administrative centre. The fifth and last section establishes another link between the northern city and the CBD with different nodes from the third line.

In 1989, after the local elections, the elected Mayor of Ankara Municipality brought a new proposal for transport system that is light rail transit. The proposed transit route would link the eastern part of the city to the inner city. This proposal is related to a proposal for a new housing area in the eastern corridor called the "East City Housing Project", which has not yet been realised.

The construction of the first phase of the rail rapid transit has continued since 1989, in spite of uncertainties and financial problems.

In 1996 the construction of the light rail transit system between east-west axis passing through the CBD was completed and it is in operation. This system is not proposed in the master plan; the decision to construct it was political.

In spite of the Urban Transport Master Plan proposals, new orbital road[6] which combines city's main entrances is under-construction to divert through traffic from the city.

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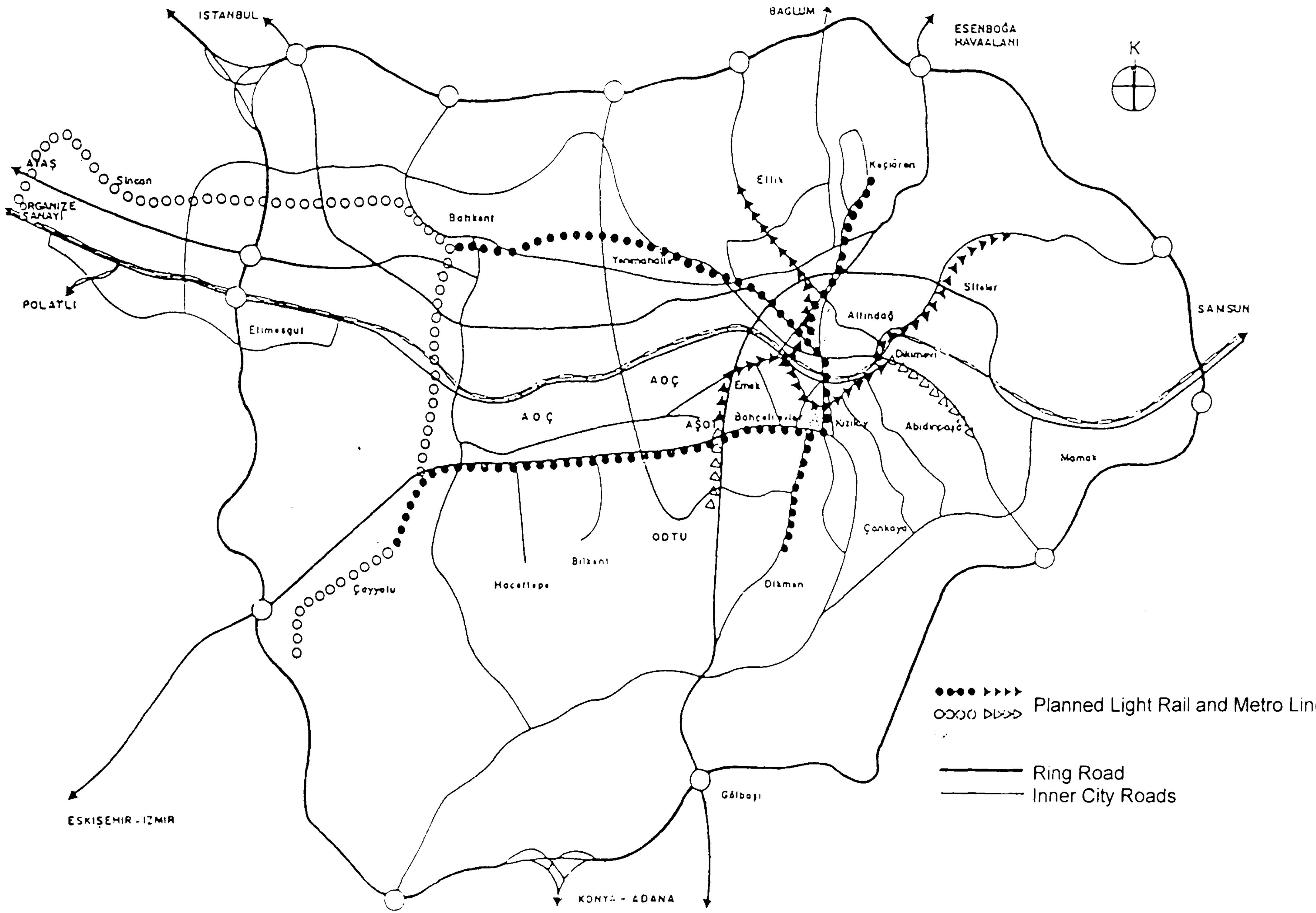
[6] The orbital road project is undertaken by central government, General Directorate of Highways who is responsible for provincial roads.

Map 4.4. Existing and Proposed Urban Transport Network in Ankara



Besides the deficiencies in providing public transport facilities, increasing car ownership results in a car-dependent urban form and a car-dependent lifestyle. In Ankara the recent development tendency of urban macroform is towards the outskirts of the city, parallel to increasing car ownership which is about 39 cars per thousand population in 1980. On the other hand, the low quality of public services in terms of reliability and safety further stimulates car dependence and use. Nearly one third of all motorised passengers were carried by private cars (including taxis and company cars) in 1985 whereas the remaining two thirds go by public modes (including buses, minibuses and dolmuses).

IV.2. Urban Development Policies

In Turkey, municipalities are the responsible authorities in terms of urban development as well as urban transportation policies and plans. Central government proposes policies, defines the legal and institutional framework and implements projects at national level in accordance with local authorities. There are metropolitan and district municipalities in big cities like Istanbul and Ankara. Metropolitan municipalities have to prepare urban development plans at different scales ranging from 1/50.000 to 1/5.000. They are responsible for the projects that are for the benefit of the city as a whole, and services that are indivisible like water supply, waste water treatment, urban transport. The control of the urban development is in the hand of district municipalities who prepare physical implementation plans at scale of 1/5.000 and 1/1.000. They give permission to the developer for construction but it is the metropolitan municipality giving a permission for the use of a building. This dual structure creates problems in practice since the division of responsibilities are not clear in many areas. This also supports political decision making rather than technically improved projects. Since municipalities are elected bodies, they also have political power together with responsibilities and duties.

Although the topics covered in the first section are under the control of planning processes, other forces like economic conjecture, availability and accessibility of resources, political preferences and conflicting interests, etc pressurise and limit the process. On the other hand, planning puts forward its own preferences and defines targets for the future of the urban environment. Besides detailed and area-specific policies for housing, industry, city centre and sub-centres, urban development plans systematise urban form policies.

In the late 1970's, the Municipality of Greater Ankara decided to promote the decentralisation of new developments to some extent, so that the city could gain without causing any difficulty within the existing pattern. The policies included

> "density control within the existing city; the rapid developments along the west corridor; in order to regulate the new development under municipal or governmental control and to increase the effectiveness of the municipalities role in this development, it is necessary to have a nationalised land stock." (Altaban, 1987; p 137).

Two new settlement areas were developed in the light of these policies. One is close to the Ankara-Istanbul motorway and the other is near Sincan, that is 23 km away from the city centre. The first is planned for middle and upper-middle income groups and the second for lower income groups as a "squatter prevention zone". This policy was further supported during the 1980's through reaffirmation of the importance of recent land use changes and improvements in urban economy.

The main idea behind the decentralisation policy was to deal with the air pollution problem. Because of topographic obstacles, new developments outside the valley were considered essential.

The decentralisation was planned in two ways: the concentration within the existing urban fringes and the encouragement of new developments outside the inner city. Work places were introduced as a tool of the decentralisation policy. It was also recommended that the location of new employment should be selected in such a way that it would support the decentralisation idea.

Decentralisation was not characterised by dispersal correlated with increasing car-ownership, but rather by dispersal depending on the improvement of the public transport system. It was proposed that the city would have a star-shape form in which residential areas were concentrated along the arterial.

The main developments were planned along the western corridor that is close to the Ankara-Istanbul and Ankara-Eskisehir motorways. The projected population was 1 million for this part of the city, and by the end of the 1990 nearly 17 per cent was realised. Although the expected level of development has not yet been reached, the new settlement projects are still under construction.

The recent planning study for the year 2025 includes some additional policies together with modifications. One of the aims is to maintain balanced residential-workplace development within and outside the municipal boundaries of Ankara. The proposals include some policies for areas that are not under the control of the municipality, but which are very near to municipal boundaries. The reason behind this is the new housing projects prepared and implemented by private companies. The municipality considers them to be an important factor in controlling future urban developments.

IV.3. Travel Demand Characteristics of Ankara

IV.3.1. Urban Transport Structure

Four types of public transport modes operate in Ankara; municipal buses, private company buses, suburban train and light rail transit.

Municipal buses have operated since 1930. There were 100 buses in operation in the early stages, but in 1993 this reached 1464. In 1935, there were 8.15 buses per ten thousand people; this ratio decreased to 5.22 in 1993.

Private companies entered into the market in 1981 by operating on 12 routes with 131 buses. Later, the number of routes increased to 27; but in 1993 private company buses were in operation along 17 routes while carrying 194.230 passengers per day. The total number of passengers carried was 43 million per year in 1985 and 53 million in 1993.

A suburban train operates along the west-east corridor and runs through the CBD. The number of passengers has increased gradually since the 1940's. At that time it was carrying 3-4 million people per year, but in 1990 it reached up to 22 million people a year. The average distance travelled by suburban train per passenger is 25 km while the total network is 37 km.

The light rail transit has been operating since late 1996 and there is only limited information available about its passenger load. Its length is 8.5 km and the planned capacity of the system is 16.000 passengers per hour.

Dolmuses, as a semi-public transport means, have been used since 1959. Today they operate on 32 routes with 2.134 minibuses. In an average working day 977.100 passengers are carried by dolmuses.

Most of the public administrations and institutions have their own bus services operating for different parts of the city. Their routes are defined by the residential areas of their workers. Such buses are usually owned by private companies.

School buses are owned by private companies and serve different parts of the city. All these semi-public services take a considerable share of the overall travel demand. According to cordon accounts, the number of these service buses commuting between central parts of the city and the periphery was 4.020 during the early peak hour in 1992 (EGO, 1995). In spite of this intensive use, there is no legal framework for these services; their routes are randomly selected and they usually operate during peak hours.

The taxi as an individual transport mode is an important means of transport in Ankara. In 1995, 7.618 taxis were in service, nearly 70 per cent of which were registered as company taxis.

In Ankara province and the city of Ankara, private car ownership has been increasing in recent years: each year more than seventy thousand cars add to the city traffic. In 1992, there were 84 cars per thousand people within the boundaries of the Greater Municipality of Ankara. This ratio changes within the city from one part to another. The income level of districts discussed in IV.1.3 of this chapter reflects these differences.

IV.3.2. Urban Travel Demand Characteristics of Ankara

Travel demand characteristics of households in the metropolitan Ankara are given in Table 4.2. These data are collected by the municipality of Ankara for the Urban Transport Master Plan and updated periodically.

Table 4.2. Travel Demand Characteristics in Ankara

	1970[a]	1980[b]	1985[c]	1988[d]	1992[e]
Number of Daily Trip per Capita					
Total	1.69	1.57	1.72	2.56	1.96
Motorised	1.17	1.01	1.16	1.37	1.34
Non-motorised	0.52	0.56	0.56	1.19	0.63
Daily Trips by Modes(%)	100.0	100.0	100.0	100.0	100.0
Private	7.3	6.4	13.7	17.3	16.3
Public[7]	59.7	54.8	53.9	33.3	51.5
Other Motorised	2.4	3.2	0.0	0.0	0.0
Pedestrian	30.6	35.6	32.4	49.4	32.2
Daily Trips by Purposes(%)	100.0	100.0	100.0	100.0	100.0
Work	61.0	52.0	36.9	32.5	40.7
School	12.2	13.0	24.6	17.7	31.1
Shopping	5.2	16.0	20.8		10.4
Other	21.6	19.0	17.7	49.8	17.8
Daily Work Trips by Mode(%)	100.0	100.0	100.0	NA	NA
Private	15.0	11.7	10.8		
Public	61.0	72.2	68.4		
Pedestrian	14.0	16.1	20.8		
Daily School Trips by Mode(%)	100.0	100.0	100.0	NA	NA
Private	4.0	1.6	2.0		
Public	30.0	28.8	32.5		
Pedestrian	66.0	69.6	65.5		

Source: a) Yasinok (1979) d) Bayazit (1989)
b) Tekeli (1976) e) EGO (1995)
c) EGO (1987)

An increasing number of trips per capita, that is trip generation rate, is observed in Ankara. The peak value for 1988 results from the detail registration of trips, particularly walking trips, through activity diary survey (Bayazit, 1989).

Private transport use has been increasing since 1970. Its share was 7.3 per cent in 1970 and increased to 16.3 per cent in 1992. The share of public transport in all trips, on the other hand, has decreased to 51.5 per cent in 1992

[7] Includes trips by taxi, dolmus, bus and train.

from 59.7 per cent in 1970. The share of walking has also increased, but not as much as the private modes.

In spite of a decreasing share of work trips, school trips have been increasing in the last 20 years. Irregular daily trips keep their overall share while their sub-division among various purposes fluctuates.

Most work trips are made by public modes whereas the shares of pedestrian trips and private modes are relatively low. In the case of school trips, walking is commonly preferred (65 %). Private mode use, on the contrary, is very low (2 %).

Results of the survey done by the Municipality of Greater Ankara indicate that the trip generation rate is higher than 2.50 for those living near to the CBD and having a higher income level. It decreases to 2.00 for those at middle income level living near the CBD. It even sinks below 1.00 in low income districts near the CBD (EGO, 1992).

The survey also shows that use of motorised modes for work trips is higher than the average for high income people. For low income people, work trips by motorised modes have a lower share than the average. This situation is also valid for middle income people (EGO, 1992).

CHAPTER FIVE : SURVEY METHODOLOGY OF CASE STUDY FROM ANKARA

V.1. Introduction

Discussions about energy efficiency of transport related to urban development and transport policies were reviewed in Part I. It is obvious from various studies that the increasing use of motorised modes namely of cars and the propensity to travel for longer distances are by-products of these policies. Changing life styles and personal preferences are usually difficult to define and control through planning measures. Nevertheless, planning policies may provide one of the most important tools in changing travel demand patterns. Possible ways of managing travel demand patterns can be understood by investigating the influences of different policies.

Urban land development policies for Ankara caused the population to move into the planned out-of city residential areas of the city during late 1980's. However, there has been little evidence of changing travel demand patterns due to these developments. The public transport system between the new development areas and main destination zones within the city has been neither planned nor well supported by policies. Although there is an orbital road under construction, it is for the benefit of car users. The planned rapid transit system has not been bid yet due to financial restrictions.

This chapter sets out the research questions to be answered and the hypotheses to be tested about this subject. It also includes explanations of the field research and methods of data collection and evaluation.

V.2. The Aim of the Research

This research attempts to establish a relationship between the travel demand patterns of residents of the inner and out-of city districts of Ankara and various socio-economic and spatial factors. Beside the comparison of these two, it tries to find out what would the out-of city residents do if they were in the inner city.

Firstly, the travel demand patterns of both inner and out-of city residents were analysed. The description of travel demand patterns in relation to socio-economic and spatial structure provides some key elements for a comparison of the two groups. Reasons behind certain travel demand patterns were examined with reference to the socio-economic characteristics of population and the spatial structure of residential areas (see chapter VII). Secondly, an experiment was carried out in order to define the possible effects of residential location on energy used by transport (see chapter VIII).

The aims were to find out whether energy efficient travel demand patterns exist in the selected districts of Ankara, and if so, to define why energy use of transport differentiates from one district to another and among people. The research also tries to provide an information for the policy decisions on urban land use and transport developments in Ankara through the analysis of why people could not have more energy efficient travel demand patterns and how planning would contribute to the changing situation.

An increasing need for an energy-integrated planning system in Turkish cities, due to the outward urban sprawl together with increasing car use, is observed especially in the metropolitan cities. Although some scholars argue that changes in the residential pattern have little impact on travel demand when compared to other land uses, such as location of employment and shopping areas (see for example Hemmens, 1967), this research will try to investigate the possible impacts of residential locations on the travel demand patterns of residents in terms of energy. Since most trips originate from residential areas, policies for new residential developments have a considerable influence on the travel demand patterns. This study argues that moving into an out-of city settlement from an inner city district results in a changing travel demand pattern which is more energy intensive.

V.3. Research Approach

Owens (1991) outlines a number of ways in which the interaction between transport energy consumption and land use can be explored and energy-efficient land use patterns defined. These are:

> "investigating how land use patterns might respond to energy constraints;

comparing actual energy consumption in different geographical areas[1];
identifying land use characteristics which are conducive to particular energy supply and conservation measures." (p 22).

In this research an attempt will be made to reach conclusions about the energy implications of out-of city planned residential developments by comparing them with inner city residences. A flow-chart showing the general methodology of this research is given in Figure 5.1. Within this framework, the out-of city housing developments in Ankara, which took place after 1985, were first defined.

Policies for the out-of city residential developments together with all other urban development policies were reviewed in Chapter IV. In the light of the recent urban development trends in Ankara, possible changes in travel demand patterns become the main focus of this research. The study also discuss these changes together with their impacts on energy consumption of transport through an analysis of data obtained from a field survey.

Three sets of factors established the content of the field survey (Figure 5.2). The spatial structure of a living environment, the socio-economic characteristics of a population, and their travel demand patterns constituted a base for the questionnaire and field work. Their interrelation indicates similarities and differences of different cases (districts) located at various part of the city. The resulting travel patterns in each residential area show the validity of the research hypotheses which will be discussed in next section.

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[1] My emphasis.

Figure 5.1. Methodology of Research

OBJECTIVES:	TO DESCRIBE THE RELATIONSHIP BETWEEN LAND USE DEVELOPMENTS, MAINLY IN TERMS OF HOUSING LOCATION, AND TRAVEL DEMAND CHANGES; TO SHOW THE INTERACTION BETWEEN THE SOCIO-ECONOMIC AND SPATIAL FACTORS (see Figure 5.2.), AND TRAVEL DEMAND PATTERNS; TO IDENTIFY THE CHANGES IN TRAVEL DEMAND PATTERN DUE TO A SHIFT IN RESIDENCE, i.e. INTRA-URBAN MIGRATION; TO PRESENT THE ENERGY COST OF LAND DEVELOPMENT POLICIES -NEW RESIDENTIAL DEVELOPMENTS POLICIES- IN TERMS OF ENERGY COST OF TRANSPORT IN ANKARA. (see Section V.4.2: hypothesis)
SURVEY:	SELECTION OF DIFFERENT DISTRICTS FROM INNER AND OUT-OF CITY AREAS. (see Figure 5.3) HOUSEHOLD QUESTIONNAIRE DESIGN (see Appendix A) DETERMINATION OF NECESSARY DATA RELATED TO SPATIAL STRUCTURE OF SAMPLED DISTRICTS
FIELD SURVEY:	APPLICATION OF A QUESTIONNAIRE FOR RESIDENTS OF THE INNER AND OUT-OF CITY DISTRICTS OF ANKARA
SURVEY RESULTS:	ANALYSES WITH THE HELP OF SPSS.
EXPERIMENT:	TO STUDY POSSIBLE TRAVEL DEMAND CHANGES OF HOUSEHOLDS LIVING IN THE OUT-OF CITY DISTRICTS IF THEY HAD LIVED IN THE INNER CITY AREAS.

Figure 5.2. Factors Covered In The Survey

SOCIO ECONOMIC FACTORS
POPULATION EMPLOYMENT BY CATEGORY FAMILY SIZE CAR OWNERSHIP INCOME EDUCATION LEVEL

SPATIAL FACTORS
PROXIMITY (DISTANCE TO CBD) POPULATION DENSITY CONCENTRATION OF FACILITIES

TRAVEL DEMAND CHARACTERISTICS OF POPULATION
MODAL SPLIT TRAVEL DISTANCE & DESTINATIONS TRAVEL PURPOSES TRAVEL TIME ENERGY USE

V.4. Research Assumptions, Hypotheses and Questions

V.4.1. Assumptions

As in all other cities, work and school trips, i.e. regular daily trips, have the highest share among all trip purposes in Ankara (see Chapter IV, Table 4.2). Although most of these trips are made either by public transport or on foot, an increasing tendency to move out of the city causes an intermodal shift from public transport to private transport and from walking (non-motorised) to motorised modes. Modal split of irregular daily trips might also change in a similar manner. Furthermore, if destination areas remain same, an increasing average travel distance adds to the problem. This also means that the planned out-of city housing developments which occurred during the late 1980's and have been accelerating in recent years would change the travel demand characteristics of households in Ankara.

> "Residents of towns are constrained to move out in an effort to find places that are more attractive to live in, and in so doing become dependent upon personal transport for maintaining their lifestyles. The overall result of this planned redistribution of the population has been a marked loosening in spatial distribution and a weakening of residential ties to workplace." (Longmore and Musgrove, 1983; p 92).

Not only are the ties between two major land uses, workplace and residence, affected, but also relative distances to all other facilities, such as shopping centres, schools, colleges, recreational areas (parks, sport centres, playgrounds, and so forth) and hospitals, change. In spite of this disintegration of land uses, if people continue to use them, travel distance and dependence on motorised modes rise.

This study will investigate the changes and possible results of such planned developments in Ankara in terms of additional energy cost of travel. It will also ask why the new out-of city residential developments generate more energy-intensive travel demand patterns.

One of the main aims of the decentralisation policy in Ankara is to take the pressure of housing and traffic demand - which causes high level of air pollution - away from the inner city (see Chapter IV). On the other hand,

> "Many proposed new settlements are not intended to be self-contained, but even if some land is allocated for employment and services, it can not be claimed that such settlements are inherently energy-efficient, since they can hardly be isolated in the areas of greatest development pressure." (Owens, 1991; p 25).

In spite of the proposal for a decentralisation of the city's population as well as the decentralisation of other facilities, the majority of the population may still be dependent on the inner-city in terms of daily commuting to work and school. This research examines the extend to which this is true for Ankara, and tries to see whether they also continue to use the inner city facilities for other purposes such as shopping, recreation, entertainment and so forth.

The comparative study of the travel demand patterns between the post-1985 out-of-town housing developments and the existing inner city areas indicates possible changes in travel demand patterns due to the intra-urban migration; that is, movement from the inner city residential areas to the out-of city residential areas.

In most of the travel surveys, one difficulty is people being able to remember about their previous trips. It is difficult even to remember details of daily travel and most of the methodological errors (non-sampling errors) arise from the misrecalling and underrecording of daily travel diaries. This research, however, is based on the travel diaries of residents both before they moved into new residence and after. Considering the difficulties of recalling and details of an earlier travel diary, it is assumed that those households living in the new housing areas used to have similar travel demand patterns to those living in the inner city before they moved. In order to minimise the possible errors resulting from this assumption, efforts have been made to match the most similar districts, while ensuring a degree of homogeneity of socio-economic characteristics of households in both areas through sampling (see section V.5).

V.4.2. Research Hypotheses

The following research hypotheses and sub-hypotheses are formulated to specify the structure of this study:

1. New out-of city residential developments are likely to be more energy demanding in terms of the travel demand patterns which result from movement to out-of city areas

> **1.a.** The residents of a new development area might be forced to change their travel demand patterns in favour of motorised modes due to lack of local facilities and a low level of transport services.
>
> **1.b.** Intra-urban migration, that is the movement of a population within a city, results in changes in the amount of travel, in the distance travelled and in the mode preferred.
>
> **1.c.** Out-of city residents travel for longer distances than inner city residents.
>
> **1.d.** There is a more intensive use of motorised modes of transport among the out-of city residents than the inner city residents.

2. The spatial structure of a living environment and accessibility to local facilities might shape travel demand patterns as well as the socio-economic characteristics of a population. They might be main factors in encouraging people to have energy intensive travel demand patterns.

V.4.3. Research Questions

In order to test the hypotheses in the case of Ankara, the following research questions were posed:

1. What are the travel demand patterns of the inner and out-of city residents?
2. What are the possible impacts of the location of residences on the travel demand characteristics?
3. Why does transport energy use differs from one district to another and among people?
4. Why do certain residential developments, presumably out-of city ones, generate more energy intensive travel demand patterns than others?
5. What would the out-of city residents do if they were living in the inner city?
6. What kind of residential developments will help to reduce the energy cost of transport?

7. What are the policies that can be used as instruments to control/manage the travel demand and hence to contribute to sustainable development through reducing the energy cost of travel?

Having answered the above questions, another policy measure that planners should incorporate in their plans will be stressed in the case of Ankara: the policies for energy efficient travel demand as a criterion for decision making on urban development.

V.5. Sampling Procedures

Research questions were studied in the case of Turkey by conducting a set of surveys in the selected residential areas of the Greater Municipality of Ankara, the population of which is around 2,6 million in 1990.

> "The choice (type of sample) depends on the nature of the research problem, the availability of good sampling frame, money, the desired level of accuracy in the sample and the method by which data are to be collected." (de Vaus, 1993; p 63).

A "multi-stage sampling" technique was implemented to select a sample from Ankara city. Following the basic procedures, first the smallest administrative division, i.e. *mahalle - muhtarlik*, was taken as a sample area, the list of 366 districts being obtained from the Greater Municipality of Ankara. Districts were further categorised as inner or out-of city areas according to historical development phases. The list of out-of city residential areas developed during the late 1980's established a sampling frame for the first phase. The area were vacant or only very partially occupied before 1980. This list was rearranged according to three income levels given by the Municipality of Ankara. In order to represent each income level, one district from each, i.e. low, middle and high income, was selected randomly (Figure 5.3). This two stage stratification ensured that districts were properly represented in terms of both location of residences and income groups.

> "One way of minimising the effect of reducing clusters on representativeness is to use stratification techniques. Thus, when selecting districts, put them into various strata (e.g. status, prices, density, etc.) and then randomly select districts within the strata." (de Vaus, 1993; p 70).

Figure 5.3. Sampling Procedure

SAMPLE FRAME: Ankara having 2,6 urban population in 1990

Classification of Districts According to Location

Post-1985 Out-of City Districts

Inner City Districts

Classification of Districts by Income Level

LOW
MIDDLE
HIGH

Sampling From Enumeration Record Files

		INCOME LEVEL		
		LOW	MIDDLE	HIGH
LOCATION	INNER	ONDER (40)	ESAT (40)	CANKAYA (40)
	OUT-OF	SINCAN (50)	ERYAMAN (50)	KORU (50)

Thirdly, a random sample of households in the sampled districts was selected. A systematic random sampling procedure was applied to obtain the addresses.

Municipal enumeration records[2], which include the lists of households in each district were used while selecting households.

After conducting the field survey for each out-of city district and considering the households' previous residential locations (obtained from questionnaire), the most common previous districts (central tendency, most common response) within the inner city were taken as a sampling frame for the second phase. These districts were assumed to be the previous residences of those selected in the first phase and to provide representative data about previous travel habits of the out-of city residents. This sampling procedure also allows for a comparative analysis between the inner and out-of city residents. Households from the inner city districts were selected from municipal enumeration records in the same way. They were examined in order to assess the most likely previous travel demand patterns of those now living in the out-of city housing areas. The same household questionnaire was implemented for all samples with some exclusions for the inner city districts.

Although it is not a primary aim of the sampling procedure to represent the overall population of Ankara, every effort was made to acquire a representative sample of two sets of districts that are inner and out-of city districts.

The sampling size was first defined as 25 households per district with a total of 150. It was further increased to 270 in order to get more reliable information,

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[2] The households are enumerated according to the street names and ranked by block numbers.

but when considering total municipal population, the sampling ratio is still low. On the other hand, as de Vaus (1993) pointed out:

> "Beyond a certain point, the cost of increasing the sample size is not worth it in terms of the extra precision.... The size of the population from which we draw the sample is largely irrelevant for the accuracy of the sample.... For a population in which most people will answer a question in a particular way or very few answers in a particular way, a smaller sample will do." (pp 70-71).

Hoinville et al. (1977; p 61) recommended that the smallest subgroup has at least 50 to 100 cases. In this research the proposed sampling size for each neighbourhood was first set at 30 households, with an expected 90-120 person (cases). During the field survey, which was conducted in April-May 1994, because of a very low response level and very low willingness to participate, only 25 households from each residential area were interviewed. In October, 1994 a complementary field survey was conducted and the sample size was increased to 50 for each out-of city neighbourhood and to 40 for each inner city neighbourhood.

At the end of two surveys, 270 households with a total population of 958, 858 of which were aged 7 and over, were interviewed about their socio-economic characteristics and their travel diary for a given weekday (Table 5.1).

Table 5.1. Number of Interviews by District

	DISTRICTS					
	INNER CITY			OUT-OF CITY		
	Cankaya	**Esat**	**Onder**	**Koru**	**Eryaman**	**Sincan**
Income Level	High	Middle	Low	High	Middle	Low
Distance to CBD (km)	5,4	3,4	7,6	18,4	17,4	28,4
Number of Sampled Households	40	40	40	50	50	50
Total Population Observed	129	120	169	151	162	227
Population Aged 7 +	123	111	146	144	149	185

The main reason behind the very low level of sampling comes from the nature of the questionnaire itself and the methodology of the survey which will be covered in the next sections. On the other hand, beside the errors due to sample size, other methodological errors, i.e. non-sampling errors were minimised as far as possible.

V.6. Survey Method

In order to achieve the aims and objectives of the research, use was made of primary sources consisting mostly of the results of the field research conducted in the Greater Municipality of Ankara.

V.6.1. Field Survey - Household Questionnaire

The field survey comprises two sets of data. The first set includes data about the socio-economic characteristics of all the households and each member aged 7 and over. The population aged 7 and over were also asked about their travel demand pattern in a usual work-day (the day before the interview). It was possible to raise the lowest range of age, but in order to get maximum information about school trips the lowest age for primary education, i.e. 7, was chosen.

If the household selected refused to participate, then it was replaced with one of the households from the reserve list. If the household was not at home on the interview day, then second visits were tried. These additional visits which are necessary for transport interviews, made the research more costly but assured an unbiased sample.

Those who did not want to participate were usually high or middle income people. The survey was conducted just after the local elections and economic crisis known as "Decisions on 4th of April" in Turkey. Thus, some might not happy with the election results, while most of the citizens were complaining about the inflation rate. Response was higher amongst low income groups who are highly motivated with expectations from the state and familiar with interviews.

The survey period was restricted to the 3 months of April, May and October 1994. These periods are the peak seasons of yearly travel. It took nearly two weeks to complete the interviews within one neighbourhood. The number of households was distributed equally among work days, and households were visited between 7.00pm and 9.00pm in order to eliminate possible biases originating from under-representation of those who were not at home during the day. This also provided the best opportunity to meet households during a first visit and to interview the working population and students.

Depending on their travel demand pattern, average interview duration for one person was approximately 15 minutes.

V.6.2. Questionnaire Design

The questions related to the characteristics of the household were answered by the head of household. These questions included information about family size, number of working people and students in the family, average monthly rent, car ownership, year and reason for moving.

Later, each person in the household was interviewed separately. As can be seen from the questionnaire (see Appendix A) socio-economic characteristics, such as age, sex and education level were asked for all aged 7 and over. For the working population, the questions about occupation and position at work were included. Reasons for not working were also requested. As a check variable, the addresses of school and workplace being the destinations of most of the regular daily trips, were also requested from students and the working population.

Those aged 7 and over were interviewed about their previous day's travel diary. It would have been possible to collect weekly travel dairies instead of daily, but considering the methodology of the survey which is based upon face-to-face interviews, daily travel dairies were chosen. Self-completion questionnaires could have been used, but considering educational prerequisites, particularly among low income group, face-to-face interviews about their daily travel were preferred. Additional informal questions were asked to remind them where, when, why and at what time they travelled within the boundaries of the Greater Municipality of Ankara. In the first few questionnaires, the respondents were asked to estimate approximate travel distance for each trip but became apparent that it is difficult even for those driving a car to estimate this. This question was therefore replaced with a request for the destination addresses, so that travel distances could be measured individually from a city map later. Each trip within a given weekday was recorded, including origin and destination addresses, starting and ending times, main purpose and method of transport. Data for 2.120 daily trips by residents of the sampled districts were obtained.

There were a couple of additional questions about previous daily travelling routines of the working population and students, and these were asked to those living in the out-of city residences.

The comparison between these two sets of travel data, i.e. travel demand patterns of households living within and out-of the city indicates the possible changes in their travel demand, particularly in terms of transport mode(s) used and travel distance. It also provides a general idea about the changes in origin and destination zones, but the sample size was not large enough to define exact origin-destination tables.

V.6.3. Field Survey - Spatial Analysis

The second set of data consists of the physical characteristics of the settlement areas, such as distance from the city centre and distance to the main facilities available within those areas, overall population density, and land use structures within and around the residences. The data were obtained in different ways: through the field work, i.e. observations and reconnaissance, from interviews with the authorities of the local municipalities and the Greater Municipality of Ankara, and from maps.

V.6.4. Methods of Evaluation

Data obtained from the household questionnaires were analysed by using the SPSS (Statistical Packages for Social Sciences) for Windows. The following statistical analyses have been carried out: cross-tabulation (chapter VII), correlation coefficient and significance analysis and analysis of variance (chapter VIII).

The data were first analysed for each district separately. Later, districts were grouped according to their location relative to the CBD as inner city and out-of city residences. Another classification was in terms of income level. Similarities and differences between each group in each classification were investigated (see Chapter VII).

The travel demand characteristics of residents were also expressed in terms of energy intensity per passenger trip (see Chapter VIII). The energy consumption of transport in each district for different purposes by different modes was calculated. Two scenarios were developed based on the assumptions that if the out-of city residents were living in the inner city districts they would have a similar average travel distance and modal split for different trip purposes. Having the same number of trips for various purposes, their travel demand patterns were estimated together with resulting energy use. Finally, a comparative analysis was made between the actual and the estimated energy consumption of the out-of city residents.

Information about the spatial structure of the districts was used in studying the similarities and differences between the travel demand patterns of inner and out-of city districts.

The energy consumption of different travel demand patterns according to the different physical structure of residential areas with different socio-economic structures was studied. Taking all these analyses into consideration, the possibilities of ensuring and encouraging energy efficient travel demand patterns in Ankara were discussed.

As mentioned earlier, if the findings show that some of these new residential developments can provide any reduction in the energy use of transport or vice versa, this study will contribute to the urban planning practice in Turkey by representing the interaction between urban land use decisions and travel demand variations. Thus, the importance of energy issues in planning activity might be pointed out once more through the discussion of whether these new urban developments in Ankara are instrumental in conservation of transport energy or accelerating energy consumption by encouraging people to travel for long distances, usually by motorised modes. Whatever the results, this study will show the possible interactions between urban development policies and energy use of transport and tries to find reasons for energy intensive travel demand patterns.

PART FOUR: EVALUATION OF SURVEY RESULTS

CHAPTER SIX: SPATIAL AND SOCIO-ECONOMIC CHARACTERISTICS OF THE INNER AND OUT-OF CITY DISTRICTS

VI.1. Introduction

A description of the study area, the city of Ankara as a whole, is summarised in Chapter IV. The present chapter describes the characteristics of the inner and out-of city districts selected for this study.

From the beginning of the 1970's cooperative housing projects were supported by the government through credit and low-cost land. All selected out-of city districts were developed during the late 1980's as a mass-housing project. In spite of this historical similarity, the districts are different in many respects. First of all, their design criteria are different. They were planned for different socio-economic groups, so, they show different physical and socio-economic structures. The inner city districts, which were the existing parts of Ankara in the 1980's, also differ from each other.

Throughout this chapter, the similarities and differences between the selected inner and out-of city districts will be discussed. The comparison of their spatial and socio-economic structures will be helpful in interpreting the travel demand characteristics. The data which are the subject of this chapter were partly obtained from the household questionnaire. Data on spatial structures of districts, however, were achieved through field work, that is through observation and reconnaissance, from interviews with the authorities of the local municipalities and the Greater Municipality of Ankara, and from maps and photographs.

Before discussing the results, the coding system used in the research and in the remaining chapters of this thesis is presented in Table 6.1. These codes indicate income level and location.

Table 6.1. Coding for Selected Districts

INCOME LEVEL	LOCATION OF DISTRICTS	
	INNER CITY DISTRICTS (IN)	OUT-OF CITY DISTRICTS (OUT)
LOW (L)	ONDER (IN-L)	SINCAN (OUT-L)
MIDDLE (M)	ESAT (IN-M)	ERYAMAN (OUT-M)
HIGH (H)	CANKAYA (IN-H)	KORU (OUT-H)

VI.2. Size, Area and Population Density of the Settlements

The populations and areas of the six districts are given in Table 6.2. These two indicators can be interpreted together in comparing the districts. The gross population density, that is the ratio of total population to total area of district, indicates the spatial structure of a district.

In OUT-L and IN-L, which are selected as low income districts, the population density is 82 and 83 per hectare respectively. Although there is a general tendency to have higher densities in low income housing areas, the lower figure for IN-L is due to a large manufacturing area within its boundaries. In OUT-L, some parts of the area are still under construction and there are some empty flats.

In IN-H, the population density is 54. In OUT-H, there are 42 people per hectare which is the lowest figure of all. This difference is an outcome of the design criteria of the areas. In IN-H most of the houses are high-rise blocks. In OUT-H, there are high-rise blocks as well as single houses. Additionally, the physical plan for OUT-H proposes necessary urban services, such as recreational and out-door sport facilities, playgrounds and so forth.

In IN-M and OUT-M, the highest gross densities are observed with 299 and 230 people per hectare. In IN-M this figure can be considered as a net population density; because services such as schools, recreational areas, shopping centres and so forth, are quite limited within district boundaries. In OUT-M, in spite of the existence the above amenities, a large number of high-rise blocks results in high population densities.

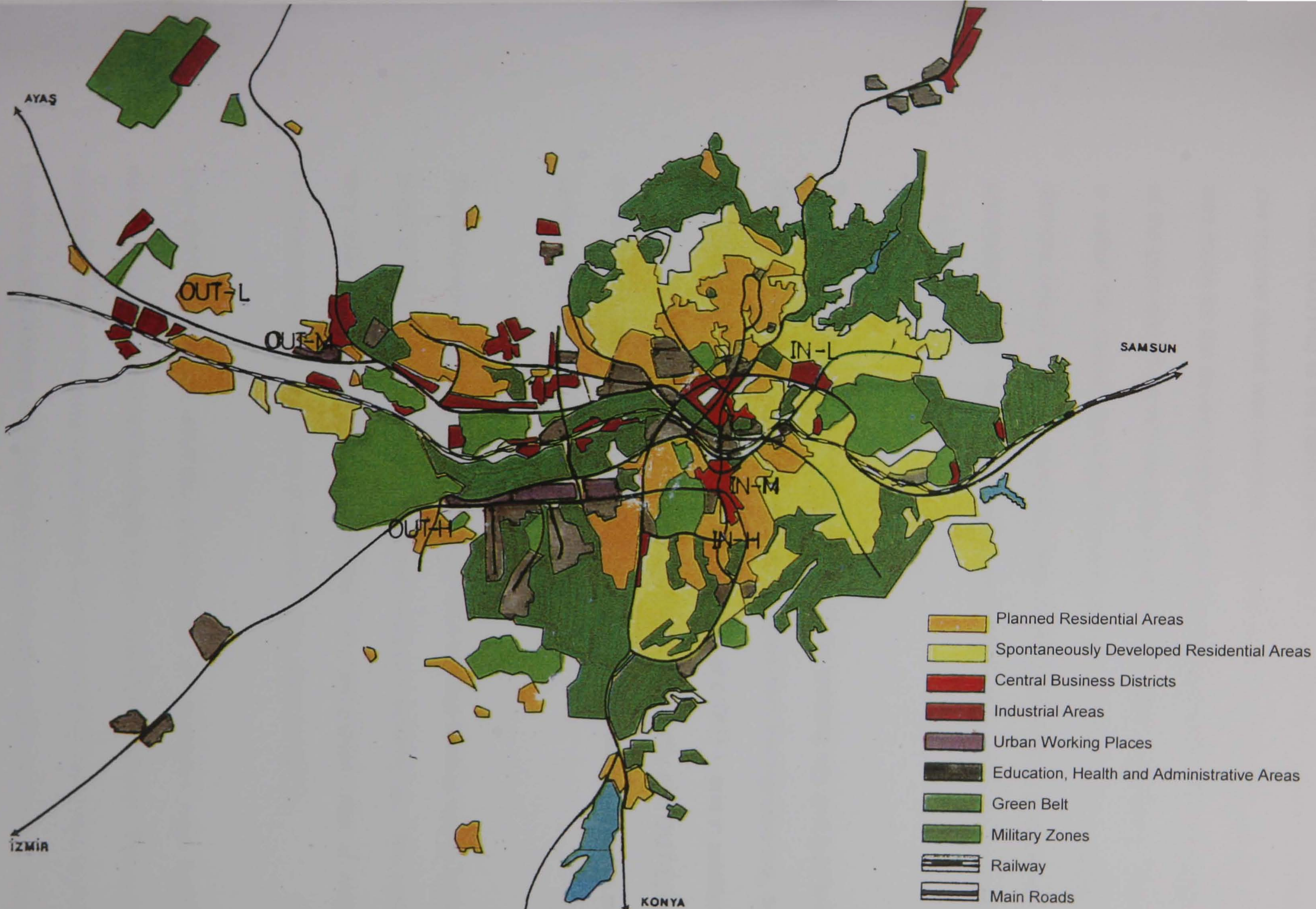
Table 6.2. Some Characteristics of Selected Districts

	IN-H	IN-M	IN-L	OUT-H	OUT-M	OUT-L
Income Level	High	Middle	Low	High	Middle	Low
Distance to CBD (km)	5,4	3,4	7,6	18,4	17,4	28,4
Area (Hectare)	181,2	11,3	121,2	86,0	110,4	168,0
Population (1990)	9837	3380	9876	3640	25500	13985
Population Density[1]	54,3	299,1	81,5	42,3	230,9	83,2
Number of Dwellings	3279	1219	2904	1300	6695	5485

VI.3. Location of Residences Relative to the CBD

Map 6.1 shows the locations of the sampled residences.

[1] Gross population density (number of people per hectare).



Map 6.1. Location of the Inner and Out-of City Districts

Sincan (OUT-L) is the name of the district municipality where an out-of city low income district was selected. Within Sincan's municipal boundary, a plan was made for the development of a mass housing project. The main objective of the plan was to provide an alternative housing area to squatters. The area is called the *Sincan Squatter Prevention Zone (SSPZ)* and consists of 3 districts, one of which is surveyed in this study. The SSPZ is isolated from the previously settled area and the main centre of the Sincan District Municipality by a highway.

The area is situated on the western side of the existing city and just beside the ring road that links several motorways. Apart from the highway link, there is a suburban train operating between the CBD and OUT-L and in addition to the municipal bus services operating between the inner city and OUT-L, there are dolmusus. Municipal buses and dolmuses also operate between the main centre of the district municipality and OUT-L.

The distance between CBD and OUT-L is 28,4 km and it takes nearly an hour to get to the CBD by bus during the peak hours of a working day. The area is very near to an existing industrial estate. The metropolitan plan of Ankara proposes new work places and residential areas close to OUT-L.

Like OUT-L, **Eryaman (OUT-M)**, which is also an organised mass housing development, is located on the north-western corridor of Ankara. The area is developed by the Housing Development Administration of the Prime Ministry. Credits on low interest and long range repayment programs were introduced by the government and priority was given to those who do not own a house. The area has been developed in four stage's, three of which are completed and settled. It is 17,4 km distant from the CBD and situated adjacent to the highway that links Ankara and Istanbul.

There are two industrial estates very near to OUT-M. The master plan proposes an extension of these estates and another business district to the south of the district.

It takes 40 minutes (including waiting time) to get to the CBD from OUT-M on a usual working day. There are municipal buses and dolmuses operating to and from the CBD.

Koru (OUT-H) is a privately developed housing area adjacent to the highway that links Ankara and Izmir. It is located on the south-western corridor where many similar housing projects have been started in recent years.

This corridor is not only the area where new housing developments take place but also the main corridor where three university campuses and several governmental establishments are located. New shopping and recreational centres have also been opened on this corridor since 1995.

All these facilities and the large number of people living along this corridor create a high volume of traffic on a highway which is the only route between the CBD and this axis. Although OUT-H's density is very low (42 people per hectare), its residents have to use this road and have to deal with this congestion problem.

OUT-H is 18.4 km from the CBD. There is a municipal bus service to and from the CBD.

The second phase of the metro project[2] proposes a line from the CBD to the south-west of Ankara overlapping the corridor between the CBD and OUT-H.

Onder (IN-L), Esat (IN-M) and Cankaya (IN-H) are the inner city districts selected according to the previous residences of out-of city residents (see Map 6.1).

Onder (IN-L), whose residents show similar socio-economic characteristics to OUT-L's residents, is situated very near to the northern end of the CBD. The distance between IN-L and the CBD is 7,6 km. There is a municipal bus service between IN-L and the CBD. Additionally, dolmuses and privately owned buses operate.

Furniture manufacturers, *Siteler*, are located to the south of IN-L. This is one of the biggest working places in Ankara, and many artisans work there. IN-L is very near to one of the attraction sides in Ankara, *Altinpark*. It is also very near to inner city hospitals and the historic city and castle as well as the old cemetery. Ankara's old centre, *Ulus*, is also very close to IN-L.

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[2] The first phase is under construction between *Kizilay* and *Batikent*. The second phase is planned between *Kizilay* and *Cayyolu*.

The urban transport master plan proposes a light rail transit[3] which will link IN-L to the CBD.

The distance between the CBD and **Esat (IN-M)** is 3,4 km. It is possible to get to the CBD by walking. It is assumed that IN-M was the previous residence of OUT-M's residents. Its closeness to the CBD means that IN-M's residents can easily access many urban services such as shopping areas, recreational and entertainment places, heath services, inner city universities, and so forth. Additionally, they have many transport possibilities in terms of municipal and private bus services and dolmuses.

IN-M is near not only to the CBD but also (a 5-10 minutes walk) to *Tunali Hilmi* where several shops, boutiques, restaurants, cinemas and clubs exist. Similarly, most of the ministry buildings are within a 4 km diameter circle.

Like those of IN-M, **Cankaya (IN-H)**'s residents have many advantages in terms of using various parts of the inner city: it is only 5,4 km from the CBD. As the next section will explain, IN-H itself contains many attractions not only in terms of social life but also in terms of the bureaucratic and business life. The district offers several attraction sides to its residents and to whole city.

The area is surrounded by main avenues providing good accessibility to other parts of the city. The urban transport master plan proposes an extension of

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[3] First phase is in service between new inter city bus station and *Dikimevi* and passes through the CBD. The second phase proposes an extension between *Dikimevi* and IN-L.

the first phase of the metro system[4] to IN-H. If this part of the plan is realised, it will add to the accessibility of the area.

VI.4. Land Use Characteristics

In **OUT-L**, mass housing projects have been being implemented step-by-step since the late 1980's, but there are still empty plots even in the local centre. Nearly two-thirds of the whole area is being built (Map 6.2).

Although the plan proposals have not all been implemented, a small local centre is in use (Photo 6.1). This centre is a commercial centre. It is located on the junction of three main roads and is the end-station for buses and dolmuses. The area includes several small shops and a market place. The market area is used as a car park on off-days. Car parking areas also exist in built-up areas.

A mosque is located just behind the market. It takes a few seconds to get to a local park, a children's park and small public library that is located north of the local centre (Photo 6.2). A primary-secondary-high school complex is situated opposite this library. Another school is located on the west side of the central area.

Some other small scale local centres are planned but have not yet been developed.

[4] The first phase is under construction and should be in operation by the end of 1997.

Map 6.2. Land Use Map of Sincan (OUT-L)

Photo 6.1. Local Centre and Open Market Area of Sincan (OUT-L)

Photo 6.2. Local Park Behind the School Complex and Public Library in Sincan (OUT-L)

Photo 6.3. Housing Areas of Sincan (OUT-L)

The whole area is located north of the motor way with a large scale centre at this entrance. Its plan proposes a hospital, municipal building, exhibition centre, sport centre, vocational schools, high school, park, nursery, rest home and pool. Half of these facilities are completed and in use. Residences, small scale local centres and the main centre are within walking distance of each other.

Although the existing and planned buildings are multi-storey (Photo 6.3), there are a number of squatters. The district is partly supplied by the sewerage and drinking water system; the road structure has not yet been completed.

IN-L is not only a residential area but also one of the largest working places in the inner city. Furniture manufacturers are situated on the southern edge of the residences (Map 6.3) and most of its workers live very near to this area.

The district's sub-center is developed along one of the main roads where public transport operates (Photo 6.4). One can easily reach this linear sub-center by walking for at most 10 minutes. It is difficult to say that this sub-center is highly specialised. Nevertheless, IN-L's residents consider this shopping area sufficient even for durable goods shopping. Neighbouring districts also use this sub-centre.

Map 6.3. Land Use Map of Onder (IN-L)

Most of the buildings are one or two storeys (Photo 6.5). The area first developed as a squatter housing area. Buildings were later legalised and residents allowed to re-build according to a plan. In recent years, multi-storey buildings have been built along the main roads (Photo 6.6). This transformation is sometimes followed by a transformation in family composition. Traditional families comprising married daughters or sons and grandchildren turn into nuclear families in separate flats but still in one building.

The area is supplied by primary and secondary schools. There are some small mosques. Both schools and mosques are within walking distance. There is also a local health centre in the sub-centre.

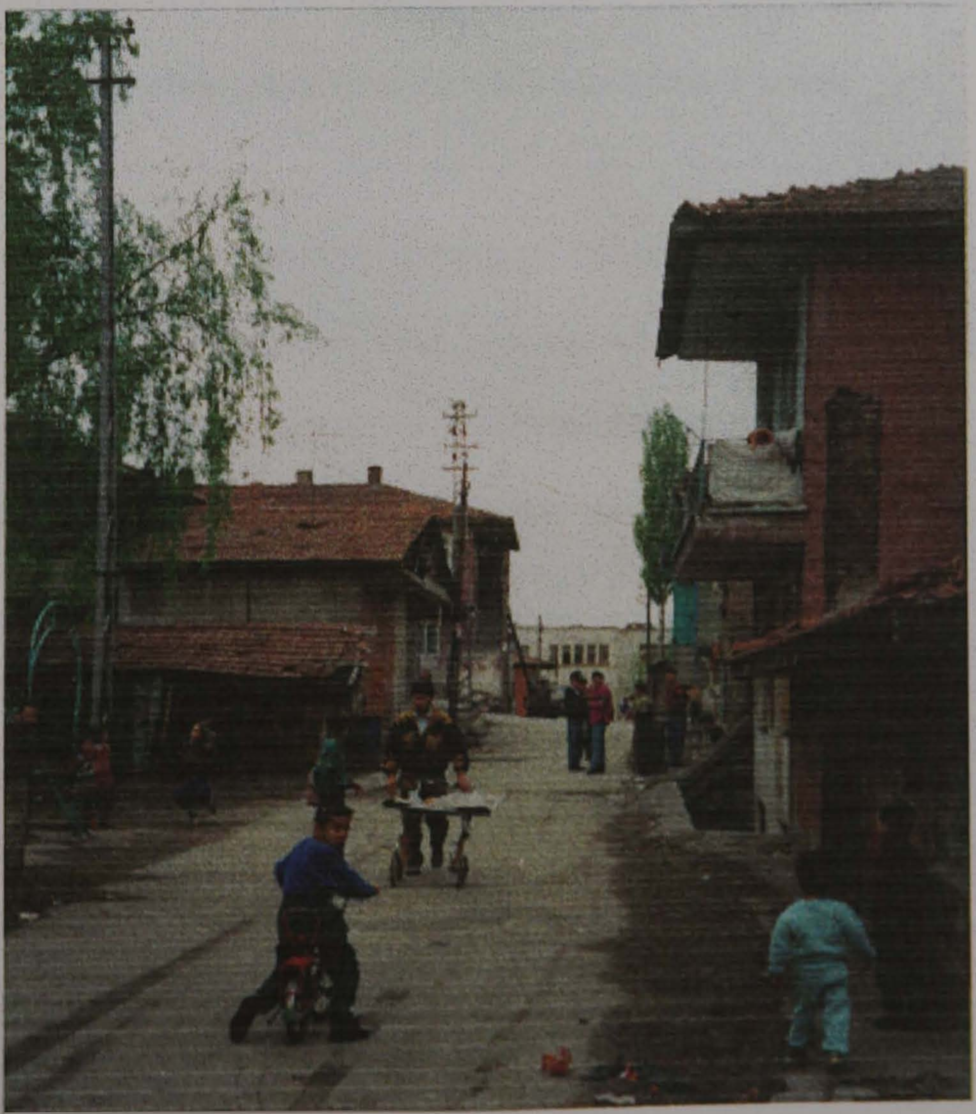
There is no recreational area for the residents. Children and young adults play in the secondary streets (see Photo 6.7). Another problem is infrastructure: sewerage and drinking water systems have not yet been fully supplied.

Photo 6.4. Linear Sub-Centre and Main Route of Public Bus Services and Dolmuses in Onder (IN-L)

Photo 6.5. Transformation of Gecekondus into Multi-Storey Buildings in Onder (IN-L)

Photo 6.6 Multi-Storey Developments Along the Main Roads in Onder (IN-L)

Photo 6.7. Secondary Streets as Play Gardens in Onder (IN-L)



Like in OUT-L, **OUT-M** has been built step-by-step. The whole area is planned to be developed in four stages, three of which are completed and settled, the fourth is still under construction (Map 6.4).

As a residential district, there exist both multi-storey buildings and single houses in OUT-M (Photo 6.8 and 6.9). Nevertheless, most of the buildings are 6-10 storeys high. Some of them are publicly owned and used as lodgings.

In terms of urban services, there are two shopping centres each containing small shops, cafés and restaurants (Photo 6.10). It is possible to get to these local centres on foot. There is an easy access by pedestrian paths from all residential lots. This access is sometimes provided along parks and playgrounds (Photo 6.11). Instead of having a limited number of large scale playgrounds and parks, there are plenty of small ones. This increases accessibility while supporting the wide use of these areas.

All infrastructures including sewerage, drinking water and road networks are supplied in settled parts. Each building lot usually includes car parks and there are also possibilities for roadside parking (see Photo 6.8 and 6.10). The area is served by buses and dolmuses.

There are three primary-secondary schools, one high school, one nursery and one mosque all of which are along the pedestrian path.

Map 6.4. Land Use Map of Eryaman (OUT-M)

Photo 6.8 Single and Multi-Storey Building Complex in Eryaman (OUT-M)

Photo 6.9. High Density Developments in Eryaman (OUT-M)

Photo 6.10. Shopping Centre of Eryaman (OUT-M)

Photo 6.11. A Pedestrian Walkway Beside the Playground and Park in Eryaman (OUT-M)

IN-M is mainly a housing area that was established in early 1950's. Some of the houses were built under a cooperative type of organisation. All buildings are multi-storey and usually comprise 4-5 storeys (Photo 6.12 and 6.13). It was originally designed for the middle income group but most of its resident's income level is in fact upper-middle.

The dwelling density is quite high (135 dwelling units per hectare) in IN-M. This indicates a number of land use characteristics: for instance there are no recreational areas for children or adults (Map 6.5).

IN-M is surrounded by two main axes one of which contains several shops, banks and other businesses (Photo 6.13 and 6.14). These two main roads are the public transport routes. Limited numbers of small shops exist at ground floor level. There is one shopping centre with car park which occupies upper floors (Photo 6.15).

The technical infrastructure of the area is well-developed. In recent years, as in most of the inner city districts, the buildings' heating system have been converted to natural gas. This has helped to reduce the air pollution level in IN-M as well as in other parts of Ankara.

Road side parking is usual (see Photo 6.12, 6.13 and 6.15). Considering the high car ownership level and high building density, car parking is one of the problems in IN-M. Road side parking limits the road space and constrains the traffic flow of both vehicles and pedestrians.

Photo 6.12. Housing Areas and First Flour Retail Stores in Esat (IN-M)

Photo 6.13. Road-Side Parking and Multi-Storey Housing Blocks Along the Main Avenue in Esat (IN-M)

Map 6.5. Land Use Map of Esat (IN-M)

Photo 6.14. First-Floor Retail Stores Along the Main Avenue in Esat (IN-M)

Photo 6.15. Shopping Centre Located on the Southern Edge of Esat (IN-M)

OUT-H is a mass-housing area that includes nearly 1.300 dwelling units. Ninety percent of all dwellings are high-rise blocks. Single houses and apartments are separated spatially. Each residential unit, whether a single house or apartment block, has its own car park (Photo 6.16 and 6.17).

There is one local centre located on top of a small hill which includes tennis courts, swimming pool, basketball fields and an entertainment building (Map 6.6). This area is the central recreational area in OUT-H. There are some other small scale parks and play-grounds as well. Public service buildings such as a post office and bank lie beside this area. The commercial centre includes many small shops including grocers, restaurants and a pharmacy. (Photo 6.18 and 6.19). In 1997, the shopping centre, which includes a supermarket and a cinema, was opened adjacent to the residential area.

All technical infrastructures are well supplied in OUT-H. Before April 1994, residents arranged their own bus services and they defined two routes for these services. This private service for their own use was additional to municipal buses,. Due to a lack of municipal permission which is necessary by law, the newly elected municipal authority did not allow the private service to continue. This occured while this research's field work was being carried out. The Mayor's decision created confusion among residents and the situation was discussed in the media. Later, the municipality provided bus services on the two routes, but with all buses open for public use. Some municipal services like cleaning the roads, collecting solid wastes and so forth are carried out by the OUT-H's managerial office.

Photo 6.16. High-Rise Housing Blocks in Koru (OUT-H)

Photo 6.17. Single Houses in Koru (OUT-H)

Map 6.6. Land Use Map of Koru (OUT-H)

Photo 6.18. Public Service Offices (Post Office and Bank) in Koru (OUT-H)

Photo 6.19. Shopping Centre of Koru (OUT-H)

Because of the presidential palace and prime minister's residence, **IN-H** is one of the most prestigious areas within the inner city. Ankara's governor is also resident in IN-H, and most of the embassies are either in IN-H or very near to it (Map 6.7).

IN-H has held this distinguished role since the early years of the republic. The palace of Ataturk, who established the Turkish Republic, is here and is used as museum today. Beside all these attractions, three of the big recreational areas, namely *Segmenler*, *Botanik* and *Kugulu,* are in IN-H. The *Ankara Tennis Club* and two of the famous shopping and entertainment centres, namely *Atakule and Karum,* are also situated in IN-H (Photo 6.20 and 6.21).

It is difficult to define IN-H as a residential area. It has a number of functions, one of which is as a business district. There are many offices of domestic and foreign companies. All the buildings, either workplace or housing, are multi-storey (Photo 6.22). Due to a lack of car parks, road side parking is common. This again limits the road space and constraints traffic flow for both vehicles and pedestrians (Photo 6.23).

There is one primary school and one mosque within the district boundaries. In addition to two shopping centres, there are small shops on ground floors (Photo 6.24). The area is very near to *Tunali Hilmi* where several shops, boutiques, restaurants, cinemas and clubs exist (Photo 6.25).

Map 6.7. Land Use Map of Cankaya (IN-H)

Photo 6.20. Atakule - Shopping Centre in Cankaya (IN-H)

Photo 6.21. Karum - Shopping Centre Located on the Northern Edge of Cankaya (IN-H)

Photo 6.22. Housing Areas of Cankaya (IN-H)

Photo 6.23. Road-Side Parking in Cankaya (IN-H)

Photo 6.24. First Floor Retail Stores in Cankaya (IN-H)

Photo 6.25 Tunali Hilmi - Main Sub-Centre of Ankara Located on the Northern Edge of Cankaya and Southern Edge of Esat (IN-H)

VI.5. Socio-economic Characteristics of Residents

VI.5.1. Household Structure

Family size as one of the indicators of the social and demographic structure of the population indicates that nearly 71 per cent of all sampled households have less than 5 members (Table 6.3). Thirty-three per cent of all households have 4 members. Large size families are usual in IN-L and OUT-L. Nuclear families, on the other hand, account for a higher proportion in middle and upper income than low income districts in both the inner and the out-of city districts.

Table 6.3. Family Size by District

	NUMBER OF FAMILIES													
Family	IN-L		IN-M		IN-H		OUT-L		OUT-M		OUT-H		TOTAL	
Size	#	%	#	%	#	%	#	%	#	%	#	%	#	%
1	0	0.0	2	5.0	3	7.5	0	0.0	4	8.0	3	6.0	12	4.4
2	4	10.0	22	27.5	9	22.5	0	0.0	10	20.0	10	20.0	44	16.3
3	7	17.5	37	35.0	10	25.0	10	20.0	15	30.0	21	42.0	77	28.5
4	16	40.0	40	27.5	12	30.0	20	40.0	14	28.0	15	30.0	88	32.6
5	6	15.0	10	5.0	6	15.0	10	20.0	5	10.0	1	2.0	30	11.1
6	5	12.5	0	0.0	0	0.0	6	12.0	2	4.0	0	0.0	13	4.8
7	1	2.5	0	0.0	0	0.0	2	4.0	0	0.0	0	0.0	3	1.1
8+	1	2.5	0	0.0	0	0.0	2	4.0	0	0.0	0	0.0	3	1.1
TOTAL	40	100.0	40	100.0	40	100.0	50	100.0	50	100.0	50	100.0	270	100.0

The household compositions of these districts, which are given in Table 6.4 also, support this finding. Parents, daughter- or son-in-law, or grandchild of the head of households usually live together with nuclear families in IN-L and OUT-L. This is also usual in OUT-M.

Table 6.4. Household Composition

Position in Family	NUMBER OF FAMILY MEMBERS AGED 7 AND OVER													
	IN-L		IN-M		IN-H		OUT-L		OUT-M		OUT-H		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Head of Household	40	27.4	41	36.9	40	32.5	49	26.5	48	32.2	48	33.3	266	31.0
Partner of Head	36	24.7	34	30.6	31	25.2	49	26.5	39	26.2	44	30.6	233	27.2
Son	34	23.3	17	15.3	16	13.0	36	19.5	24	16.1	24	16.7	151	17.6
Daughter	28	19.2	16	14.4	30	24.4	43	23.2	30	20.1	24	16.7	171	19.9
Mother/Father	4	2.7	1	0.9	3	2.4	3	1.6	5	3.4	2	1.4	18	2.1
Daughter/Son-in-Law	3	2.1	0	0.0	1	0.8	2	1.1	1	0.7	0	0.0	7	0.8
Grandchild	1	0.7	2	1.8	2	1.6	0	0.0	1	0.7	0	0.0	6	0.7
Other	0	0.0	0	0.0	0	0.0	3	1.6	1	0.7	2	1.4	6	0.7
TOTAL	146	100.0	111	100.0	123	100.0	185	100.0	149	100.0	144	100.0	858	100.0

As explained in chapter V, the districts were further classified according to income level during the sampling procedure. This classification was based on data obtained from the Greater Municipality of Ankara. The average monthly housing rent and car ownership levels according to district which were derived from the questionnaire, also support this classification (Table 6.5). These two indicators have the lowest values for low income districts and the highest value for high income districts. This conclusion is valid for both the inner and the out-of city districts.

Table 6.5. Income Level of Districts According to Housing Rent and Car Ownership

	INNER CITY			OUT-OF CITY		
	IN-H	IN-M	IN-L	OUT-H	OUT-M	OUT-L
Income Level	High	Middle	Low	High	Middle	Low
Average Rent[5]	12,5	8	3	15	7,6	3,4
Car Ownership[6]	348,8	241,0	65,1	503,3	179,0	48,5

[5] Housing rent per month (million TL).
[6] Number of cars per thousands.

VI.5.2. Socio-Ecomomic Characteristics of Trip Makers

A total of 858 people aged 7 and over were interviewed about their travel diaries. IN-L and OUT-L have the youngest population among the districts surveyed (Table 6.6). The female population is higher than the male population in all districts (Table 6.7).

Table 6.6. Age Structure by District

Age Cohorts	IN-L #	IN-L %	IN-M #	IN-M %	IN-H #	IN-H %	OUT-L #	OUT-L %	OUT-M #	OUT-M %	OUT-H #	OUT-H %	TOTAL #	TOTAL %
7-9	12	8.2	2	1.8	9	7.3	16	8.6	5	3.4	4	2.8	48	5.6
10-14	27	18.5	9	8.1	9	7.3	29	15.7	11	7.4	8	5.6	93	10.8
15-19	15	10.3	11	9.9	16	13.0	28	15.1	19	12.8	14	9.7	103	12.0
20-24	13	8.9	6	5.4	7	5.7	14	7.6	14	9.4	15	10.4	69	8.0
25-29	19	13.0	8	7.2	7	5.7	20	10.8	19	12.8	9	6.3	82	9.6
30-34	19	13.0	9	8.1	9	7.3	30	16.2	14	9.4	9	6.3	90	10.5
35-39	14	9.6	12	10.8	14	11.4	20	10.8	20	13.4	7	4.9	87	10.1
40-44	9	6.2	12	10.8	8	6.5	12	6.5	13	8.7	17	11.8	71	8.3
45-49	9	6.2	8	7.2	5	4.1	8	4.3	7	4.7	21	14.6	58	6.8
50-54	3	2.1	5	4.5	15	12.2	4	2.2	5	3.4	16	11.1	48	5.6
55-59	2	1.4	3	2.7	8	6.5	1	0.5	6	4.0	12	8.3	32	3.7
60-64	0	0.0	10	9.0	9	7.3	3	1.6	8	5.4	8	5.6	38	4.4
65+	4	2.7	16	14.4	7	5.7	0	0.0	8	5.4	4	2.8	39	4.5
TOTAL	**146**	**100.0**	**111**	**100.0**	**123**	**100.0**	**185**	**100.0**	**149**	**100.0**	**144**	**100.0**	**858**	**100.0**

Table 6.7. Gender by District

	IN-L #	IN-L %	IN-M #	IN-M %	IN-H #	IN-H %	OUT-L #	OUT-L %	OUT-M #	OUT-M %	OUT-H #	OUT-H %	TOTAL #	TOTAL %
Female	75	51.4	56	50.5	71	57.7	98	53.0	83	55.7	75	52.1	458	53.4
Male	71	48.6	55	49.5	52	42.3	87	47.0	66	44.3	69	47.9	400	46.6
TOTAL	**146**	**100.0**	**111**	**100.0**	**123**	**100.0**	**185**	**100.0**	**149**	**100.0**	**144**	**100.0**	**858**	**100.0**

Approximately 28 per cent of all trip makers are students and 60 per cent of them are not working (Table 6.8 and 6.9). The proportion of working population to the total is high in OUT-H (48 %) and in OUT-M (45 %). In both in IN-M and IN-H this ratio is lower (41 %). OUT-L and IN-L have the lowest rates of all (34 per cent in each district).

Table 6.8. Education Level of Population by District

	NUMBER OF PEOPLE													
	IN-L		IN-M		IN-H		OUT-L		OUT-M		OUT-H		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Student	43	29.5	26	23.4	38	30.9	60	32.4	36	24.2	41	28.5	244	28.4
Graduate	91	62.3	85	76.6	85	69.1	114	61.6	108	72.5	103	71.5	586	68.3
Other	12	8.2	0	0.0	0	0.0	11	5.9	5	3.4	0	0.0	28	3.3
TOTAL	**146**	**100.0**	**111**	**100.0**	**123**	**100.0**	**185**	**100.0**	**149**	**100.0**	**144**	**100.0**	**858**	**100.0**

Table 6.9. Economically Active Population by District

	NUMBER OF PEOPLE													
	IN-L		IN-M		IN-H		OUT-L		OUT-M		OUT-H		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Working	49	33.6	45	40.5	50	40.7	62	33.5	67	45.0	70	48.6	343	40.0
Not Working	97	66.4	66	59.5	73	59.3	123	66.5	82	55.0	74	51.4	515	60.0
TOTAL	**146**	**100.0**	**111**	**100.0**	**123**	**100.0**	**185**	**100.0**	**149**	**100.0**	**144**	**100.0**	**858**	**100.0**

Illiteracy is typical in IN-L and OUT-L. A low educational background is also observed in these two districts, whereas in other districts high school and university graduates have higher shares (Table 6.10).

Table 6.10. Literacy and Level of Formal Education Completed by District

	NUMBER OF PEOPLE													
	IN-L		IN-M		IN-H		OUT-L		OUT-M		OUT-H		TOTAL	
Education Level	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Illiterate	5	3.4	0	0.0	0	0.0	8	4.3	2	1.3	0	0.0	15	1.7
School Unattended	29	19.9	6	5.4	11	8.9	31	16.8	9	6.0	5	3.5	91	10.6
Primary School	75	51.4	17	15.3	7	5.7	69	37.3	19	12.8	11	7.6	198	23.1
Secondary School	22	15.1	13	11.7	10	8.1	37	20.0	24	16.1	13	9.0	119	13.9
High School	11	7.5	29	26.1	43	35.0	29	15.7	42	28.2	30	20.8	184	21.4
University	4	2.7	46	41.4	52	42.3	11	5.9	53	35.6	85	59.0	251	29.3
TOTAL	146	100.0	111	100.0	123	100.0	185	100.0	149	100.0	144	100.0	858	100.0

As it can be seen in Table 6.11, the main reason for not working is being a student. Retired people and housewives are also economically inactive. The percentages of housewives is quite high in IN-L and OUT-L whereas it is relatively low in OUT-H and IN-H. Unemployment is high in IN-L where 4.1 per cent of the total population is not working.

Table 6.11. Reasons for Not Working by District

	NUMBER OF PEOPLE													
	IN-L		IN-M		IN-H		OUT-L		OUT-M		OUT-H		TOTAL	
Reasons	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Student	43	44.3	26	39.4	38	52.1	60	48.8	36	43.9	41	55.4	244	47.4
Retired	1	1.0	15	22.7	6	8.2	2	1.6	8	9.8	10	13.5	42	8.2
Unemployed	4	4.1	0	0.0	2	2.7	3	2.4	1	1.2	1	1.4	11	2.1
Housewife	48	49.5	25	37.9	26	35.6	56	45.5	35	42.7	21	28.4	211	41.0
Disable	1	1.0	0	0.0	1	1.4	1	0.8	0	0.0	0	0.0	3	0.6
Other	0	0.0	0	0.0	0	0.0	1	0.8	2	2.4	1	1.4	4	0.8
TOTAL	97	100.0	66	100.0	73	100.0	123	100.0	82	100.0	74	100.0	515	100.0

The occupations of the working population are given in Table 6.12. Seventy-four percent in IN-L are in non-agricultural production and related jobs. This percentage is 27 in OUT-L, where 32 per cent of the total are service workers and 35 per cent are clerical or commercial workers. In OUT-M and IN-M, more than 65 per cent of working people are scientific, technical, administrative or managerial workers. Their proportions are 80 per cent in IN-H and 97 per cent in OUT-H.

Although the percentage of employers has the highest value (26,5 %) in IN-L, one should keep in mind that all of them are working in non-agricultural production. Unpaid family workers also have a high share (12 %) and they are also working in non-agricultural production. The proportion of employees to total working population is 94 per cent in OUT-L most of which are working as service workers (Table 6.13 and 6.14). In spite of the fact that the percentages of employees are higher than the expected level in IN-H and OUT-H, they usually work as scientific, technical, administrative or managerial workers.

Table 6.13. Position at Work of Working Population by District

	NUMBER OF PEOPLE													
Position at Work	**IN-L**		**IN-M**		**IN-H**		**OUT-L**		**OUT-M**		**OUT-H**		**TOTAL**	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Employee	21	42.9	34	75.6	34	68.0	58	93.5	60	89.6	50	71.4	257	74.9
Employer	13	26.5	6	13.3	9	18.0	3	4.8	4	6.0	12	17.1	47	13.7
Self-Employed	9	18.4	3	6.7	5	10.0	0	0.0	0	0.0	7	10.0	24	7.0
Unpaid Family Worker	6	12.2	2	4.4	2	4.0	1	1.6	3	4.5	1	1.4	15	4.4
TOTAL	**49**	**100.0**	**45**	**100.0**	**50**	**100.0**	**62**	**100.0**	**67**	**100.0**	**70**	**100.0**	**343**	**100.0**

The following chapter, chapter VII, provides a descriptive analysis of travel demand patterns in these districts in relation with the characteristics of these districts and their residents.

Table 8.12 Occupation of Working Population by Districts

Occupation	Position	IN-L #	IN-L %	IN-M #	IN-M %	IN-H #	IN-H %	OUT-L #	OUT-L %	OUT-M #	OUT-M %	OUT-H #	OUT-H %	TOTAL #	TOTAL %
Scientific, Technical, Professional and Related Workers	Employee	3	6.1	22	48.9	23	46.0	9	14.5	42	62.7	42	60.0	141	41.1
	Employer	0	0.0	2	4.4	5	10.0	0	0.0	1	1.5	10	14.3	18	5.2
	Self-Employed	0	0.0	0	0.0	1	2.0	0	0.0	0	0.0	6	8.6	7	2.0
	Unpaid Family Worker	0	0.0	0	0.0	2	4.0	0	0.0	1	1.5	1	1.4	4	1.2
Administrative Managerial Workers	Employee	0	0.0	4	8.9	6	12.0	0	0.0	4	6.0	8	11.4	22	6.4
	Employer	0	0.0	1	2.2	1	2.0	0	0.0	0	0.0	0	0.0	2	0.6
	Self-Employed	0	0.0	1	2.2	2	4.0	0	0.0	0	0.0	1	1.4	4	1.2
	Unpaid Family Worker	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Clerical and Related Worker	Employee	2	4.1	4	8.9	3	6.0	8	12.9	7	10.4	0	0.0	24	7.0
	Employer	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Self-Employed	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Unpaid Family Worker	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Commercial and Sales Workers	Employee	1	2.0	2	4.4	1	2.0	8	12.9	3	4.5	0	0.0	15	4.4
	Employer	0	0.0	3	6.7	1	2.0	0	0.0	2	3.0	2	2.9	8	2.3
	Self-Employed	2	4.1	1	2.2	2	4.0	0	0.0	0	0.0	0	0.0	5	1.5
	Unpaid Family Worker	0	0.0	2	4.4	0	0.0	0	0.0	0	0.0	0	0.0	2	0.6
Workers Service	Employee	3	6.1	1	2.2	1	2.0	20	32.3	2	3.0	0	0.0	27	7.9
	Employer	0	0.0	0	0.0	2	4.0	0	0.0	1	1.5	0	0.0	3	0.9
	Self-Employed	2	4.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.6
	Unpaid Family Worker	0	0.0	0	0.0	0	0.0	0	0.0	1	1.5	0	0.0	1	0.3
Nonagricultural Production and Related Workers, Transport Equipment Operators	Employee	12	24.5	1	2.2	0	0.0	13	21.0	2	3.0	0	0.0	28	8.2
	Employer	13	26.5	0	0.0	0	0.0	3	4.8	0	0.0	0	0.0	16	4.7
	Self-Employed	5	10.2	1	2.2	0	0.0	0	0.0	0	0.0	0	0.0	6	1.7
	Unpaid Family Worker	6	12.2	0	0.0	0	0.0	1	1.6	1	1.5	0	0.0	8	2.3
TOTAL		49	100.0	45	100.0	50	100.0	62	100.0	67	100.0	70	100.0	343	100.0

Table 6.14. Occupation of Working Population According to Position at Work

Occupation	IN-L #	IN-L %	IN-M #	IN-M %	IN-H #	IN-H %	OUT-L #	OUT-L %	OUT-M #	OUT-M %	OUT-H #	OUT-H %	TOTAL #	TOTAL %
Scientific, Technical, Professional and Related Workers	3	6.1	24	53.3	31	62.0	9	14.5	44	65.7	59	84.3	170	19.8
Administrative managerial Workers	0	0.0	6	13.3	9	18.0	0	0.0	4	6.0	9	12.9	28	3.3
Clerical and Related Worker	2	4.1	4	8.9	3	6.0	8	12.9	7	10.4	0	0.0	24	2.8
Commercial and Sales Workers	3	6.1	8	17.8	4	8.0	8	12.9	5	7.5	2	2.9	30	3.5
Service Workers	5	10.2	1	2.2	3	6.0	20	32.3	4	6.0	0	0.0	33	3.8
Nonagricultural Production and related Workers	36	73.5	2	4.4	0	0.0	17	27.4	3	4.5	0	0.0	58	6.8
TOTAL	49	100.0	45	100.0	50	100.0	62	100.0	67	100.0	70	100.0	343	40.0

CHAPTER SEVEN: TRAVEL DEMAND PATTERNS OF THE INNER AND OUT-OF CITY RESIDENTS - A PROFILE

VII.1. Introduction

This chapter first tries to summarise the travel demand patterns of the surveyed population. It was noted in the previous chapter that selected districts are grouped in terms of their location with reference to the CBD and their dates of establishment. Another classification is according to the income levels of the districts. In fact, income level and location of residential area are the two main factors defining the travel demand pattern of households. These factors affect not only the number of daily trips but also modal split, duration, length and purpose of trips. A comparative analysis of travel demand patterns mainly depends on these factors. Additionally, and where appropriate, other factors such as occupation and education of the surveyed population, which are important in explaining the differences in each category were included.

VII.2. Main Findings: Overall Travel Demand Patterns

Before going into full details of the surveyed population's travel demand patterns, it is necessary to keep in mind coding of the districts given in Table 6.1 according to their income levels and locations.

Research findings verify the existence of a correlation between income level and mobility. High mobility typifies high income people, whereas those who show lower mobility in their daily activities are represented by a higher share in the low income group. This correlation is more obvious in the inner-city districts.

It is very rare for residents of the low income districts to make more than 4 trips a day per person (Table 7.1). In contrast, it is more common for the high income and particularly for the out-of city residents to travel more than this.

Table 7.1. Number of Trips by District

	NUMBER OF TRIPS										TRIP GENERATION RATE PER CAPITA[1]
	1	2	3	4	5	6	7	8	9	10	
IN-L	1	150	6	108	0	6	0	0	0	0	1.85 (VI)
IN-M	0	104	30	80	5	30	21	0	0	0	2.43 (IV)
IN-H	0	112	33	104	30	30	14	16	9	0	2.83 (II)
OUT-L	1	192	12	180	0	12	0	0	0	0	2.14 (V)
OUT-M	0	142	30	116	25	48	7	24	9	0	2.69 (III)
OUT-H	2	126	60	116	50	24	21	24	0	10	3.01 (I)
TOTAL	**4**	**826**	**171**	**704**	**110**	**150**	**63**	**64**	**18**	**10**	

The trip generation rate per capita is higher for the out-of city districts than for the inner city districts (Table 7.1). For example, in IN-L trip generation rate per capita is 1.85, whereas in OUT-L it is 2.14. This situation is also observed in all other districts a similar income level.

VII.2.1. Modal Split of the Travel Demand

Pedestrian trips are more common among the inner city residents, whereas dependency on motorised modes is widely observed among the out-of city

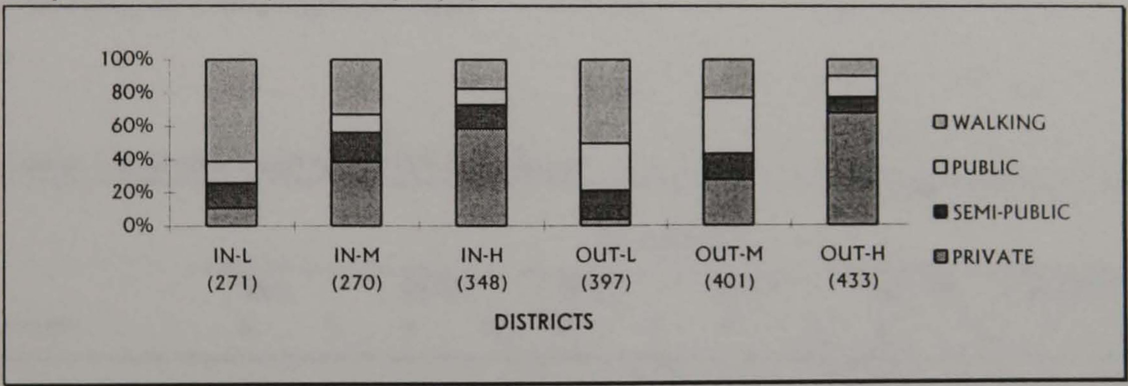
[1] Numbers in parenthesis represent rank order from the highest to the lowest.

residents. The share of trips on foot trips extends to 61 per cent in the inner city area (in IN-L) and decreases to 10 per cent in the out-of city area (in OUT-H).

Private motorised modes are widely used by high income people, particularly by those living in the out-of city districts. OUT-H has the highest percentage among all with 67,7 per cent. The lowest figure is from OUT-L with only 3,8 per cent (Table 7.2 and Graph 7.1).

Trips by public transport have similar shares both for low and middle income groups but their shares are higher in OUT-L and OUT-M. They are rarely preferred by OUT-H's and IN-H's residents who have better access to cars.

Graph 7.1. Modal Split of Trips (%) [2]



Among low income people, besides public transport use, a preference for walking is apparent with the share of walking trips exceeding 50 per cent in both IN-L and OUT-L.

[2] Numbers in parenthesis represent total number of trips.

It is obvious that income level has an indicative role on the modal split of daily trips. There is an apparent variation in the modal split. In spite of the high preference for walking by the inner city residents, dependency on motorised modes increases with income level. Nevertheless, propensity to use cars is not as high as in the out-of city case. Lower dependence on motorised modes is the result of walking possibilities within the inner city area: since travel distances are shorter for the inner city residents, they can easily walk to their destinations. In the case of out-of city residents, they usually travel to the inner city by motorised modes. They sometimes walk within the inner city to get their final destination. Walking can only be considered as a main mode of transport when they use urban facilities that are near to their houses. These generalisations vary with the income level with increasing income level resulting in higher use of private modes and decreasing income level resulting in more trips on foot.

Table 7.2. Modal Split of Travel By District

	DISTRICTS													
	IN-L		IN-M		IN-H		OUT-L		OUT-M		OUT-H		TOTAL	
MODE	#	%	#	%	#	%	#	%	#	%	#	%	#	%
PRIVATE	29	10.7	104	38.5	204	58.6	15	3.8	111	27.7	293	67.7	756	35.7
SEMI-PUBLIC	41	15.1	48	17.8	50	14.4	69	17.4	63	15.7	42	9.7	313	14.8
PUBLIC	36	13.3	29	10.7	33	9.5	114	28.7	134	33.4	54	12.5	400	18.9
WALKING	165	60.9	89	33.0	61	17.5	199	50.1	93	23.2	44	10.2	651	30.7
TOTAL	**271**	**100.0**	**270**	**100.0**	**348**	**100.0**	**397**	**100.0**	**401**	**100.0**	**433**	**100.0**	**2120**	**100.0**

Car ownership, as an indicator of income level, is one of the most important variables shaping the modal split of journeys. Those who do not own a car usually belong to low income level and their share of walking is high. In IN-L and OUT-L, walking trips have the highest share, together with low car ownership. In OUT-L, nearly a quarter of all trips is made by car owning family members, but trips by car still have a lower share than walking: that is, walking is common even among car owners in OUT-L. This shows a low level of car usage among low income people. In the case of IN-L, the situation is quite different. Trips by car owners have a higher share when compared to OUT-L, which means a higher level of car usage. Nevertheless, walking remains the most popular way of travelling at low income level even among car-owning family members. One reason for this low level of car usage is the monopoly of one person over the family's single car.

Trips by private modes increase with car ownership level. This direct correlation between car ownership and car use is particularly obvious among high income families (Appendix B.1).

Having a similar income and car ownership level, car usage is higher in out-of city residences than in inner city residences. Among low income people, non-car owners prefer walking if they are living in the inner-city area whereas those living in the out-of city area use public transport. For middle income groups, living outside the city encourages the extensive use of public transports, even among the car-owning families. Use of public transport decreases significantly as car ownership increases.

Walking is usually preferred by younger ages in all districts. Most of the pupils walk between their residences and schools. In the out-of city districts, the share of non-motorised trips in younger ages is higher than in the inner city districts, particularly for those in the 7-14 year age band. This share decreases with an increasing income level, while keeping higher percentages when compared to the inner city districts (Appendix B.2).

The modal split is different for older people. In the inner city districts, middle-aged people prefer walking in their daily trips; whereas in the out-of city districts, dependency on motorised modes increases in this age group.

Private mode use is high among the 25-54 age, but the majority of trips by private mode concentrates on a particular age at low income level; that is 30-34. With an increasing income level, there is an even distribution of car usage among 25-54 year old people.

Working is another factor affecting the modal split of daily trips. Working people depend more on motorised modes, while walking is more popular among non-working people (Appendix B.3). Both private and public modes are preferred by the working population. Within a similar income level this situation can be observed both in the inner and out-of city districts, with some changes in percentages resulting from location differences.

In the case of the out-of city people, motorised modes have a higher share among working people, whereas in the inner city districts walking is also common among working people.

In the case of the non-working population, living in the inner city area encourages walking trips. For example, at a high income level (in IN-H) 22 per cent of all their trips are pedestrian trips in the inner city. In OUT-H, this ratio decrease to 15 per cent with 50 per cent of them preferring to travel by car. Similarly, in OUT-M, nearly 50 per cent of all trips by non-working people are made by public transport modes whereas in IN-M this percentage is only 30.

Location of a residence obviously affects the modal choice of both the working and the non-working population.

In IN-L, walking is a very popular method of travelling, whereas in OUT-L, public and semi- public modes are commonly used by working people. As explained in the previous chapter, IN-L is located close to the manufacturing area. This area is the workplace of most of the working people and it takes only 10 minutes to get there on foot. In the case of OUT-L, the workplace is usually far from the residential area and it is very rare for working people to walk to their workplaces. They use public transport instead and any pedestrian trips they made are not to or from work.

At the low income level, it is not only the working population but also the non-working population which prefers walking. Nearly 65 and 80 per cent of all trips in this group are pedestrian (in IN-L and OUT-L, respectively) (Appendix B.3). The higher percentage of walking in OUT-L is due to the spatial characteristics of the district. Since it is located far from the city centre, its residents usually have to use local facilities such as schools and local shops. Their social life is also restricted by these forces. They visit each other and use local entertainment places. A similar structure is also found in IN-L, but besides the local amenities provided the city centre is nearby.

The wider walking preference of low income people is replaced with a dependency on motorised modes among the working population at middle and high income levels. With an increasing income level, car usage accelerates among the working population.

In IN-M, private car use is more common among working people than in OUT-M where car usage is replaced with public transport. Walking is, on the other hand, more common in IN-M. Similar to the low income level, working people living in IN-M have more chance to walk both for work and for irregular trips. In the case of OUT-M, walking trips by working people are usually for irregular trips and they very rarely walk to work.

At high income levels, working people depend more on motorised modes. This is particularly obvious in OUT-H where 90 per cent of all trips by the working population are motorised. In IN-H, the share of motorised trips by working people is lower, since they have better opportunities to walk within the inner city. Nevertheless 88 per cent of all trips by these working people are motorised. Similarly, private car usage among working people is higher in OUT-H than IN-H. Nearly 88 per cent of all motorised trips by OUT-H's working people are in private vehicles. This share decreases to 76 per cent in IN-H where the share of public mode use is 24 per cent at most (Appendix B.3).

In the case of high income districts, the car is the dominating mode among all the working population. At middle income level, public transport modes substitute for cars together with walking. In OUT-M, only 37 per cent of all trips by the working population are by private vehicles whereas 51 per cent are by transit modes. In IN-M, the share of private modes is higher than in OUT-M. Similarly, walking is also more common than in OUT-M.

In OUT-L, 76 per cent of all the working population's trips are made by public transport and the share of private modes is only 6 per cent. Among all out-of city districts, only the OUT-L working population prefers walking, and its share is 17 per cent of all trips. As explained before, in IN-L, walking is the most popular mode for working people (56 per cent of all trips) (Appendix B.3).

Walking is the means of transport for students, housewives and retired people who are economically inactive. Students and housewives also use any available of motorised modes but students prefer public or semi-public modes whereas housewives also use private modes. Only students at higher income levels living in IN-H and OUT-H use private modes (Appendix B.4). It is necessary to note that both students and housewives are usually passengers, not the drivers of private modes.

Occupational structure determines the income level of a district; that is having a better occupation usually means belonging to a higher income level and owning a car. Private car use is therefore wider among those who have better occupations, both in the inner and out-of city districts (see Appendix B.4). Although this seems to be a general tendency, the location of a residence relative to the working place sometimes stimulates the use of other modes of transport. In IN-L, where the number of people working as non-agricultural production workers is quite high, walking is popular. This is of course a positive result of living near to work place. On the other hand, in OUT-L, where socio-economic characteristics of population similar to IN-L's are observed, walking is replaced by public transport. This is a result of living in the out-of city areas and distant from the working place.

Only 10 per cent of all pedestrian trips are made by those working as scientific, technical or professional workers, even though 25 per cent of all trips are made by them. They usually prefer motorised modes, particularly private ones. Forty-two per cent of all trips are by private mode in this occupation group, and its share directly increases with income level. Nearly 20 per cent of all trips by transit modes are made by this occupation group. It is the out-of city residents who use motorised modes in this occupation group. Nevertheless, 20 and 34 per cent of all walking trips in OUT-M and OUT-H respectively, are made by those working as scientific, technical or professional workers (Appendix B.4). This does not mean that their trips between home and work are on foot but rather they prefer walking when it is possible. Their walking trips are therefore usually irregular daily trips within the inner city area.

Position at work also affects the modal split of the working population in a way similar to that of occupational structure. Employees and paid workers are more dependent on public transport and they also have a higher propensity to walk. More than 90 per cent of all trips by public transport are made by employees. Employers, on the other hand, neither use public transport nor walk frequently in their daily trips. IN-L is the only exception, since 58 per cent of all trips by employers are pedestrian and 21 per cent are by public transport modes (Appendix B.5). Like employees, self-employed people also have made little use of public transport and walking the only exception being again, in IN-L.

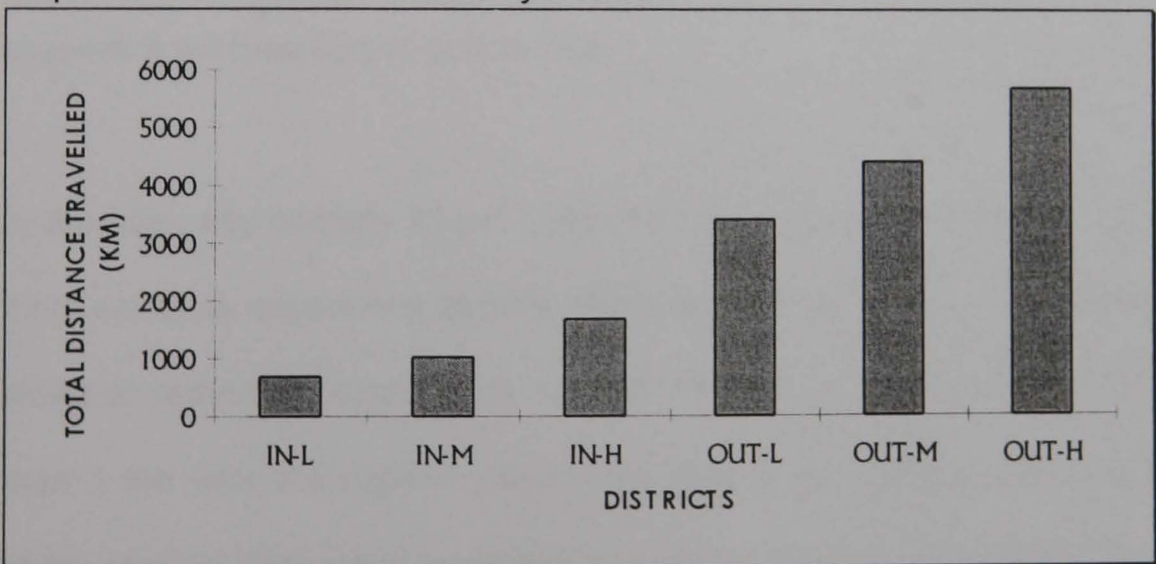
Together with all other factors, education level also affects the modal split of travel demand. A low educational background results in a wider use of public transport and in a higher propensity to walk. Most private vehicle users, on the other hand, are well educated.

Location of residence of course affects this relation between educational background and modal split. Pedestrian trips are still high among low income people, even among highly educated people, particularly for those living in OUT-L. Having a better educational background means a wider use of public transport in the middle income level, both in the inner and out-of city districts. Even university graduates prefer public transport, as in the case of OUT-M. Forty-seven per cent of all their trips are by public transport whereas 40 per cent are by car (Appendix B.6).

VII.2.2. Travel Distance and Main Destinations

Graph 7.2. shows how total travel distance changes with selected districts. A comparison of total travel distances by income level indicates that there exists a high correlation between income level and total travel distance; that is, high income people travel longer travel distances in total.

Graph 7.2. Total Distance Travelled by Districts



Not only income level but also residence location has a powerful influence on travel distance. In the inner city districts total travel distance is less than in the out-of city districts. Even the total travel distance of OUT-L's residents has a higher value than that of IN-H's residents. The comparison of travel distances by IN-L's and OUT-L's residents confirms that living in an out-of city area results in five times more travel distance at a low income level. In the case of the high income level, the influence of district is lowest: that is total travel distance in OUT-H is 3 times more than IN-H (Table 7.3).

Table 7.3. Total Travel Distances by District

TOTAL TRAVEL DISTANCE (KM)						
IN-L	**IN-M**	**IN-H**	**OUT-L**	**OUT-M**	**OUT-H**	**TOTAL**
685.6	1024	1683.2	3406.4	4401.8	5681.4	16882.4

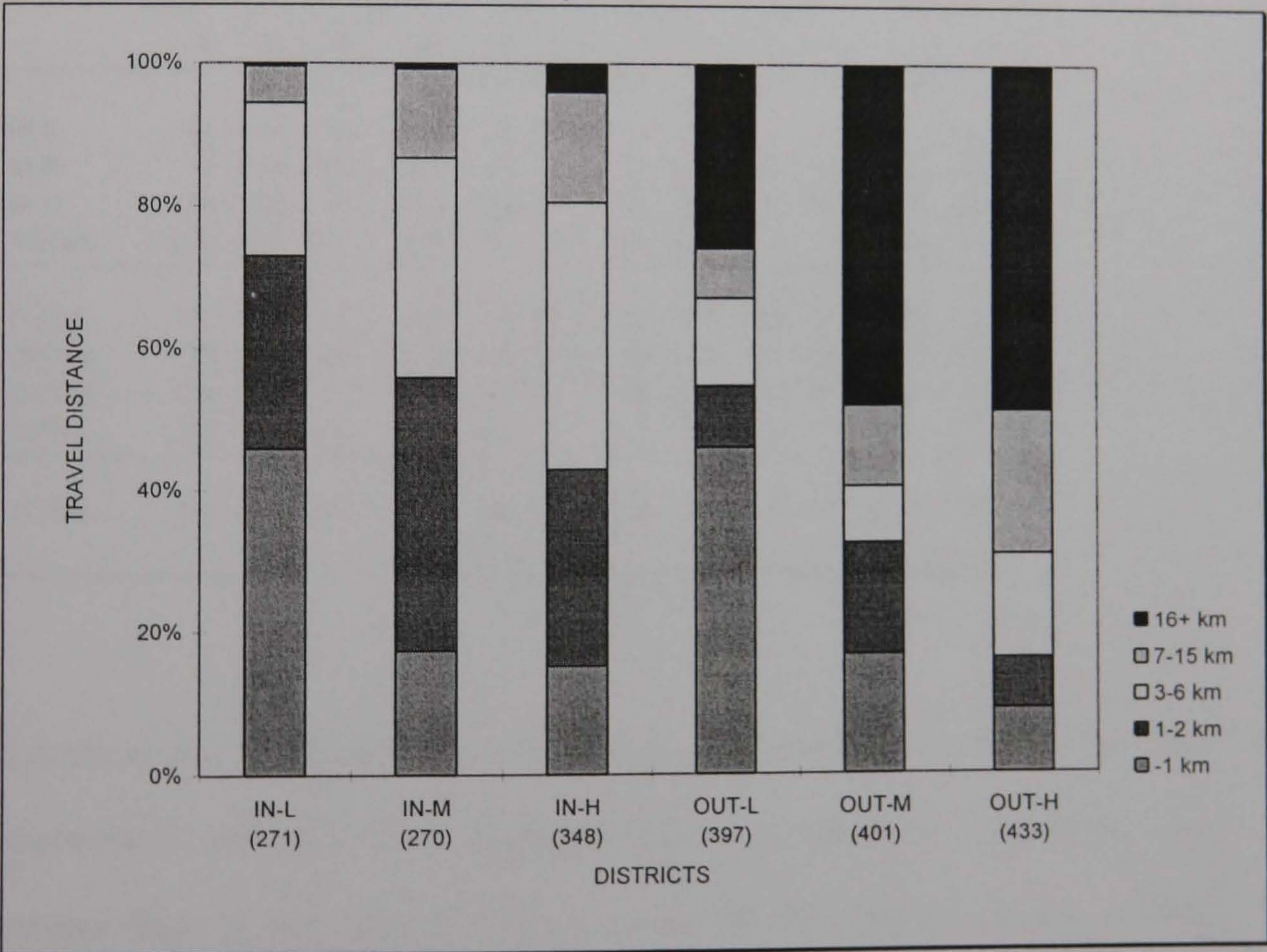
Disaggregating the total travel distance of the districts for different intervals reveals that for residents of the inner city districts nearly 87 per cent of all trips are less than 7 km (Table 7.4). This is lower in IN-H, with 80 per cent, whereas it reaches 95 per cent in IN-L.

In the inner city districts 25 per cent of all trips are less than 1 km, so that there exists an opportunity to make these trips by walking. In IN-L, where the share of pedestrian trips is quite high, most of the trips (45.8 %) are shorter than 1 km with the highest percentage among all inner city districts. The share of short distance trips decreases with an increasing income level while percentages for trips longer than 1 km increases.

In the out-of city districts, on the other hand, 55 per cent of all trips are more than 7 km reaching 70 per cent in OUT-H. This share decreases with a decreasing income level (60 % in OUT-M and 33 % in OUT-L). Similar to IN-L, trips shorter than 1 km have the highest share in OUT-L where walking is the most common way of travelling.

All these figures show a correlation between income level and travel distance as well as the travel mode (Graph 7.3). Low income level leads to shorter distance trips and a wider preference of walking. This is more obvious in the inner city case where spatial structure provides better opportunities for these trips as in IN-L.

Graph 7.3. Distribution of Trip Lengths by Districts[3]



[3] Numbers in parenthesis represent total number of trips.

As mentioned in previous sections, the area is located very near to the workplaces. Working people may easily walk to their work places. For other trips, especially long-distance motorised trips, they have some monetary restrictions. It is not so much spatial forces, but rather income level which shapes their travel demand in terms of distance. They have to walk instead of using a motorised mode, since the cost of walking is negligible. They are therefore forced to use local facilities and do not use facilities in other parts of Ankara.

Table 7.4. Travel Distances by District

	TRAVEL DISTANCE (KM)											
	-1		1-2		3-6		7-15		16+		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%
IN-L	124	45.8	74	27.3	58	21.4	14	5.2	1	0.4	271	100.0
IN-M	47	17.4	104	38.5	83	30.7	34	12.6	2	0.7	270	100.0
IN-H	53	15.2	96	27.6	131	37.6	54	15.5	14	4.0	348	100.0
TOTAL	224	25.2	274	30.8	272	30.6	102	11.5	17	1.9	889	100.0
OUT-L	182	45.8	35	8.8	49	12.3	28	7.1	103	25.9	397	100.0
OUT-M	67	16.7	63	15.7	32	8.0	46	11.5	193	48.1	401	100.0
OUT-H	39	9.0	31	7.2	63	14.5	88	20.3	212	49.0	433	100.0
TOTAL	288	23.4	129	10.5	144	11.7	162	13.2	508	41.3	1231	100.0
TOTAL	**512**	**24.2**	**403**	**19.0**	**416**	**19.6**	**264**	**12.5**	**525**	**24.8**	**2120**	**100.0**

Location of a destination area relative to a residence determines the travel distance. In the case of the inner city districts, most of the trips, even those longer than 1 km, are either within or on the fringes of the district's boundaries. The remaining trips are usually to the CBD and they are longer than 3 km. This is particularly true for IN-L (Appendix B.7).

Destination areas can be various for high income people. This usually means long distance travelling together with a wider use of private modes, as in IN-H and OUT-H. Even though long distance travelling is usually observed among the out-of city districts, multiplicity of destination areas together with high car ownership lead to long distance travelling in IN-H also. All these mean long distance trips by motorised modes in IN-H and OUT-H, usually by car.

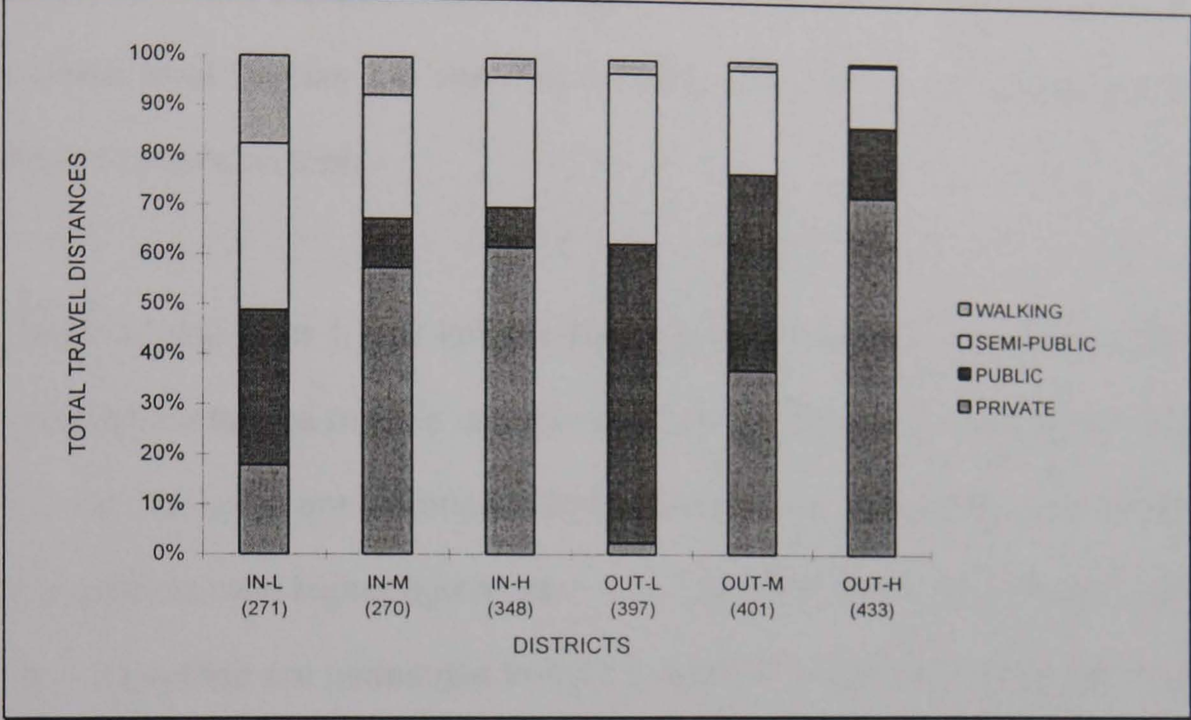
The reverse is the case for OUT-L. Due to monetary restrictions, the destination areas of OUT-L's residents are to a certain extent homogeneous. This inevitably results in the highest percentage of short distance trips among all out-of city residents. OUT-L's residents use local facilities whenever possible.

The frequency distribution of destination areas shows that the share of daily trips to the inner city from the out-of city districts is very high. This indicates an extensive use of different parts of Ankara by those living in the out-of city districts.

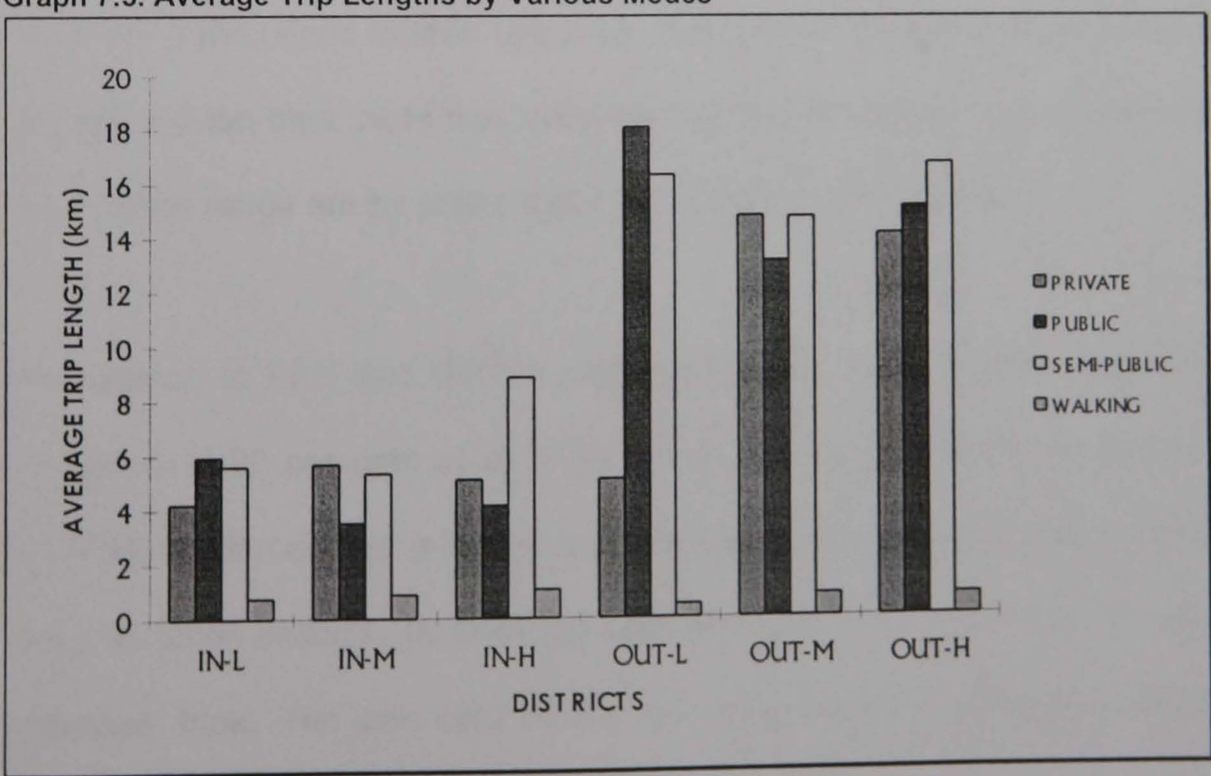
A high propensity to commute between the home and the inner city means travelling for longer distances and long distance travel requires extensive use of motorised modes. Income level permitting, the travel mode is a car. Living far from the CBD may force people to travel for long distances if there are few alternative destination areas nearby. In the case of the low income district (OUT-L) where long distance trips have the lowest share among all out-of city districts, people usually have homogenous destination areas which are either near to their residence or to the CBD.

All these preferences and obligations shape the modal choice of a trip in terms of overall travel distance and average trip length covered by each mode. (Graph 7.4 and 7.5).

Graph7.4. Total Distance Travelled by Various Modes[4]



Graph 7.5. Average Trip Lengths by Various Modes



[4] Numbers in parenthesis represent total number of trips.

As travel distance rises, dependency on motorised modes increases. Survey results also verify this situation. More than 90 per cent of all trips which are less than 1 km are pedestrian and this share decreases with an increasing income level (Tables 7.5 and 7.6). In IN-L and IN-M, all trips that are less than 1 km are on foot.

Trips ranging from 1 to 2 km are also usually pedestrian in IN-L and IN-M, although motorised mode's use can also be observed here. Nearly half of the trips in this range are motorised. Similar tendencies exist in the case of out-of city districts, with higher figures than IN-L and IN-M. More than 50 per cent of all 1-2 km trips are pedestrian in OUT-L and OUT-M while 35 per cent of are by either public or semi-public modes of transport (Table 7.5). At similar income levels, living in an out-of city area encourages pedestrian trips whereas a motorised modes' use lower than that of the inner city is observed among 1-2 km trips. Note that more than 85 and 70 per cent of all motorised trips in this range are by public transport in OUT-L and OUT-M.

In contrast, in IN-H and OUT-H motorised modes have a wider use in this range. Only 20 per cent of all 1-2 km trips are on foot in IN-H whereas in OUT-H this percentage is higher at 29 per cent. Car use has higher rate here than in other districts. In IN-H car use is higher than in OUT-H for short-distance trips. Ten per cent of 1-2 km trips that are walked in OUT-H residents would be made by car if they were living in IN-H. This part of the travel demand is supplied by car in IN-H while in OUT-H walking is preferred. For short-distance trips living in an out-of city area creates an advantage for walking, if the spatial structure is as convenient as in the case of OUT-H. A well-organised local shopping centre which offers a diversity of services in specialised shops, sport facilities and schools lead to wider pedestrian trips and lower car use in OUT-H than IN-H. Note that car ownership is higher in OUT-H than IN-H.

Not only at high income level but at all income levels, living in an out-of city area may result in a wider walking preference for trips of less than 2 km. At a high income level, the spatial structure of the district is an incentive. At a lower income level, on the other hand, the economic structure of a household shapes the demand for different modes. In spite of the limited local facilities and absence of pleasant environment for pedestrian trips, their income structures force them into pedestrian trips.

Pedestrian trips reduce gradually with increasing travel distance, while the share of motorised trips rises. This is more usual in the out-of city districts. Buses substitute for the pedestrian trips in OUT-L and OUT-M and in OUT-H the car is also popular for long distances.

In the inner city districts nearly half of all trips longer than 3 km are made by public or semi-public transport modes.

Table 7.5. Travel Distances by Districts According to Travel Mode (Column %)

	TRANSPORT MODE	TRAVEL DISTANCE (KM) -1 #	%	1-2 #	%	3-6 #	%	7-15 #	%	16+ #	%	TOTAL #	%
IN-L	PRIVATE			17	23.0	6	10.3	4	28.6			27	10.0
	PUBLIC			7	9.5	26	44.8	2	14.3	1	100.0	36	13.3
	SEMIPUBLIC			10	13.5	25	43.1	8	57.1			43	15.9
	WALKING	124	100.0	40	54.1	1	1.7					165	60.9
	TOTAL	124	100.0	74	100.0	58	100.0	14	100.0	1	100.0	271	100.0
IN-M	PRIVATE			25	24.0	44	53.0	22	64.7	2	100.0	93	34.4
	PUBLIC			16	15.4	13	15.7					29	10.7
	SEMIPUBLIC			21	20.2	26	31.3	12	35.3			59	21.9
	WALKING	47	100.0	42	40.4							89	33.0
	TOTAL	47	100.0	104	100.0	83	100.0	34	100.0	2	100.0	270	100.0
IN-H	PRIVATE	12	22.6	49	51.0	74	56.5	31	57.4	6	42.9	172	49.4
	PUBLIC			7	7.3	22	16.8	4	7.4			33	9.5
	SEMIPUBLIC	4	7.5	20	20.8	31	23.7	19	35.2	8	57.1	82	23.6
	WALKING	37	69.8	20	20.8	4	3.1					61	17.5
	TOTAL	53	100.0	96	100.0	131	100.0	54	100.0	14	100.0	348	100.0
OUT-L	PRIVATE	4	2.2	2	5.7	5	10.2	4	14.3			15	3.8
	PUBLIC			10	28.6	31	63.3	8	28.6	65	63.1	114	28.7
	SEMIPUBLIC	1	0.5	2	5.7	12	24.5	16	57.1	38	36.9	69	17.4
	WALKING	177	97.3	21	60.0	1	2.0					199	50.1
	TOTAL	182	100.0	35	100.0	49	100.0	28	100.0	103	100.0	397	100.0
OUT-M	PRIVATE	8	11.9	9	14.3	9	28.1	19	41.3	66	34.2	111	27.7
	PUBLIC			20	31.7	14	43.8	11	23.9	89	46.1	134	33.4
	SEMIPUBLIC			1	1.6	8	25.0	16	34.8	38	19.7	63	15.7
	WALKING	59	88.1	33	52.4	1	3.1					93	23.2
	TOTAL	67	100.0	63	100.0	32	100.0	46	100.0	193	100.0	401	100.0
OUT-H	PRIVATE	3	7.7	13	41.9	43	68.3	70	79.5	145	68.4	274	63.3
	PUBLIC			4	12.9	6	9.5	5	5.7	39	18.4	54	12.5
	SEMIPUBLIC	2	5.1	5	16.1	13	20.6	13	14.8	28	13.2	61	14.1
	WALKING	34	87.2	9	29.0	1	1.6					44	10.2
	TOTAL	39	100.0	31	100.0	63	100.0	88	100.0	212	100.0	433	100.0
TOTAL	PRIVATE	27	5.3	115	28.5	181	43.5	150	56.8	219	41.7	692	32.6
	PUBLIC	0	0.0	64	15.9	112	26.9	30	11.4	194	37.0	400	18.9
	SEMIPUBLIC	7	1.4	59	14.6	115	27.6	84	31.8	112	21.3	377	17.8
	WALKING	478	93.4	165	40.9	8	1.9	0	0.0	0	0.0	651	30.7
	TOTAL	512	100.0	403	100.0	416	100.0	264	100.0	525	100.0	2120	100.0

Table 7.6. Travel Distances by Districts According to Travel Mode (Row %)

	TRANSPORT MODE	TRAVEL DISTANCE (KM) -1 #	%	1-2 #	%	3-6 #	%	7-15 #	%	16+ #	%	TOTAL #	TOTAL %
	PRIVATE		0.0	17	63.0	6	22.2	4	14.8		0.0	27	100.0
	PUBLIC		0.0	7	19.4	26	72.2	2	5.6	1	2.8	36	100.0
IN-L	SEMIPUBLIC		0.0	10	23.3	25	58.1	8	18.6		0.0	43	100.0
	WALKING	124	75.2	40	24.2	1	0.6		0.0		0.0	165	100.0
	TOTAL	124	45.8	74	27.3	58	21.4	14	5.2	1	0.4	271	100.0
	PRIVATE		0.0	25	26.9	44	47.3	22	23.7	2	2.2	93	100.0
	PUBLIC		0.0	16	55.2	13	44.8		0.0		0.0	29	100.0
IN-M	SEMIPUBLIC		0.0	21	35.6	26	44.1	12	20.3		0.0	59	100.0
	WALKING	47	52.8	42	47.2		0.0		0.0		0.0	89	100.0
	TOTAL	47	17.4	104	38.5	83	30.7	34	12.6	2	0.7	270	100.0
	PRIVATE	12	7.0	49	28.5	74	43.0	31	18.0	6	3.5	172	100.0
	PUBLIC		0.0	7	21.2	22	66.7	4	12.1		0.0	33	100.0
IN-H	SEMIPUBLIC	4	4.9	20	24.4	31	37.8	19	23.2	8	9.8	82	100.0
	WALKING	37	60.7	20	32.8	4	6.6		0.0		0.0	61	100.0
	TOTAL	53	15.2	96	27.6	131	37.6	54	15.5	14	4.0	348	100.0
	PRIVATE	4	26.7	2	13.3	5	33.3	4	26.7		0.0	15	100.0
	PUBLIC		0.0	10	8.8	31	27.2	8	7.0	65	57.0	114	100.0
OUT-L	SEMIPUBLIC	1	1.4	2	2.9	12	17.4	16	23.2	38	55.1	69	100.0
	WALKING	177	88.9	21	10.6	1	0.5		0.0		0.0	199	100.0
	TOTAL	182	45.8	35	8.8	49	12.3	28	7.1	103	25.9	397	100.0
	PRIVATE	8	7.2	9	8.1	9	8.1	19	17.1	66	59.5	111	100.0
	PUBLIC		0.0	20	14.9	14	10.4	11	8.2	89	66.4	134	100.0
OUT-M	SEMIPUBLIC		0.0	1	1.6	8	12.7	16	25.4	38	60.3	63	100.0
	WALKING	59	63.4	33	35.5	1	1.1		0.0		0.0	93	100.0
	TOTAL	67	16.7	63	15.7	32	8.0	46	11.5	193	48.1	401	100.0
	PRIVATE	3	1.1	13	4.7	43	15.7	70	25.5	145	52.9	274	100.0
	PUBLIC		0.0	4	7.4	6	11.1	5	9.3	39	72.2	54	100.0
OUT-H	SEMIPUBLIC	2	3.3	5	8.2	13	21.3	13	21.3	28	45.9	61	100.0
	WALKING	34	77.3	9	20.5	1	2.3		0.0		0.0	44	100.0
	TOTAL	39	9.0	31	7.2	63	14.5	88	20.3	212	49.0	433	100.0
	PRIVATE	27	3.9	115	16.6	181	26.2	150	21.7	219	31.6	692	100.0
	PUBLIC	0	0.0	64	16.0	112	28.0	30	7.5	194	48.5	400	100.0
TOTAL	SEMIPUBLIC	7	1.9	59	15.6	115	30.5	84	22.3	112	29.7	377	100.0
	WALKING	478	73.4	165	25.3	8	1.2	0	0.0	0	0.0	651	100.0
	TOTAL	512	24.2	403	19.0	416	19.6	264	12.5	525	24.8	2120	100.0

Trips of less than 1 km are common among those who do not own cars in IN-L and OUT-L (Appendix B.8). The number of trips shorter than 1 km decreases among car owners with an increasing car ownership level, long distance trips become usual. Those living in the out-of city districts and having at least one car are more likely to travel more than 16 km per trip. Income level does not have a definitive role, since they are living far away from the city centre and main working areas. In the out-of city districts, long distance trips are typical even among those who do not own cars due to location of residence. In the case of the inner city residents, on the other hand, only those owning a car are more likely to travel for long distances.

Trips of less than 1 km are typical of the young (Appendix B.9). This is more obvious in low income districts (IN-L and OUT-L) and it is necessary to indicate that this relation is more apparent in OUT-L. This is closely related to trips between home and local schools. The case of IN-H is the only exception since here 42 per cent of all trips longer than 16 km are made by those in the 7-14 age band. In recent years, besides the university campuses, school campuses including primary, secondary and high schools have been established. They are sometimes located far from the CBD. Some of these schools belong to the private sector. High income people sometimes prefer these schools as in the case of IN-H. Instead of local schools which are only 5-10 minutes away on foot, students living in IN-H have to travel longer distances and usually have to use school buses. A similar situation is observed in OUT-H. However, OUT-H's residents do not have to travel long distances, since these campuses are near to OUT-H.

Short-distance trips are typical of females in all districts and being at work or living in an out-of city district results in long distance trips (Appendix B.10). Housewives living in the inner city districts travel for shorter distances than those living in the out-of city districts. IN-L, where most of the housewives (75 %) travel for less than 1 km and OUT-H, where most of the housewives (46 %) travel for more than 16 km per trip, are two extremes (Appendix B.11).

Students usually travel for relatively short distances in the inner city districts, although they sometimes travel for more than 16 km. With an increasing income level, travel distance by students also increases. As explained above, in IN-H students may have to travel to out-of city school campuses.

In OUT-L, 74 per cent of all trips by students are less than 1 km. This figure shows a sharp decrease with an increasing income level among the out-of city districts. In OUT-M and OUT-H, 33 and 15 per cent of all trips by students are less than 1 km. On the other hand, trips of more than 16 km have higher shares in these two districts (37 and 38 per cent respectively).

It is apparent from the research that having a better paid occupation is directly related to long distance travelling (see Appendix B.11). Position at work has a similar impact on travel distance; that is, being employee or self-employed means travelling for long distances (Appendix B.12). This is particularly true for the inner city residents who usually travel shorter distances for work than the out-of city residents.

Educational background affects travel distance but its influence wanes in the out-of city districts due to the location of residences. In OUT-L, 41 per cent of all trips by university graduates are less than 1 km, whereas this ratio is only around 5 per cent in OUT-M and OUT-H. Inversely, 55 per cent of all trips by university graduates are longer than 16 km in these two districts. Fifty-two per cent of all trips by primary school graduates are longer than 16 km in OUT-H while this figure is only 14 per cent in OUT-L (Appendix B.13). This difference is partly due to preference of secondary school and its location. Primary school graduates are not usually secondary school attendants in OUT-L. They may be working or non-working mature people and their long distance trips are not necessarily school trips as in the case of OUT-H.

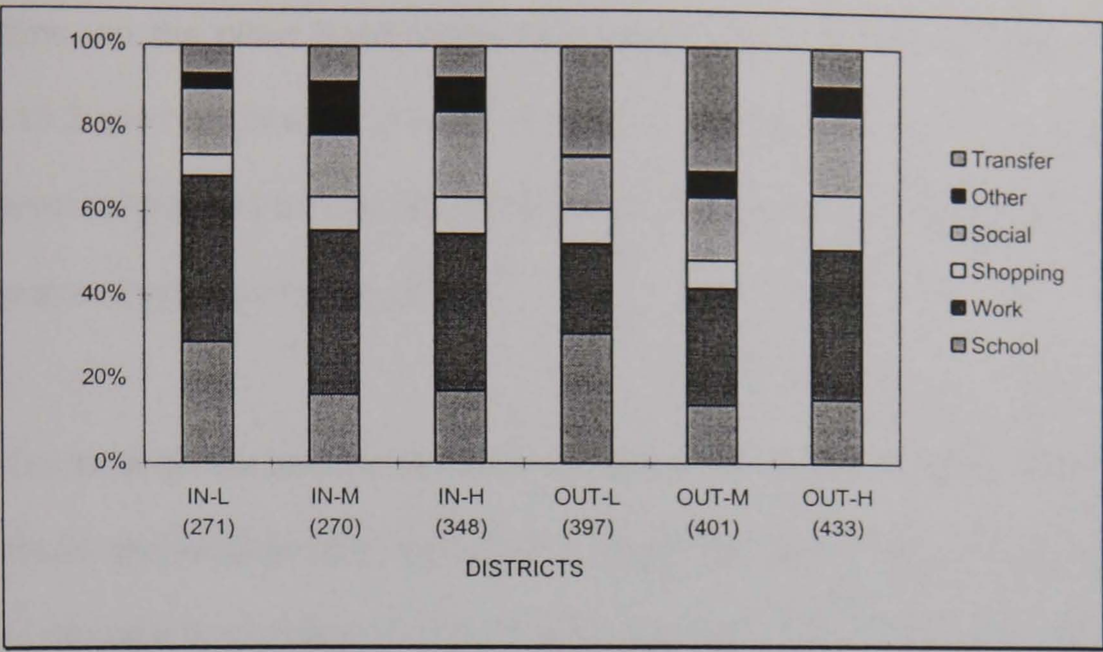
VII.2.3. Trip Purposes

As shown in Graph 7.6, most of the daily trips (50 %) are regular ones between residence and work, or residence and school. Irregular trips also have considerable share among all trips. Irregular social trips are the most common ones among all social trips. Seventeen per cent of all trips are irregular social trips, which constitute 33 per cent of all irregular trips (Table 7.7).

Table 7.7. Travel Purposes by Districts

	School		Work		Business		Recreation and Sport		Shopping		Health		Social		Transfer to Mode for School		Transfer to Mode for Work		Transfer to Mode		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
IN-L	78	28.8	102	37.6	6	2.2	0	0.0	14	5.2	10	3.7	43	15.9	16	5.9	0	0.0	2	0.7	271	100.0
IN-M	44	16.3	99	36.7	7	2.6	21	7.8	22	8.1	14	5.2	40	14.8	16	5.9	0	0.0	7	2.6	270	100.0
IN-H	60	17.2	111	31.9	20	5.7	16	4.6	31	8.9	13	3.7	71	20.4	19	5.5	2	0.6	5	1.4	348	100.0
OUT-L	123	31.0	85	21.4	1	0.3	0	0.0	33	8.3	2	0.5	50	12.6	16	4.0	74	18.6	13	3.3	397	100.0
OUT-M	56	14.0	100	24.9	13	3.2	13	3.2	27	6.7	12	3.0	61	15.2	21	5.2	56	14.0	42	10.5	401	100.0
OUT-H	67	15.5	144	33.3	13	3.0	21	4.8	57	13.2	9	2.1	83	19.2	10	2.3	12	2.8	17	3.9	433	100.0
TOTAL	**428**	**20.2**	**641**	**30.2**	**60**	**2.8**	**71**	**3.3**	**184**	**8.7**	**60**	**2.8**	**348**	**16.4**	**98**	**4.6**	**144**	**6.8**	**86**	**4.1**	**2120**	**100.0**

Graph 7.6. Trip Purposes by Districts (%)[5]



The number of regular trips is directly correlated with the number of working people and students. In IN-L and OUT-L school trips have the highest share due to their age structure. The share of work trips is higher in the inner city districts at low and middle income levels. At a high income level, the share of work trips by OUT-H's residents is higher than those of IN-H's residents.

The number and types of irregular trips, on the other hand, may change due to several reasons. Income level is one of the most important; irregular trips constitute 24 per cent of all trips at the low income level, their shares being 34 per cent and 42 per cent at the middle and high income levels respectively. These figures show a positive correlation between income level and number of irregular trips. Disaggregating the irregular trips for different types, however, does not reveal a particular correlation. One of the findings is

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[5] Numbers in parenthesis represent total number of trips.

the absence of recreational and sport trips at low income level. Shopping trips, on the other hand, have the highest share among all trips in OUT-H (13.2 per cent of all trips are this type). It is apparent that increasing income level contributes to diversity of trips purposes; that is, at high income level the purposes of trips are various.

There is a relationship between number of transfers to another transport mode and location of a residence. Living in an out-of city area forces people to modal interchanges. A significant proportion of this type of trip is by out-of city residents. Among the out-of city residents surveyed, these trips have the lowest share in OUT-H where car ownership is high. The number of these trips is correlated not only with location of residence but also with modal choice.

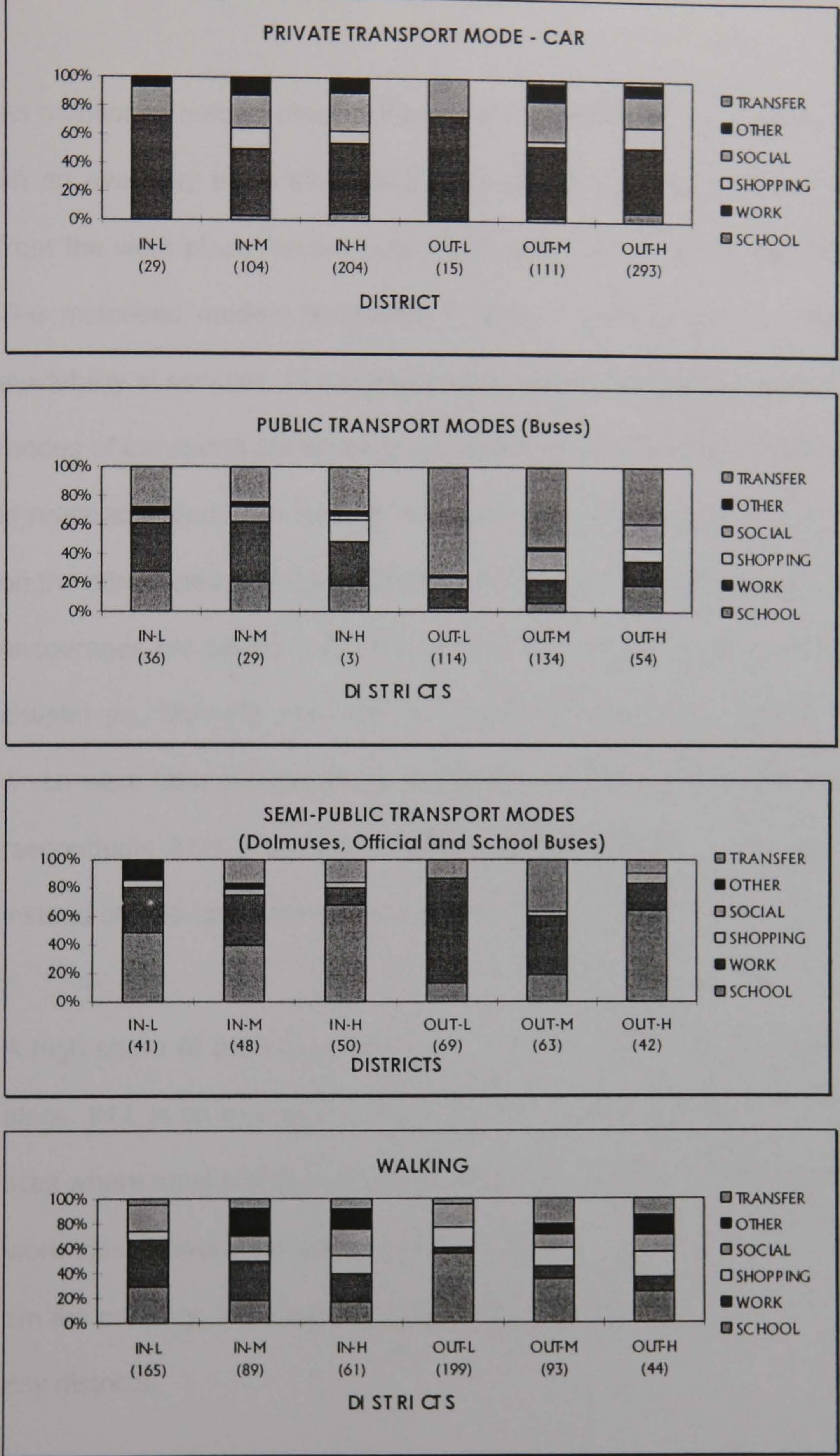
The relation between trip purpose and modal split indicates that motorised modes for regular daily trips have a wider preference among the out-of city residents than among the inner city residents (Graph 7.7). Motorised school trips are common among high income people: in OUT-H, where 84 per cent of all school trips are by motorised modes, the car is used even for school trips (28 %); in many cases, students are car passengers not drivers (Table 7.8). Similarly, the use of semi-public transport modes is prevalent among school trips. This implies that school buses are widely used at all income levels in the inner and out-of city districts. Walking, on the other hand, is an important means of transport for school trips, particularly in low income districts. Its share is higher in OUT-L and OUT-M than IN-L and IN-M.

Like school trips, the share of motorised work trips is higher among the out-of city districts than among the inner city ones. Eighty five per cent of all work trips by OUT-H's residents are by car. This share decreases with income level, and this decrease turns into an increasing tendency of public transport use. Public transport use has the highest value in OUT-L among all out-of city districts. The high share of work trips by semi-public transport in OUT-L and OUT-M is a result of an extensive use of office buses which operate between home and work place. Pedestrian trips have a negligible share when compared to the inner city districts. Even in OUT-L, only 9.4 per cent of all work trips are on foot.

In the inner city districts, the modal split profile has some similarities with that of the out-of city districts. That is increasing income level means more dependence on cars. The main differences between these two sets of districts are in terms of work trips by public transport and those on foot.

In IN-L and IN-M, public transport for work trips is not as popular as in OUT-L and OUT-M. Approximately two times as many people travel to work by public transport in OUT-L and OUT-M as in IN-L and IN-M. An alternative transport mode is walking in these inner city districts. The share of work trips on foot is considerably high in the inner city, particularly in IN-L. Even in IN-H, nearly 12 per cent of all work trips are on foot. This increase to 26 per cent in IN-M and 59 per cent in IN-L . Walking as a transport mode does not have high shares among the out-of city districts. Its share ranges between 3.5 per cent (in OUT-H) and 9.4 per cent (in OUT-L).

Graph.7.7. Trip Purposes According to Different Modes[6]



[6] Numbers in parenthesis represent total number of trips.

As mentioned before, most of the out-of city residents travel to the inner city on an everyday basis since their work places are located there. Living far from the work place forces them into a wide use of public transport or car. The motorised mode's preference is also shaped by the accessibility and availability of services. At low and middle income level, public and semi-public modes of transports are widely used. Office buses as a semi-public transport, is preferable since the cost for the passenger is negligible. Public transport, on the other hand is cheaper than a private car. A low level of service quality encourages car use in OUT-H where car ownership is high. As explained in chapter six, OUT-H's residents were used to having their own bus services which were later prevented from operating by the municipality. Most of the respondents from OUT-H mentioned that they used to use these buses instead of their cars even for work trips.

A high share of pedestrian work trips is a result of living near to a working place. IN-L is an example of this. It is very near to a furniture manufacturing area where most of IN-L's residents work. This spatial advantage encourages work trips on foot. The work trips within an inner city area are usually on foot. On the contrary, the share of walking among all work trips is low in the out-of city districts.

In terms of irregular daily trips, walking and private vehicles are the most popular modes.

Walking is widely preferred by OUT-M's and IN-M's residents for recreational and sport trips. Its share is considerably higher in IN-M (95 %) than in OUT-M (54 %). For these trips, private car use has an important share among high income people (nearly 67% of all recreational and sport trips in OUT-H and 63% in IN-H).

Shopping trips are usually either by car or on foot, the choice between these depending on income level. In OUT-H, 75 per cent of all shopping trips are by car, whereas only 16 per cent are by walking. Like OUT-H, 63 per cent of all shopping trips are by car in IN-H. Shopping trips on foot, on the other hand have a higher share (29%) in IN-H than in OUT-H. Thus, living in the inner city encourages walking for shopping even at high income level.

The considerable fluctuations in the use of semi-public transport modes by trip purposes is a result wide use of office bus services for work trips and extensive use of school bus services for school trips. For other purposes, semi-public transport modal choice usually refers to dolmuses.

Table 7.8. Travel Purposes by Districts According to Travel Mode (Column %)

		SCHOOL		WORK		BUSINESS		RECREATION AND SPORT		SHOPPING		HEALTH		SOCIAL		TRANSFER TO MODE FOR SCHOOL		TRANSFER TO MODE FOR WORK		TRANSFER TO MODE		TOTAL	
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
P	IN-L			20	19.6	1	16.7					2	20.0	6	14.0							29	10.7
R	IN-M	3	6.8	44	44.4	5	71.4			15	68.2	12	85.7	24	60.0	1	6.3					104	38.5
I	IN-H	10	16.7	83	74.8	18	90.0	10	62.5	17	54.8	8	61.5	55	77.5	1	5.3	1	50.0	1	20.0	204	58.6
V	OUT-L			11	12.9									4	8.0							15	3.8
A	OUT-M	3	5.4	48	48.0	8	61.5	6	46.2	4	14.8	8	66.7	31	50.8			1	1.8	2	4.8	111	27.7
T	OUT-H	19	28.4	122	84.7	13	100.0	14	66.7	43	75.4	9	100.0	65	78.3			3	25.0	5	29.4	293	67.7
E	TOTAL	35	8.2	328	51.2	45	75.0	30	42.3	79	42.9	39	65.0	185	53.2	2	2.0	5	3.5	8	9.3	756	35.7
P	IN-L	10	12.8	11	10.8	1	16.7					2	20.0	2	4.7	8	50.0			2	100.0	36	13.3
U	IN-M	6	13.6	12	12.1			1	4.8					3	7.5	3	18.8			4	57.1	29	10.7
B	IN-H	6	10.0	9	8.1	1	5.0			5	16.1	1	7.7	1	1.4	8	42.1			2	40.0	33	9.5
L	OUT-L	3	2.4	15	17.6							2	100.0	9	18.0	13	81.3	61	82.4	11	84.6	114	28.7
I	OUT-M	8	14.3	22	22.0					9	33.3	3	25.0	18	29.5	14	66.7	34	60.7	26	61.9	134	33.4
C	OUT-H	10	14.9	9	6.3					5	8.8			9	10.8	6	60.0	5	41.7	10	58.8	54	12.5
	TOTAL	43	10.0	78	12.2	2	3.3	1	1.4	19	10.3	8	13.3	42	12.1	52	53.1	100	69.4	55	64.0	400	18.9
SEMI	IN-L	20	25.6	11	10.8	2	33.3			2	14.3	6	60.0									41	15.1
P	IN-M	19	43.2	17	17.2							2	14.3	2	5.0	6	37.5			2	28.6	48	17.8
U	IN-H	34	56.7	6	5.4									2	2.8	7	36.8			1	20.0	50	14.4
B	OUT-L	9	7.3	51	60.0													8	10.8	1	7.7	69	17.4
L	OUT-M	12	21.4	26	26.0									2	3.3	6	28.6	14	25.0	3	7.1	63	15.7
I	OUT-H	27	40.3	8	5.6									3	3.6	1	10.0	2	16.7	1	5.9	42	9.7
C	TOTAL	121	28.3	119	18.6	2	3.3	0	0.0	2	1.1	8	13.3	9	2.6	20	20.4	24	16.7	8	9.3	313	14.8
W	IN-L	48	61.5	60	58.8	2	33.3			12	85.7			35	81.4	8	50.0					165	60.9
A	IN-M	16	36.4	26	26.3	2	28.6	20	95.2	7	31.8			11	27.5	6	37.5			1	14.3	89	33.0
L	IN-H	10	16.7	13	11.7	1	5.0	6	37.5	9	29.0	4	30.8	13	18.3	3	15.8	1	50.0	1	20.0	61	17.5
K	OUT-L	111	90.2	8	9.4	1	100.0			33	100.0			37	74.0	3	18.8	5	6.8	1	7.7	199	50.1
I	OUT-M	33	58.9	4	4.0	5	38.5	7	53.8	14	51.9	1	8.3	10	16.4	1	4.8	7	12.5	11	26.2	93	23.2
N	OUT-H	11	16.4	5	3.5			7	33.3	9	15.8			6	7.2	3	30.0	2	16.7	1	5.9	44	10.2
G	TOTAL	229	53.5	116	18.1	11	18.3	40	56.3	84	45.7	5	8.3	112	32.2	24	24.5	15	10.4	15	17.4	651	30.7
	IN-L	78	100.0	102	100.0	6	100.0	0	100.0	14	100.0	10	100.0	43	100.0	16	100.0	0	100.0	2	100.0	271	100.0
T	IN-M	44	100.0	99	100.0	7	100.0	21	100.0	22	100.0	14	100.0	40	100.0	16	100.0	0	100.0	7	100.0	270	100.0
O	IN-H	60	100.0	111	100.0	20	100.0	16	100.0	31	100.0	13	100.0	71	100.0	19	100.0	2	100.0	5	100.0	348	100.0
T	OUT-L	123	100.0	85	100.0	1	100.0	0	100.0	33	100.0	2	100.0	50	100.0	16	100.0	74	100.0	13	100.0	397	100.0
A	OUT-M	56	100.0	100	100.0	13	100.0	13	100.0	27	100.0	12	100.0	61	100.0	21	100.0	56	100.0	42	100.0	401	100.0
L	OUT-H	67	100.0	144	100.0	13	100.0	21	100.0	57	100.0	9	100.0	83	100.0	10	100.0	12	100.0	17	100.0	433	100.0
	TOTAL	428	100.0	641	100.0	60	100.0	71	100.0	184	100.0	60	100.0	348	100.0	98	100.0	144	100.0	86	100.0	2120	100.0

In contrast, walking has high share for shopping trips in OUT-L and IN-L. In this case, income level plays a certain role. Local facilities are good enough for the residents' demands, with basic necessities being supplied at local markets with a low level of specialisation. Using a motorised mode results in an additional cost. Residents of these areas therefore prefer local shops and walking as a mode of transport.

Those living in OUT-M use either public transport (33%) or walking (52%). IN-M's residents, on the other hand, widely prefer cars for shopping trips (68%) together with walking (32%). At middle income level, living in the out-of city area results in less dependence on motorised modes for shopping trips than the inner city case, which can be explained by a wider use of local facilities in OUT-M than IN-M.

Car usage for health trips is quite evenly spread among all districts except IN-L. People living in IN-L use semi-public transport instead. For social trips, on the other hand, car usage is highly correlated with income level. The share of social trips by car increases together with income level. At low income levels, high car usage for social trips is replaced by walking both in the inner and out-of city districts (81.4% and 74% respectively). Public transport mode has a limited usage for social trips. Nevertheless it has a wider preference among the out-of city residents than in the inner city cases.

The purpose of a trip is usually explained by the main land use of a destination area. While dealing with trip purposes, it is necessary to indicate that 15,5 per cent of all trips are made in order to get to another mode of transport. The interchange point of these trips is usually the CBD. Transfers between modes are very common among the out-of city residents. Trips with interchanges are usually observed if the main mode of transport is either public or semi-public. The secondary mode is either public transport or, usually, walking.

The relationship between trip purpose and travel distance indicates that school trips are usually short distance trips. It is, on the other hand, obvious that increasing income level provides opportunities for long distance school trips. The share of short distance school trips among all school trips decreases to 16 per cent in OUT-H and IN-H. As with income level, living far from the CBD sometimes results in long distance school trips, as in the cases of OUT-M and OUT-H where 32 per cent and 45 per cent of all school trips are longer than 16 km (Table 7.9).

In OUT-L, 82 per cent of all school trips are less than 1 km whereas in IN-L 51.3 per cent of all school trips are less than 1 km. This does not mean that in IN-L there are long distance school trips but rather that living in the inner city area provides more opportunities for longer school trips. In IN-L, 43.6 per cent of them are between 1 and 6 km. This implies that low income people have very limited opportunities for long distance school trips due to monetary reasons. They have to use nearby school facilities if they live in an out-of city district, but if they live in an inner city district then they have some opportunity to walk schools situated in neighbouring districts.

Table 7.9. Travel Purposes by District According to Travel Distance (Raw %)[1]

	TRAVEL DISTANCE RANGES (KM)											
	-1		1-2		3-6		7-15		16+		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%
PURPOSE												
SCHOOL												
IN-L	40	51.3	23	29.5	11	14.1	4	5.1			78	100.0
IN-M	9	20.5	20	45.5	13	29.5	2	4.5			44	100.0
IN-H	10	16.7	7	11.7	20	33.3	17	28.3	6	10.0	60	100.0
OUT-L	101	82.1	12	9.8	8	6.5			2	1.6	123	100.0
OUT-M	28	50.0	5	8.9			5	8.9	18	32.1	56	100.0
OUT-H	11	16.4	1	1.5	1	1.5	24	35.8	30	44.8	67	100.0
TOTAL	199	46.5	68	15.9	53	12.4	52	12.1	56	13.1	428	100.0
WORK												
IN-L	41	38.0	36	33.3	24	22.2	6	5.6	1	0.9	108	100.0
IN-M	16	15.1	37	34.9	38	35.8	13	12.3	2	1.9	106	100.0
IN-H	12	9.2	33	25.2	63	48.1	21	16.0	2	1.5	131	100.0
OUT-L	8	9.3	5	5.8	12	14.0	12	14.0	49	57.0	86	100.0
OUT-M	3	2.7	10	8.8	11	9.7	21	18.6	68	60.2	113	100.0
OUT-H	6	3.8	6	3.8	20	12.7	21	13.4	104	66.2	157	100.0
TOTAL	86	12.3	127	18.1	168	24.0	94	13.4	226	32.2	701	100.0
SHOPPING												
IN-L	12	85.7			2	14.3					14	100.0
IN-M	5	22.7	4	18.2	5	22.7	8	36.4			22	100.0
IN-H	5	16.1	8	25.8	15	48.4	3	9.7			31	100.0
OUT-L	33	100.0									33	100.0
OUT-M	16	59.3	5	18.5	1	3.7			5	18.5	27	100.0
OUT-H	10	17.5	8	14.0	9	15.8	8	14.0	22	38.6	57	100.0
TOTAL	81	44.0	25	13.6	32	17.4	19	10.3	27	14.7	184	100.0
SOCIAL												
IN-L	31	72.1	7	16.3	3	7.0	2	4.7			43	100.0
IN-M	16	26.2	29	47.5	14	23.0	2	3.3			61	100.0
IN-H	21	24.1	40	46.0	19	21.8	5	5.7	2	2.3	87	100.0
OUT-L	39	78.0	2	4.0	6	12.0			3	6.0	50	100.0
OUT-M	13	17.6	14	18.9	3	4.1	3	4.1	41	55.4	74	100.0
OUT-H	9	8.7	12	11.5	20	19.2	27	26.0	36	34.6	104	100.0
TOTAL	129	30.8	104	24.8	65	15.5	39	9.3	82	19.6	419	100.0
OTHER												
IN-L					8	80.0	2	20.0			10	100.0
IN-M			4	28.6	9	64.3	1	7.1			14	100.0
IN-H	4	30.8			5	38.5			4	30.8	13	100.0
OUT-L									2	100.0	2	100.0
OUT-M	1	8.3			1	8.3	2	16.7	8	66.7	12	100.0
OUT-H					2	22.2	6	66.7	1	11.1	9	100.0
TOTAL	5	8.3	4	6.7	25	41.7	11	18.3	15	25.0	60	100.0
TRANSFER TO MODE FOR SCHOOL												
IN-L			7	43.8	9	56.3					16	100.0
IN-M			9	56.3	1	6.3	6	37.5			16	100.0
IN-H			8	42.1	4	21.1	7	36.8			19	100.0
OUT-L			5	31.3	4	25.0			7	43.8	16	100.0
OUT-M			5	23.8			8	38.1	8	38.1	21	100.0
OUT-H	3	30.0			3	30.0			4	40.0	10	100.0
TOTAL	3	3.1	34	34.7	21	21.4	21	21.4	19	19.4	98	100.0
TRANSFER TO MODE FOR WORK												
IN-L												
IN-M												
IN-H					1	50.0	1	50.0			2	100.0
OUT-L			11	14.9	14	18.9	16	21.6	33	44.6	74	100.0
OUT-M	1	1.8	17	30.4	8	14.3	5	8.9	25	44.6	56	100.0
OUT-H			2	16.7	2	16.7	1	8.3	7	58.3	12	100.0
TOTAL	1	0.7	30	20.8	25	17.4	23	16.0	65	45.1	144	100.0
TRANSFER TO MODE												
IN-L			1	50.0	1	50.0					2	100.0
IN-M	1	14.3	1	14.3	3	42.9	2	28.6			7	100.0
IN-H	1	20.0			4	80.0					5	100.0
OUT-L	1	7.7			5	38.5			7	53.8	13	100.0
OUT-M	5	11.9	7	16.7	8	19.0	2	4.8	20	47.6	42	100.0
OUT-H			2	11.8	6	35.3	1	5.9	8	47.1	17	100.0
TOTAL	8	9.3	11	12.8	27	31.4	5	5.8	35	40.7	86	100.0
TOTAL												
IN-L	124	45.8	74	27.3	58	21.4	14	5.2	1	0.4	271	100.0
IN-M	47	17.4	104	38.5	83	30.7	34	12.6	2	0.7	270	100.0
IN-H	53	15.2	96	27.6	131	37.6	54	15.5	14	4.0	348	100.0
OUT-L	182	45.8	35	8.8	49	12.3	28	7.1	103	25.9	397	100.0
OUT-M	67	16.7	63	15.7	32	8.0	46	11.5	193	48.1	401	100.0
OUT-H	39	9.0	31	7.2	63	14.5	88	20.3	212	49.0	433	100.0
TOTAL	512	24.2	403	19.0	416	19.6	264	12.5	526	24.8	2120	100.0

[1] For column percentages, see Appendix B.14.

For middle income people, travel distance for school trips also differs between the inner and out-of city residents. Similar to OUT-L, those living in OUT-M have to use nearby facilities. So 50 per cent of all their school trips are less than 1 km. In IN-M the share of these trips decreases to 21 per cent while most of the school trips (75 %) range from 1 to 6 km. School trips more than 7 km have a negligible share (5 %) in IN-M. On the contrary, this figure is 41 per cent in OUT-M.

In the case of the out-of city districts, an insufficient number of secondary and high schools encourages long distance school trips. In such cases low income people prefer using the nearest facilities, which are 6 km far away from OUT-L. Long distance school trips are common among OUT-H's residents due to better access to all facilities situated in different parts of the city, since they can pay for organised school buses. Similarly, car use is high among university students. For OUT-M's residents the situation is quite different: in spite of income restrictions when compared to OUT-H, the share of long distance school trips is high due to insufficient local facilities.

In the out-of city districts even in low income districts people travel for longer distances to work is usual than for school trips. In OUT-L, 57 per cent of all work trips are longer than 16 km whereas only 1.6 per cent of all school trips are longer than this (Table 7.9). The share of long distance work trips increases gradually with income level among the out-of city districts. In OUT-H it reaches the highest percentage with 66 per cent.

Work trips shorter than 2 km, on the other hand, have a very low share in all out-of city districts. Although income level causes some fluctuations, these are negligible. For school trips, spatial structure, that is existence of local schools, may result in short distance trips in the out-of city districts. In case of work trips, on the other hand, people have to travel for longer distance since their work place is far away from their residence and usually located in the inner city.

Income level also has an effective role on distances of work trips in the inner city districts. For the higher income group, it is more usual to have long distance work trips than for the low income group. Nevertheless, trips longer than 16 km have very low share (1-2 %) among all work trips by the inner city residents. In IN-H, most of the work trips (48 %) are 3 to 6 km. Work trips longer than 7 km constitute 17 per cent of all.

Like out-of city districts, propensity to travel for longer distances decreases with income level. Twelve per cent of all work trips are 7 to 16 km in IN-M, while only 6 per cent of IN-L work trips are in this range. Work trips shorter than 2 km have their highest share (71 %) in IN-L. This percentage decreases to 50 and 34 per cent in IN-M and IN-H.

The comparison of work trip distances between the inner and out-of city residents indicates that living in an out-of city area enforces people to travel for long distances. Those living in the inner city district do not have to travel such long distances since they live nearer to their work places.

In the case of school trips, in addition to income level, availability of local facilities has a determining role on travel distance, particularly for the out-of city residents. For work trips, the location of their workplace defines the trip route and travel distance to work. The workplace of out-of city residents is usually far from their residences. Most of their short-distance work trips are linked trips within the inner city area. Long distance work trips are common even among OUT-L's residents, whereas work trips by IN-L's residents are usually less than 2 km due to living very near to their workplace.

Income level has a more effective role on travel distance of work trips for the inner city districts than for the out-of city districts, since location of a residence relative to workplace defines trip lengths and this reality causes a high percentage of long distance work trips among the out-of city residents.

In the case of irregular trips, income level shapes travel demand in terms of the distance travelled both for inner and for out-of city residents. This situation is particularly true for low income people: in IN-L, 51 per cent of all irregular trips are less than 1 km. This figure is 39 per cent in OUT-L, which is the highest of all among the out-of city districts. For middle and high income people living in the inner city, most of the irregular trips (66%) range from 1 to 7 km. Long distance irregular trips are also common here. Those living in OUT-H have better opportunities for long distance irregular trips when compared to other out-of city residents. They usually travel long distances for shopping and social purposes, their propensity to travel shorter distances is, on the other hand, very low, in comparison to the others.

The relation between trip purpose and car ownership level shows that car owners travel for plenty of reasons and have a higher propensity to travel due to leisure activities (Appendix B.15).

In IN-L and OUT-L most of the school trips (more than 80 per cent of all school trips) are within their regional boundaries (Appendix B.16). This also explains the high share of walking and short distance trips in these districts. In IN-L, 90 per cent of all work trips are within the regional boundaries. In OUT-L, 50 per cent of all work trips are trips to neighbourhood areas, whereas the remaining work trips are those to the inner city.

For the middle income group, destination areas for school and work trips are various. People living in OUT-M travel to the inner-city for work and school. Although its share is very small, OUT-M's residents also travel to inner city areas for social reasons. Those living in IN-M usually use inner city areas for regular daily activities, but they also travel to the out-of city areas. Most of the irregular trips by IN-M's residents are within the inner city.

In IN-H and OUT-H, destination areas for trips to school and work place vary. In IN-H, these varying areas are usually within the inner city. In OUT-H, on the other hand, even for irregular trips, people use the out-of city districts as well as the inner city ones.

People of all ages might travel for various purposes (Appendix B.17). This is particularly true for younger ages, due to the changing and extending activity patterns of the young population. Living in an inner city district, on the other hand, provides more opportunities for irregular trips due to the variety of activities available in an urban area and the high accessibility of these activities by the inner city residents.

Trip purposes differ for middle-aged people, particularly among high income people. With the increasing income level, the upper-age limit for school trips extends to 24, due to the increasing number of trips to universities. Income level also has an accelerating role on the number of work trips in later ages.

Females at a high income level have a considerable share in the total amount of trip generation, but most of their daily trips are still irregular (Appendix B.18). Only 20 per cent of their trips are for work. Social trips have the highest share, with 24 per cent among all trips by women.

Following the work trips, social trips account for the second highest share among all trips by the working population (Appendix B.19). This situation becomes more obvious with an increasing income level. In addition to school trips, two reasons for travelling among the non-working population are social and shopping.

Transfer to other modes for work trips is higher among the working population living in the out-of city districts than among those living in the inner city districts. Intermodal shift within one journey is also common among the non-working population, particularly among students. Similarly, the working population sometimes has to travel in order to get to their main modes of transport. This is particularly apparent in OUT-L and OUT-M. Intermodal shift within one journey is not generally observed among high income people.

Shopping and social trips are usually made by housewives in all districts. They are very rare among the working population. Those having a better occupational structure travel for various purposes which usually results from their diversified activity patterns. The share of irregular daily trips among these people is higher among the out-of city residents than among the inner city residents (Appendix B.20).

Intermodal shifts are usual for trips by employees, particularly in the out-of city districts. Living in an inner city area, on the other hand, provides more chance to travel for social reasons both for employers and for the self-employed (Appendix B.21).

A higher educational background means more travel not only due to work but also due to social reasons (Appendix B.22). In the out-of city districts, irregular trips are quite common even among those with lower educational backgrounds.

VII.2.4. Peak-Hour and Travel Time

Peak hour does not vary greatly from one district to another. There are variations only in terms of the upper limits of the morning peaks.

Nearly one quarter of all journeys are between 7.00 and 9.00 a.m. The upper bound extends to 11.00 a.m. in the higher income levels (Appendix B.23).

In terms of smaller intervals, more than 10 per cent of all journeys are within 8.00 and 9.00 a.m., in the inner city districts. However, in OUT-L and OUT-M the peak hour is 7.00-8.00 a.m. In OUT-H, the peak hour is the same as in the inner city.

Average travel time varies according to the location of residences. It reaches 29 minutes per trip in the out-of city districts, and decreases to 14 minutes in the inner city districts (Graph 7.8 and Table 7.10).

Graph 7.8. Total and Average Travel Time by Districts

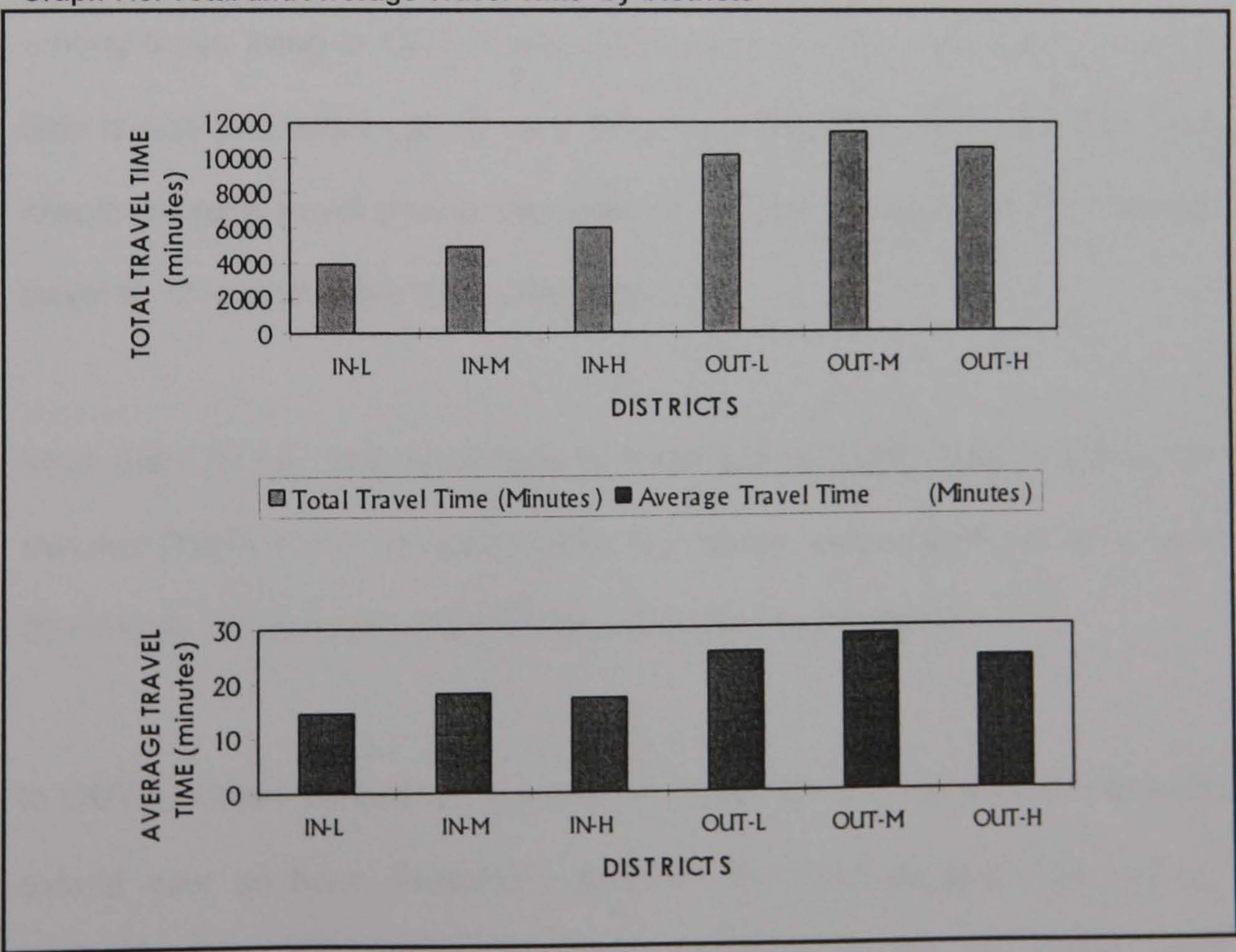


Table 7.10. Average Travel Time by District

	Total Travel Time (Minutes)	Average Travel Time (Minutes)
IN-L	3965	14.63
IN-M	4925	18.24
IN-H	6020	17.30
OUT-L	10155	25.58
OUT-M	11465	28.59
OUT-H	10555	24.39

Middle income people living in OUT-M have the highest average travel time among all. In addition to a high propensity to travel for long distances, a wider use of public transport is one of the main reasons behind an extended travel duration.

Among all out-of city districts, the lowest average travel time is observed among those living in OUT-H with 24 minutes per trip. This lowering travel time is due to a wider use of cars. In case of the inner city residences, the lowest average travel time is observed among IN-L's residents who usually travel for short distances and prefer walking.

More than 70 per cent of all trips by inner city residents take less than 20 minutes (Table 7.11). In spite of this high share, extending travel time over 20 minutes is also usual, particularly among IN-H's residents.

In OUT-L, 42 per cent of all trips take less than 10 minutes while 10 per cent extend over an hour. Propensity to travel for short distances by walking results in a lowered travel time when compared to other out-of city districts. Considering the share of long distance trips among all out-of city residents, the high percentage of trips extending over an hour in OUT-L indicates a wide use of public buses for long distance trips. Nevertheless, the high percentage of trips less than 20 minutes indicates that its residents are not dependent on the inner city as other out-of city residents are.

At upper income levels, the shares of trips less than 10 or 20 minutes are not as high as in OUT-L. Nearly 26 per cent of all trips take less than 10 minutes in OUT-M while this share decreases to 22 per cent in OUT-H. In OUT-M, on the other hand, 90 per cent of all trips take less than 50 minutes. Trips shorter than 50 minutes constitute 98 per cent of all trips by OUT-H's residents. A study of the travel time changes of all out-of city residents shows that with an increasing income level the share of trips taking longer duration falls. Modal choice has a defining role in these changes. Preference for private modes results in a decreased travel time in a given distance whereas bus use extends it. Travel distance, at the same time, shapes the modal choice. For short distances, walking is widely preferred by low income people living in OUT-L whereas for long distances the bus is used. With an increasing income level, due to high level of car ownership, the car is used not only for long distance but also for short distance trips.

Travel time falls among the out-of city residents due to an increase in their income level. In the inner city case, this relationship between income level and travel time is not as obvious.

	TRAVEL TIME (Minutes)															
	5-10		15-20		25-30		35-40		45-50		55-60		65+		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
IN-L	147	54.2	71	26.2	43	15.9	9	3.3					1	0.4	271	12.8
IN-M	93	34.4	110	40.7	50	18.5	10	3.7	3	1.1	3	1.1	1	0.4	270	12.7
IN-H	156	44.8	106	30.5	57	16.4	14	4.0	11	3.2	4	1.1			348	16.4
OUT-L	167	42.1	83	20.9	43	10.8	13	3.3	20	5.0	30	7.6	41	10.3	397	18.7
OUT-M	106	26.4	71	17.7	63	15.7	52	13.0	67	16.7	29	7.2	13	3.2	401	18.9
OUT-H	96	22.2	117	27.0	123	28.4	53	12.2	35	8.1	5	1.2	4	0.9	433	20.4
TOTAL	**765**	**36.1**	**558**	**26.3**	379	17.9	151	7.1	136	6.4	71	3.3	60	2.8	2120	100.0

[8] For raw data, see Appendix B.24.

Travel time by modal split also verifies the above discussions (Graph 7.9). As can be seen from Tables 7.12, use of private modes reduces travel time, particularly for the out-of city residents.

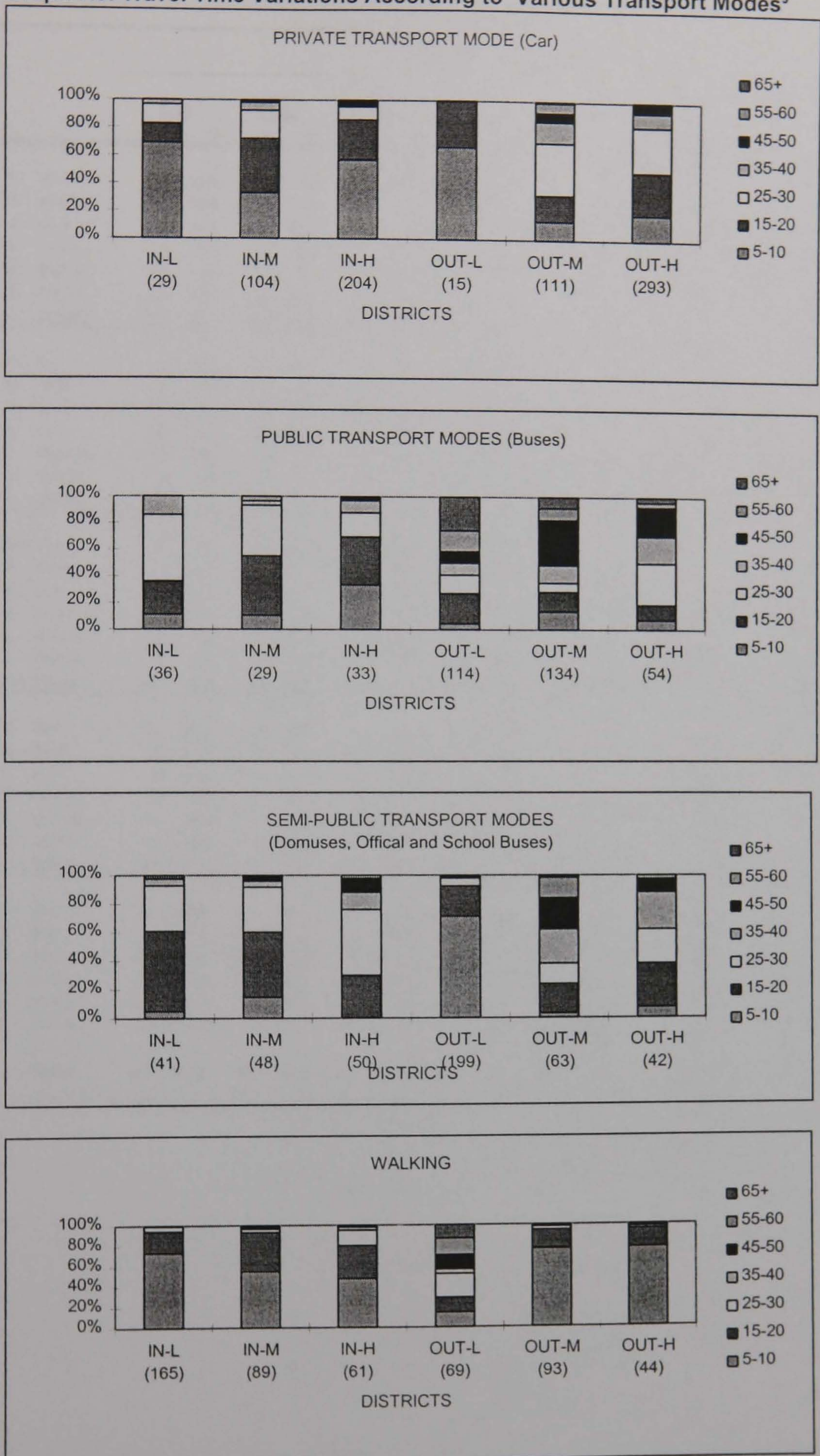
Average trips by car take less than 20 minutes for OUT-L's residents. Travel duration by car extends up to an hour in OUT-M and OUT-H.

In the case of the inner city residents, an average trip by car takes less than 30 minutes. Like the out-of city districts, extended travel duration by car is common among high and middle income people living in IN-M and IN-H.

Use of public bus services usually means extending travel duration when compared to private modes. This is particularly true for all out-of city residents. Even in OUT-H, 50 per cent of all trips that take more than an hour are by bus. This percentage rises to 85 in OUT-M and 70 in OUT-L.

Use of public transport is usual for trips taking less than 40 minutes among the inner city residents. In IN-H and IN-M, nearly 90 per cent of all trips by public transport take less than 30 minutes. In IN-L, all trips by public transport take less than 40 minutes.

Graph 7.9. Travel Time Variations According to Various Transport Modes[9]



[9] Numbers in parenthesis represent total number of trips.

Table 7.12. Travel Time by District According to Travel Mode (Column)[3]

		TRAVEL TIME (Minutes)															
		5-10		15-20		25-30		35-40		45-50		55-60		65+		TOTAL	
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
P	IN-L	20	13.6	4	5.6	4	9.3	1	11.1							29	10.7
R	IN-M	34	36.6	41	37.3	21	42.0	6	60.0	2	50.0					104	38.5
I	IN-H	116	74.4	59	55.7	19	33.3	3	21.4	5	45.5	2	50.0			204	58.6
V	OUT-L	10	6.0	5	6.0											15	3.8
A	OUT-M	15	14.2	21	29.6	42	66.7	17	32.7	7	10.4	8	27.6	1	7.7	111	27.7
T	OUT-H	55	57.3	90	76.9	96	78.0	30	56.6	18	51.4	2	40.0	2	50.0	293	67.7
E	TOTAL	250	32.7	220	39.4	182	48.0	57	37.7	32	23.4	12	17.1	3	5.0	756	35.7
P	IN-L	4	2.7	9	12.7	18	41.9	5	55.6							36	13.3
U	IN-M	3	3.2	13	11.8	11	22.0	1	10.0			1	50.0			29	10.7
B	IN-H	11	7.1	12	11.3	6	10.5	3	21.4	1	9.1					33	9.5
L	OUT-L	5	3.0	26	31.3	16	37.2	10	76.9	10	50.0	18	60.0	29	70.7	114	28.7
I	OUT-M	18	17.0	20	28.2	9	14.3	18	34.6	46	68.7	12	41.4	11	84.6	134	33.4
C	OUT-H	4	4.2	6	5.1	17	13.8	11	20.8	12	34.3	2	40.0	2	50.0	54	12.5
	TOTAL	45	5.9	86	15.4	77	20.3	48	31.8	69	50.4	33	47.1	42	70.0	400	18.9
SEMI	IN-L	2	1.4	23	32.4	13	30.2	2	22.2					1	100.0	41	15.1
P	IN-M	7	7.5	22	20.0	15	30.0	2	20.0	2	50.0					48	17.8
U	IN-H			15	14.2	23	40.4	6	42.9	5	45.5	1	25.0			50	14.4
B	OUT-L	142	85.0	42	50.6	11	25.6					1	3.3	3	7.3	199	50.1
L	OUT-M	2	1.9	13	18.3	9	14.3	15	28.8	14	20.9	9	31.0	1	7.7	63	15.7
I	OUT-H	3	3.1	13	11.1	10	8.1	11	20.8	4	11.4	1	20.0			42	9.7
C	TOTAL	156	20.4	128	22.9	81	21.4	36	23.8	25	18.2	12	17.1	5	8.3	443	20.9
W	IN-L	121	82.3	35	49.3	8	18.6	1	11.1							165	60.9
A	IN-M	49	52.7	34	30.9	3	6.0	1	10.0			1	50.0	1	100.0	89	33.0
L	IN-H	29	18.6	20	18.9	9	15.8	2	14.3			1	25.0			61	17.5
K	OUT-L	10	6.0	10	12.0	16	37.2	3	23.1	10	50.0	11	36.7	9	22.0	69	17.4
I	OUT-M	71	67.0	17	23.9	3	4.8	2	3.8							93	23.2
N	OUT-H	34	35.4	8	6.8			1	1.9	1	2.9					44	10.2
G	TOTAL	314	41.0	124	22.2	39	10.3	10	6.6	11	8.0	13	18.6	10	16.7	521	24.6
	IN-L	147	100.0	71	100.0	43	100.0	9	100.0	0	100.0	0	100.0	1	100.0	271	100.0
T	IN-M	93	100.0	110	100.0	50	100.0	10	100.0	4	100.0	2	100.0	1	100.0	270	100.0
O	IN-H	156	100.0	106	100.0	57	100.0	14	100.0	11	100.0	4	100.0	0	100.0	348	100.0
T	OUT-L	167	100.0	83	100.0	43	100.0	13	100.0	20	100.0	30	100.0	41	100.0	397	100.0
A	OUT-M	106	100.0	71	100.0	63	100.0	52	100.0	67	100.0	29	100.0	13	100.0	401	100.0
L	OUT-H	96	100.0	117	100.0	123	100.0	53	100.0	35	100.0	5	100.0	4	100.0	433	100.0
	TOTAL	765	100.0	558	100.0	379	100.0	151	100.0	137	100.0	70	100.0	60	100.0	2120	100.0

[3] For row percentages see Appendix B.25.

In terms of semi-public transport modes, travel duration falls at low income levels. This is particularly obvious among the out-of city residents. More than 90 per cent of all trips by semi-public transport take less than 20 minutes in OUT-L. This ratio decreases to 60 per cent in IN-L. Similarly, 60 per cent of all trips by semi-public transport are less than 20 minutes in IN-M whereas this extends up to an hour among OUT-M's residents. In IN-H, travel time by semi-public transport also extends up an hour, but most of the trips by this means take less than 30 minutes. In OUT-H, in spite of extending travel duration by semi-public transport, travel times range between 15 and 40 minutes.

In all districts, most of the walking trips are less than 20 minutes, excepting OUT-L where travel duration for walking reaches up to an hour. In IN-L, OUT-M and OUT-H more than 70 per cent of all walking trips take less than 10 minutes. For IN-L's case, the spatial possibilities of the districts, that is the concentration of different land uses including workplaces, is one of the reasons for shorter travel duration. In the cases of OUT-M and OUT-H, since there are limited opportunities for long distance walking trips, travel duration by walking concentrates between 5 and 10 minutes. OUT-L, on the other hand, is located near an out-of city sub-centre called Sincan, so travel duration for walking extends. Extended travel duration is usual in IN-M and IN-H due to there being more opportunities for long distance walking trips.

Travel duration also differs according to travel purpose. Most of the work trips are less than 20 minutes in the inner city districts. In the out-of city districts, on the other hand, the duration of a work trip may exceed an hour (Table 7.13 and Appendix B.26).

Sixty per cent of all work trips are less than 10 minutes in IN-L due to a nearby workplace. In OUT-L, on the other hand, the travel time for a work trip is sometimes more than an hour (14 %).

In IN-H, 93 per cent of all work trips take less than half an hour, this decreases to 73 per cent in OUT-H, while the remaining work trips do not take more than an hour. Having a similar income level, it is due to their living in an out-of city area that OUT-H's residents have to travel for longer distances, which usually means longer travel duration for work trips. Since OUT-H's residents' work places are usually located within the inner city area, getting into the inner city area takes a minimum of 30 minutes during peak-hour.

Travel time for a work trip sometimes exceeds an hour for those living in OUT-M whereas 92 per cent of all work trips are less than 30 minutes in IN-M.

It is evident that living in an out-of city district usually means extending travel duration for work trips. It is equally obvious, on the other hand, that living near to a workplace (as in the case of IN-L) means lowering travel duration.

Table 7.13. Travel Time by District According to Travel Purposes (Row %)

	TRAVEL TIME (Minutes)															
	5-10		15-20		25-30		35-40		45-50		55-60		65+		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
WORK																
IN-L	65	60.2	23	21.3	16	14.8	4	3.7							108	100.0
IN-M	29	27.4	46	43.4	23	21.7	5	4.7	1	0.9	2	1.9			106	100.0
IN-H	65	49.6	41	31.3	16	12.2	4	3.1	5	3.8					131	100.0
OUT-L	13	15.1	18	20.9	11	12.8	6	7.0	11	12.8	15	17.4	12	14.0	86	100.0
OUT-M	12	10.6	23	20.4	27	23.9	19	16.8	21	18.6	7	6.2	4	3.5	113	100.0
OUT-H	19	12.1	36	22.9	59	37.6	22	14.0	17	10.8	4	2.5			157	100.0
TOTAL	203	29.0	187	26.7	152	21.7	60	8.6	55	7.8	28	4.0	16	2.3	701	100.0
SCHOOL																
IN-L	41	52.6	21	26.9	12	15.4	3	3.8					1	1.3	78	100.0
IN-M	14	31.8	20	45.5	8	18.2	2	4.5							44	100.0
IN-H	10	16.4	23	37.7	18	29.5	6	9.8	3	4.9	1	1.6			61	100.0
OUT-L	91	74.0	19	15.4	7	5.7					2	1.6	4	3.3	123	100.0
OUT-M	33	58.9	4	7.1	3	5.4	3	5.4	6	10.7	4	7.1	3	5.4	56	100.0
OUT-H	16	23.9	23	34.3	10	14.9	12	17.9	5	7.5	1	1.5			67	100.0
TOTAL	205	47.8	110	25.6	58	13.5	26	6.1	14	3.3	8	1.9	8	1.9	429	100.0
SHOPPING																
IN-L	12	85.7			2	14.3									14	100.0
IN-M	8	36.4	6	27.3	6	27.3	2	9.1							22	100.0
IN-H	12	38.7	12	38.7	5	16.1	1	3.2	1	3.2					31	100.0
OUT-L	25	75.8	7	21.2	1	3.0									33	100.0
OUT-M	18	66.7	4	14.8			2	7.4			2	7.4	1	3.7	27	100.0
OUT-H	19	33.3	8	14.0	19	33.3	9	15.8	2	3.5					57	100.0
TOTAL	94	51.1	37	20.1	33	17.9	14	7.6	3	1.6	2	1.1	1	0.5	184	100.0
SOCIAL																
IN-L	28	65.1	12	27.9	3	7.0									43	100.0
IN-M	27	44.3	26	42.6	5	8.2	1	1.6			1	1.6	1	1.6	61	100.0
IN-H	54	62.1	23	26.4	7	8.0	2	2.3			1	1.1			87	100.0
OUT-L	29	58.0	11	22.0	6	12.0					2	4.0	2	4.0	50	100.0
OUT-M	17	23.0	15	20.3	16	21.6	12	16.2	10	13.5	4	5.4			74	100.0
OUT-H	33	31.7	35	33.7	24	23.1	6	5.8	4	3.8			2	1.9	104	100.0
TOTAL	188	44.9	122	29.1	61	14.6	21	5.0	14	3.3	8	1.9	5	1.2	419	100.0
OTHER																
IN-L			4	40.0	5	50.0	1	10.0							10	100.0
IN-M	6	42.9	5	35.7	2	14.3			1	7.1					14	100.0
IN-H	8	61.5					1	7.7	2	15.4	2	15.4			13	100.0
OUT-L											2	100.0			2	100.0
OUT-M	1	8.3			3	25.0	2	16.7	5	41.7	1	8.3			12	100.0
OUT-H	2	22.2	6	66.7					1	11.1					9	100.0
TOTAL	17	28.3	15	25.0	10	16.7	4	6.7	9	15.0	5	8.3	0	0.0	60	100.0
TRANSFER TO OTHER MODE FOR SCHOOL																
IN-L			10	62.5	5	31.3	1	6.3							16	100.0
IN-M	8	50.0	4	25.0	3	18.8			1	6.3					16	100.0
IN-H	6	31.6	4	21.1	9	47.4									19	100.0
OUT-L	1	6.3	6	37.5	3	18.8			1	6.3	2	12.5	3	18.8	16	100.0
OUT-M	2	9.5	5	23.8	2	9.5	3	14.3	5	23.8	3	14.3	1	4.8	21	100.0
OUT-H	2	20.0	2	20.0	3	30.0			3	30.0					10	100.0
TOTAL	19	19.4	31	31.6	25	25.5	4	4.1	10	10.2	5	5.1	4	4.1	98	100.0
TRANSFER TO OTHER MODE FOR WORK																
IN-L															0	100.0
IN-M															0	100.0
IN-H					2	100.0									2	100.0
OUT-L	6	8.1	19	25.7	14	18.9	4	5.4	8	10.8	7	9.5	16	21.6	74	100.0
OUT-M	13	23.2	13	23.2	6	10.7	5	8.9	11	19.6	4	7.1	4	7.1	56	100.0
OUT-H	2	16.7	2	16.7	4	33.3	1	8.3	2	16.7			1	8.3	12	100.0
TOTAL	21	14.6	34	23.6	26	18.1	10	6.9	21	14.6	11	7.6	21	14.6	144	100.0
TRANSFER TO OTHER MODE																
IN-L	1	50.0	1	50.0											2	100.0
IN-M	1	14.3	3	42.9	3	42.9									7	100.0
IN-H	1	25.0	3	75.0											4	100.0
OUT-L	2	15.4	3	23.1	1	7.7	3	23.1					4	30.8	13	100.0
OUT-M	10	23.8	7	16.7	6	14.3	6	14.3	9	21.4	4	9.5			42	100.0
OUT-H	3	17.6	5	29.4	4	23.5	3	17.6	1	5.9			1	5.9	17	100.0
TOTAL	18	21.2	22	25.9	14	16.5	12	14.1	10	11.8	4	4.7	5	5.9	85	100.0
TOTAL																
IN-L	147	54.2	71	26.2	43	15.9	9	3.3	0	0.0	0	0.0	1	0.4	271	100.0
IN-M	93	34.4	110	40.7	50	18.5	10	3.7	3	1.1	3	1.1	1	0.4	270	100.0
IN-H	156	44.8	106	30.5	57	16.4	14	4.0	11	3.2	4	1.1	0	0.0	348	100.0
OUT-L	167	42.1	83	20.9	43	10.8	13	3.3	20	5.0	30	7.6	41	10.3	397	100.0
OUT-M	106	26.4	71	17.7	63	15.7	52	13.0	67	16.7	29	7.2	13	3.2	401	100.0
OUT-H	96	22.2	117	27.0	123	28.4	53	12.2	35	8.1	5	1.2	4	0.9	433	100.0
TOTAL	766	36.1	558	26.3	379	17.9	151	7.1	136	6.4	71	3.3	60	2.8	2120	100.0

One consequence of living in out-of city districts is a decreasing travel time for school. This is particularly true in OUT-L where 74 per cent of all school trips take less than 10 minutes and 90 per cent take less than 20 minutes. Similarly, in OUT-M 59 per cent of all school trips take less than 10 minutes and 82 per cent of all take less than 20 minutes. These figures are totally different in the case of OUT-H. Here only 24 per cent of all school trips take less than 10 minutes. Travel time for school trips extends gradually to 35 and 40 minutes which has an 18 per cent share among all school trips.

For those living in an out-of city area, the existence of local schools provides an opportunity for short distance school trips. This inevitably means shorter travel duration when compared to work trips.

In the case of the inner city, most school trips do not take more than 30 minutes, but the share of school trips less than 10 minutes is not as high as in the out-of city districts. School trips that take more than 30 minutes decrease below 5 per cent in IN-L and IN-M, where most of these trips (nearly 78 %) take less than 20 minutes.

It is also seen that living in the out-of city districts increases the travel time for shopping with most of the shopping trips taking less than 10 minutes in OUT-L. Travel time for these trips increases with income level. Ninety per cent of all shopping trips are less than 40 minutes in OUT-H and 97 per cent are less than 20 minutes in OUT-L. Like out-of city districts, most of the shopping trips take less than 10 minutes in IN-L (86%) whereas they extend to 30 minutes in IN-H (93%). All these figures show that living in an out-of city area increases the travel time for shopping trips but that income level also affects people's preferences for shopping place. Using local facilities means shorter travel distances and shorter travel duration in both inner and out-of city cases.

In terms of social trips, the situation is very similar to that of the shopping trips but there are some exceptions. In all inner city districts, more than 80 per cent of all social trips are within the interval of 5-20 minutes. The upper limit extends to an hour in OUT-H and OUT-M. OUT-L's residents show travel time structures similar to those of the inner city districts and 80 per cent of all their social trips take less than 20 minutes.

The use of more than one mode for one journey is usual among out-of city residents. For school trips, the use of more than one mode is observed in the inner city districts and the travel time of these transfer trips is usually less than 30 minutes. In the out-of city districts, on the other hand, travel time in a transfer trip sometimes exceeds an hour, as in the case of OUT-M and OUT-L. The use of more than one mode is very rare for journeys to work among the inner city residents whereas this is particularly common among the out-of city residents. Similar to those of school trips, travel duration may even exceed an hour, particularly for OUT-L residents. Transfer trips for other purposes do not take more than 30 minutes in the case of the inner city residents. For the out-of city residents, however, travel duration reaches up to an hour and even exceeds an hour as in the case of OUT-L.

CHAPTER EIGHT: ENERGY CONSUMPTION OF DAILY PASSENGER TRAVEL: COMPARISON OF THE INNER AND OUT-OF CITY RESIDENCES

VIII.1. Introduction

As discussed in the previous chapter, travel demand in the selected districts varies due to several reasons. The influence of spatial factors and socio-economic characteristics of the population on travel demand are emphasised through chapter VII. It is obvious from the survey results that income level and location of residence are two main determinants of travel demand patterns. This chapter first defines the energy use of passenger trips in each district and then attempts to answer the research questions about

> How spatial and socio-economic factors affect energy intensity of daily passenger trip; why there exists particular variations among districts; and under what circumstances, energy intensity of passenger trips can lessen.

Before answering the above questions, it is necessary to remind ourselves of the fact that transport consumes energy not only for vehicle operation; the manufacture of raw material, vehicles and their components, and the maintenance of vehicle and transport infrastructures also require energy. Traffic volume, network capacity, congestion level and the technological features of a vehicle have a considerable influence on the energy use of transport operations, and transport mode is one of the main factors defining energy use during transport operation.

The average energy consumption for various modes can be derived at different occupancy levels. There are limited attempts to define energy intensities of various modes in different conditions. Due to a lack of comprehensive data on energy use of transport operations, the energy intensities of passenger trips for various vehicles are taken as constant. It is further accepted that all trips by a particular type of transport mode are not affected by varying traffic conditions on different routes. The available data on energy intensities of transport modes for Ankara are given in Table 8.1. Some examples from the UK and USA have been added to the table for comparison.

Table 8.1. Energy Intensity of Various Modes

	Travel Mode	**Occupancy**	**Energy Intensity** (Calories per passenger kilometre)	**Energy Intensity** (MJ per passenger kilometre)
ANKARA[a]	Car	1.75 occupants	980.0	4.10
	Bus	75 passengers	72.0	0.31
	Semi-public	15 occupants	158.0	0.66
	Walking		62.0	
UK[b]	Car	25 %	869.5	2.64
	Bus		176.8	0.74
	Underground		200.6	0.84
	Walking		96.2	
	Cycling		38.5	
USA[c]	Car	1 occupant	1153.4	4.83
	Bus	45 passengers	174.2	0.73
	Rapid Rail	60 passengers	189.5	0.79
	Walking		62.2	
	Cycling		21.7	

Source: [a] Yildirim (1990)
[b] Frost et al. (1997)
[c] Lowe (1990)

The energy intensity of a mode varies from one country to another, depending on the most common type of vehicle and its technology in each country. At different occupancy levels, buses consume nearly 40 per cent less energy per passenger km in Ankara than in US cities. The high passenger load of buses in the Ankara case is the main reason for this difference. Like buses, energy consumption of cars is higher in US cities than in Ankara. In spite of occupancy, which is nearly twice as high as in US cities, cars consume less energy in Ankara. This difference may due to the technology of a preferred vehicle type.

As discussed in chapter II, there are optimal settlement structures for different transport modes. It is necessary to consider the spatial structures of cities and the quality of road infrastructure while discussing energy intensities.

In addition to motorised modes, walking and cycling are also important as non-motorised modes of transport. They are added to Table 8.1, not only for comparison: as explained in chapter VII, walking is part of almost every trip. Nearly 60 calories are consumed per km while walking. Cycling is even less energy intensive than walking with 21.7 calories per passenger km. They are the only travel modes which use renewable energy forms.

Among all modes, the car is the least energy efficient mode of transport in all cities and the bus is the most energy efficient mode of public transport.

As reviewed in chapter II, energy use of transport is the product of the amount of energy required to move 1 passenger 1 kilometre multiplied by the number of kilometres driven. Although variation in travel distance itself indicates the energy consumption for travel activity, other possible determinants of energy consumption of transport are discussed below.

VIII.2. Energy Use of Transport By Changing Trip Purposes

It is possible to measure the energy intensity of a mode in different terms (see Table 8.1). Calories can be used if we include walking and cycling. For motorised modes, energy intensity figures are supplied in terms of MJ per passenger kilometres. In order to see the influence of various variables on all modes including walking, the Calorie is used as a unit of measure through the analysis of this section.

Owning a car, belonging to a high income level, or living in particular part of a city has a precise influence on destination area preferences for a trip and on travel distance. Trip purpose is one of the key factors of energy use, due to its indirect influence on travel distance.

Table 8.2 shows the relationship between travel distances by purposes and by spatial and socio-economic variables, as well as the influence of travel distance on overall energy consumption of transport.

Increasing travel distances for school and shopping trips are highly correlated with car ownership and average housing rent, which are two indicators of income level. At 0.07 significance level, they have also an important influence on travel distance for social trips. It is true to say these two variables shape travel distances for irregular trips.

Distance from CBD has a considerable influence over the total distance of work trips. There is a significant direct correlation between them; with an increasing distance from the CBD, travel distance for a work trip increases (p=0.005)

Table 8.2. Travel Distance of Trips for Various Purposes Correlated with Socio-Economic and Spatial Variables - Sampled Survey [1, 2]

		TRAVEL DISTANCES (km) FOR				
		School	Work	Shopping	Social	Other
Socio-Economic Variables	Car Ownership[3]	.73603 (.047)	.17621 (.369)	.87192 (.011)	.67667 (.069)	.01716 (.487)
	Average Rent[4]	.76585 (.037)	.22339 (.335)	.76081 (.039)	.67369 (.071)	.13709 (.397)
	Family Size	-.47173 (.172)	.08748 (.434)	.59768 (.105)	-.55486 (.126)	-.16067 (.380)
Spatial Variables	Urban Density[5]	-.34887 (.248)	-.25148 (.315)	-.23572 (.326)	-.10952 (.418)	-.20915 (.345)
	Distance From CBD (km)	.39154 (.221)	.91496 (.005)	.10969 (.418)	.32897 (.262)	.57396 (.116)
Total Travel Distance (km)		.90176 (.007)	.92928 (.003)	.67175 (.071)	.88895 (.008)	.74413 (.044)
Total Energy Used by Transport[6]		.95935 (.001)	.55844 (.104)	.94334 (.002)	.95212 (.001)	.42487 (.200)

[1] The first numbers represent the Pearson Correlation Coefficient and the numbers in parenthesis represent Significance.
[2] The shaded cells indicate the observed high correlation, either negative or positive, between two variables. The correlation coefficient is very close to -1 or +1 in these cells. Significance, on the other hand, is less than 0.05 which is also statistically acceptable.
[3] Number of cars per 1000 people.
[4] Housing rent per month.
[5] Number of people per hectare (gross population density).
[6] Calories per passenger km.

As can be seen from the table, there is weak correlation between urban density and travel distance for various purposes, but the findings indicate the existence of a negative correlation: increasing urban density always results in decreasing travel distances for all purposes. In the cases of the surveyed districts this relationship is not strong and statistically acceptable due to low significance. As mentioned in chapter VI, the population densities are not net densities and in some districts there are non-residential uses (like a large manufacturing area in IN-L or presidential palace and big recreational areas in IN-H) and empty flats or part of an area under construction (like in OUT-L). So all these special cases affect the level of correlation between these variables.

Increasing travel distances for all purposes means increasing overall distance travelled. In other words, they are highly correlated ($p<0.05$). This relation is not statistically significant for the shopping trips ($p=0.071$), but most likely for work trips ($p=0.003$).

There is a strong relationship between the overall energy used by transport and the travel distances for school, shopping and social trips ($p=0.001$). In the case of work trips, there is a moderate association between total energy use of transport and travel distance. This shows that it is not travel distance of work trips which causes important changes in the energy use of work trips, since it does not contribute much to total energy use (Table 8.2.).

The energy used for daily regular, social and shopping trips is positively correlated with total energy use by private transport modes and these relationships are statistically significant ($p<0.05$). Energy use for walking, on the other hand, has a negative and high impact on the energy use for all purposes (Table 8.3).

Table 8.3. Total Energy Consumption of Trips for Various Purposes Correlated with Total Energy Use of Trips by Various Modes - Sampled Survey[7, 8]

		TOTAL ENERGY USE FOR				
		School	Work	Shopping	Social	Other
TOTAL ENERGY USE BY	Private Mode	.98080 (.001)	.98863 (.001)	.89594 (.008)	.98209 (.001)	.69322 (.063)
	Public Mode	-.02482 (.481)	.17198 (.372)	-.19176 (.357)	.14404 (.392)	.19688 (.354)
	Semi-public Mode	.12934 (.403)	-.28915 (.289)	-.23179 (.456)	-.05800 (.329)	.24349 (.320)
	Walking	-.88110 (.010)	-.85475 (.015)	-.80355 (.027)	-.82127 (.022)	-.68140 (.068)

It is difficult to talk about a direct correlation between energy use and travel purpose, but the overall energy consumption of transport increases with the number and distance of trips and the diversity of purposes.

VIII.3. Energy Use of Transport by Changing Modes

As emphasised before, travel mode is an important determinant of the energy use of transport. Factors influencing the modal choice were analysed in chapter VII. Some of these factors and their influences are re-analysed in this part with a special emphasis on energy issues.

[7] The first numbers represent the Pearson Correlation Coefficient and the numbers in parenthesis represent Significance.
[8] The shaded cells indicate the observed high correlation, either negative or positive, between two variables. The correlation coefficient is very close to -1 or +1 in these cells. Significance, on the other hand, is less than 0.05 which is also statistically acceptable.

In terms of the travel distances covered by different modes, increasing car ownership and average rent, which are two indicators of an upper income level, stimulate car usage and the overall distance covered by cars ($p<0.05$). In contrast, decreasing income level encourages walking ($p=0.003$). Increasing car ownership or average rent means decreasing the total distance travelled on foot. These strong positive and negative interrelationships are presented in Table 8.4.

Table 8.4. Travel Distance of Trips by Various Modes Correlated with Socio-Economic and Spatial Variables - Sampled Survey [9, 10]

		TRAVEL DISTANCES BY			
		Private Modes	Public Modes	Semi-public Modes	Walking
Socio-Economic Variables	Car Ownership [11]	.85575 (.014)	-.34866 (.249)	-.16446 (.377)	-.92746 (.003)
	Average Rent [12]	.80478 (.026)	-.24300 (.321)	-.04115 (.469)	-.93224 (.003)
	Family Size	-.61894 (.095)	.39759 (.217)	.31810 (.269)	.75785 (.040)
Spatial Variables	Urban Density [13]	-.24791 (.317)	-.00804 (.493)	-.15428 (.385)	-.11835 (.411)
	Distance From CBD (km)	.18021 (.366)	.92166 (.004)	.94232 (.002)	-.09280 (.430)
Total Travel Distance (km)		.78699 (.031)	.63917 (.085)	.71680 (.054)	-.67506 (.070)
Total Energy Use [14]		.99676 (.000)	.11002 (.417)	.22557 (.333)	-.86529 (.013)

[9] The first numbers represent the Pearson Correlation Coefficient and the numbers in parenthesis represent Significance.
[10] The shaded cells indicate the observed high correlation, either negative or positive, between two variables. The correlation coefficient is very close to -1 or +1 in these cells. Significance, on the other hand, is less than 0.05 which is also statistically acceptable.
[11] Number of cars per 1000 people.
[12] Housing rent per month.
[13] Number of people per hectare (gross population density).
[14] Calories per passenger km.

The correlation between family size, as an indicator of demographic structure, and travel distance by car is inverse and moderate. There is a weak negative correlation between distance covered by car and family size (p=0.095). Family size is, on the other hand, positively correlated with travel distance by walking. This association is more likely to occur (p=0.040).

Urban density, as a spatial variable, does not have a powerful influence on travel distances by various modes. In fact, there is a negative and weak correlation between them (p>0.05). On the contrary, location of a residence with reference to the CBD has a direct and powerful influence on travel distances by modes, particularly on travel distances by public and semi-public modes of transport. Increasing distance from the CBD directly affects the distance travelled by municipal buses, dolmuses, school or official buses (p=<0.002).

Travel distances by private and semi-public transport modes are positively correlated with total distance travelled (p=<0.05). It is necessary to mention the existence of a weak positive correlation between total travel distance and travel distance by public transport. Another weak but negative correlation is observed in the case of travel distance by walking and total travel distance.

There is a strong correlation between the total energy consumption of transport and the total travel distance by private modes. Increasing travel distance by cars results in an increasing total energy consumption of transport. In the case of walking, travel distance has a negative significant influence on the total energy used by transport (p=0.013).

In terms of average energy used by different modes of transport, socio-economic factors do not have any considerable influence. Even car ownership does not affect average energy use by various modes. Among all socio-economic variables, family size is the only one having a negative correlation with the average energy used by walking (Table 8.5.).

It is difficult to talk about a direct correlation between the average energy use by different modes of transport and urban density. Distance from CBD, on the other hand, has a considerable influence on the average energy used by public and semi-public modes and by walking. In terms of motorised modes, this influence is positive (p=<0.005), whereas for walking it is negative (p=0.024). In the case of living away from the CBD, the average energy used by public or semi-public modes increase whereas distance from the CBD encourages lower average energy usage for walking. Keeping in mind the energy efficiency of walking, this correlation not only indicates the decreasing travel distance by walking, but also shows a decreasing number of walking trips due to living away from the CBD.

Parallel to this, there is a weak correlation between average energy use by walking and total travel distance. In terms of motorised modes including cars, there is a significant (p=<0.02) positive correlation only between average energy used by cars and total travel distance. An increasing average energy use of cars is the only factor contributing to total energy consumption by transport.

Table 8.5. Average Energy Consumption of Trips by Various Modes Correlated with Socio-Economic, Spatial Variables, Total Travel Distance and Energy Use - Sampled Survey [15, 16]

		AVERAGE ENERGY USE BY			
		Private Modes	Public Modes	Semi-public Modes	Walking
Socio-Economic Variables	Car Ownership [17]	.49101 (.161)	-.06015 (.454)	-.17940 (.366)	.55047 (.128)
	Average Rent [18]	.50278 (.154)	-.02341 (.482)	.25891 (.310)	.59878 (.104)
	Family Size	-.52001 (.145)	.33998 (.254)	.10789 (.419)	-.75394 (.041)
Spatial Variables	Urban Density[19]	.11042 (.417)	-.29249 (.286)	-.32635 (.263)	.16270 (.379)
	Distance From CBD (km)	.35610 (.244)	.98200 (.001)	.91228 (.005)	-.81534 (.024)
Total Travel Distance (km)		.86100 (.014)	.82092 (.022)	.91615 (.005)	-.29635 (.284)
Total Energy Use[20]		.83134 (.020)	.41955 (.203)	.57648 (.115)	-.52883 (.408)

The following conclusions can be derived from Tables 8.4 and 8.5 for the inner and out-of city districts in Ankara:

I - Socio-economic variables have a significant influence on the total travel distance by private modes and walking. An upper income profile permits

[15] The first numbers represent the Pearson Correlation Coefficient and the numbers in parenthesis represent Significance.
[16] The shaded cells indicate the observed high correlation, either negative or positive, between two variables. The correlation coefficient is very close to -1 or +1 in these cells. Significance, on the other hand, is less than 0.05 which is also statistically acceptable.
[17] Number of cars per 1000 people.
[18] Housing rent per month.
[19] Number of people per hectare (gross population density).
[20] Calories per passenger km.

increasing total travel distance by private modes whereas the total travel distance for walking is higher for lower income people.

II - Whatever the income level is, the location of a residence with reference to the CBD is an important factor affecting the travel distance and energy used by different modes of transport. This is particularly true for public and semi-public modes and for walking.

III - The average energy use of the private mode is the only one that does not fluctuate due to location of residence. Travel distances by private modes are similar for inner and out-of city residents.

IV - Private modes and walking are the modes of transport which have a significant influence on the total energy use of transport and travel distance.

V - The existence of a positive correlation between the energy used by private modes and the total travel distance indicates that both inner and out-of city residents travel for long distances by private modes.

VI - Since public and semi-public modes of transport have limited flexibility in terms of origin and destination areas, the location of residence has a powerful influence on the average energy used and distance travelled.

VII - Average energy use per walking trip is negatively correlated with residence's distance from the CBD. In fact, walking distance is usually within certain margins, particularly for regular trips, and thus the location of residence does not define walking distance to a great extent. Nevertheless, survey results indicate that long distance walking trips are probable for those living near to the CBD and this results in an increased average energy use for walking trips.

VIII.4. Analysis of Energy Consumption at District Level

This part of the study summarises the above findings at district level. First, the correlation among two interval variables, namely distance and energy use of transport in each district, are analysed. Secondly, these variables are studied together with a nominal variable, which is the travel mode.

Table 8.6 and 8.7 provide the Pearson Correlation Coefficients for travel distances and energy use of transport in each district. These variables are analysed by districts grouped according to location and the income level of their residents. The values presented are statistically acceptable because all significance levels are less than or equal to 0,01.

There is a strong correlation between energy use and travel distance. The high sensitivity results from a direct influence of travel distance on energy use which is more obvious among the inner city districts (Table 8.6). It can be explained by differing travel distances among these districts, whereas travel distances are more homogeneous among the out-of city districts. A modal split also defines these relationships.

Table 8.6. Pearson Correlation Coefficients Between Travel Distance and Energy Use of Transport According To The District - Sampled Survey

Districts	Pearson Correlation Coefficients Between Travel Distance and Energy Use of Transport
IN-L	.75158
IN-M	.80447
IN-H	.66989
OUT-L	.56356
OUT-M	.53253
OUT-H	.54191

Table 8.7 shows the relationship between these two variables according to the income levels of the districts. The correlation between travel distance and energy use shows that an increasing energy use due to an increasing travel distance is more probable in high income districts. This is a result of the wider use of private modes. For low income districts, an increasing energy use as resulting from an increasing travel distance is less likely. This time it is the high percentage of walking which shapes the figures.

The high correlation between the two variables in the case of the low and middle income districts is a consequence of modal choice. Public modes and walking are widely preferred in these districts. Due to the operation of public transport modes on a previously authorised route, the distance travelled by public buses does not vary very much among residents of a district. Destination areas of the low income people are not diverse; people at this income level either travel within their regional boundaries or travel to nearby regions. All these conditions result in a high correlation between energy use and travel distance per trip. The wide use of private modes creates the strong correlation between travel distance and energy use among high income people.

Table 8.7. Pearson Correlation Coefficients Between Travel Distance and Energy Use of Transport For Settlements of Different Income Levels

Settlements of Different Income Levels	Pearson Correlation Coefficients Between Travel Distance and Energy Use of Transport
Low Income (IN-L and OUT-L)	.62145
Middle Income (IN-M and OUT-M)	.62268
High Income (IN-H and OUT-H)	.74480

The two dependent variables to be compared, which are travel distance and energy use, and the grouping variables (travel modes) are analysed with the help of "One Way Analysis of Variance". Results of this analysis, the F ratios for each district, are given in Table 8.8.

All F ratios are high (p=0.001) which indicates that the four groups of transport mode (private, public, semi-public and walking) create meaningful differences in the distances and energy uses of trips.

In IN-L, for example, the highest F ratio of all inner city districts is observed for travel distance. The high share of short distance walking trips as against comparatively longer distance trips by motorised modes in IN-L, is one of the determinants of this observed strong relationship[21]. In IN-H, the F ratio is low due to more homogenous values for travel distances by various modes.

21 "Mean" travel distance values for various modes are in Appendix C.

Table 8.8. Variations (F Ratios) Of Travel Distance And Energy Use Due To Modal Choice[22]

DEPENDENT VARIABLES	DISTRICTS					
	IN-L	IN-M	IN-H	OUT-L	OUT-M	OUT-H
Travel Distance	120.205	42.332	26.993	163.357	112.302	55.375
Energy Use	89.933	84.835	46.982	139.043	287.204	132.405

In the out-of city districts, travel distance variations related to modal choice also differ from one district to another (Table 8.8). In OUT-H, the F ratio is the lowest for all out-of city districts whereas, it has its highest value for OUT-L. Like IN-L, mean travel distance is low for walking and private modes in OUT-L and public modes are usually used for long distance trips. The average travel distance does not differ from one motorised mode to another in OUT-H and OUT-M, and this is also observed in IN-H and IN-M. The difference of F ratios within the same income group is a product of long distance trips by motorised modes by out-of city residents.

F ratio between energy use and travel mode fluctuates from one district to another among the out-of city districts. These variations are independent of income level. In OUT-M, variations of energy use resulting from modal choice have the highest value. This indicates that, in OUT-M, the energy use of transport changes considerably from one travel mode to another when compared to other districts. A lower variation of energy use depending on modal choice in OUT-H is the result of an agglomeration of trips by private modes as well as of the wider use of motorised modes. In OUT-L, the high variation of energy use resulting from modal choice is due to the diversity of transport modes including walking. Consequently, the agglomeration of travel

[22] F Probabilities are less than 0.001.

demand on a particular mode and the diversity of travel modes have considerable influence on the energy use of transport in out-of city districts.

VIII.5. Possible Changes in Travel Demand Due to Location of Residence

As summarised in chapter VI, the socio-economic structures of the surveyed inner and out-of city residents show some similarities. In the light of these similarities, the travel demand patterns of the six districts have been analysed in chapter VII and in the preceding parts of this chapter.

The study now turns to an analysis of the travel demand pattern of the out-of city residents from a different point of view. It is assumed that those living in OUT-L, OUT-M and OUT-H were previously living in IN-L, IN-M and IN-H, respectively. It is also assumed that moving out of the city caused changes in their travel demand patterns, and that if they had settled in the inner city districts, they would have had similar travel demands with IN-L, IN-M and IN-H's residents.

Following this hypothesis, two scenarios were developed. It is first assumed that these people would have had average trip lengths similar to those of the current inner city residents (Scenario-I). Numbers of trips for various purposes by various modes are taken as the observed values for the out-of city district. Total travel distances and energy uses are calculated for all trip purposes and modes under the first scenario.

In the second stage, modal split is added. Thus actual percentage shares of modes for each purpose in IN-L, IN-M and IN-H are applied to the total number of trips generated by the residents of OUT-L, OUT-M and OUT-L (Scenario-II). It is assumed that both travel distance and modal split have shifted from an actual pattern to another pattern which is observed among the inner city residents.

For all these analyses, MJ is used as the unit of energy use for transport in order to show energy use differences in terms of finite resources. In other words, the energy consumption of walking is taken as zero.[23]

Changing average trip distances (Scenario-I) result in a decreasing total travel distance for each purpose in all districts, excluding shopping trips in OUT-L and OUT-M (Table 8.9 and 8.10). For school trips there is a mere 6 percent decrease of travel distance in OUT-L, whereas in OUT-M total travel distance for school decreases from 655.8 km to 276.4 km, which is a 57 per cent change. There are considerable decreases in the total travel distance of work trips in all districts, for instance it decreases to 446,5 km with a 82,8 per cent change in OUT-L. For social trips, there are important changes in terms of travel distances for social trips too. These changes are particularly observed in OUT-M and OUT-H. In the case of shopping trips, living in OUT-L and OUT-M is more advantageous in terms of energy use of transport than living in IN-L and IN-M, because of the lower actual total travel distance for shopping in OUT-L and OUT-M.

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[23] Tables, showing the energy use scenarios in terms of *Calories* and including walking are provided in Appendix D.

The effects of the changes of average trip length (Scenario-I) on the energy use of transport are generally negative. In other words, total energy used by various purposes would have decreased, if OUT-L, OUT-M and OUT-H's residents were living in the inner city. Shopping trips by OUT-L and OUT-M's residents and social trips by OUT-L's residents are the exceptions. In OUT-L, energy use for shopping trips does not change due to modal choice. All observed shopping trips by OUT-L and IN-L's residents are on foot. Thus, there would have been no change in the energy use of shopping trips, if OUT-L's residents had been living in IN-L. In the case of OUT-M, changing location of residence increases energy use for shopping trips more than 200 per cent. This time the high average length of shopping trips by IN-M residents is the main reason.

All these variations are due not only to changes in travel distance but also to modal split. When we add the modal split changes to the analysis (Scenario-II), since average distances by each mode for all purposes and number of trips are the same as Scenario-I, changes in travel distances for all purposes are also the same as Scenario-I (Tables 8.9 and 8.10).

According to Scenario-II energy use decreases for most purposes. For all purposes, any reduction of energy use resulting from changing travel mode (Scenario-II) is not as great as those due to changes in average travel distance (Scenario-I). Thus, living in the out-of city district does not always mean using more energy intensive modes. Sometimes out-of city residents prefer less energy intensive modes than inner city residents, as in the cases of shopping trips by OUT-M's residents and school trips by OUT-L's residents. The modal split of IN-L's residents has an accelerating effect on the transport energy use by OUT-L's residents in terms of social and school trips.

The actual modal choice of OUT-H's residents has a considerable negative influence on energy use for different purposes, since the decrease in energy use is even greater than under Scenario-I (Table 8.10). Instead of living in OUT-H, if they were living in IN-H and if they had similar modal choices to those of IN-H's residents, they would have spent more than 65 percent less energy than they actually do.

Changes in travel distances and energy use by modal split according to two scenarios are given in Tables 8.11 and 8.12. The percentage changes for travel distance and energy use for motorised trips have same values in each scenario.

By applying the average travel distances of the inner city residents to the out-of city districts (Scenario-I), considerable reductions in terms of travel distances by motorised modes of transport are achieved. These reductions are particularly observed in the case of bus trips by OUT-M's and OUT-H's residents. There are also 65 and 63 percent reductions in distance travelled as well as energy used by private modes in OUT-M and OUT-H respectively. Decreases in total travel distance by semi-public modes are higher in OUT-L and OUT-M than in OUT-H.

Table 8.9. Two Scenarios for Total Energy Consumption of Trips For Various Purposes

	TRAVEL PURPOSES					
	SCHOOL	WORK	SHOPPING	SOCIAL	OTHER	TOTAL
TOTAL ENERGY USE PER DAY (MJ)						
IN-L	91.42	388.79	7.94	127.77	99.58	715.50
IN-M	163.79	1252.88	587.56	367.22	245.86	2617.32
IN-H	569.89	2311.33	279.25	922.51	520.51	4603.49
OUT-L	107.81	1474.71	0.00	46.77	86.81	1716.11
OUT-M	483.32	4147.89	42.13	2315.37	888.95	7877.67
OUT-H	1476.64	9282.45	2065.16	4171.16	660.83	17656.24
TOTAL TRAVEL DISTANCE PER DAY (km)						
IN-L	231.60	301.40	16	63.8	72.80	685.6
IN-M	215.40	422.40	148	140.7	97.50	1024
IN-H	491.00	679.80	104.9	266.1	141.40	1683.2
OUT-L	365.20	2608.60	14.6	134.2	283.80	3406.4
OUT-M	655.80	2154.40	107.6	857.8	626.20	4401.8
OUT-H	964.80	2663.80	584.6	1167.8	300.40	5681.4
TOTAL NUMBER OF TRIPS PER DAY						
IN-L	94	108	14	43	12	271
IN-M	60	106	22	61	21	270
IN-H	80	133	31	87	17	348
OUT-L	139	160	33	50	15	397
OUT-M	77	169	27	74	54	401
OUT-H	77	169	57	104	26	433
AVERAGE TRIP DISTANCE (km)						
IN-L	2.46	2.79	1.14	1.48	6.07	2.53
IN-M	3.59	3.98	6.73	2.31	4.64	3.79
IN-H	6.14	5.11	3.38	3.06	8.32	4.84
SCENARIO-I						
TOTAL TRAVEL DISTANCE PER DAY (km)						
OUT-L	342.47	446.52	37.71	74.19	91.00	991.89
OUT-M	276.43	673.45	181.64	170.69	250.71	1552.91
OUT-H	472.59	863.81	192.88	318.10	216.26	2063.63
TOTAL ENERGY USE PER DAY (MJ)						
OUT-L	62.92	585.83	0	99.97	24.91	773.63
OUT-M	138.79	1551.07	156.68	581.06	235.79	2663.40
OUT-H	742.47	3144.88	692.79	1133.79	812.51	6526.45
SCENARIO-II						
TOTAL TRAVEL DISTANCE PER DAY (km)						
OUT-L	342.47	446.52	37.71	74.19	91.00	991.89
OUT-M	276.43	673.45	181.64	170.69	250.71	1552.91
OUT-H	472.59	863.81	192.88	318.10	216.26	2063.63
TOTAL ENERGY USE PER DAY (MJ)						
OUT-L	135.18	575.99	18.71	148.57	124.47	1002.93
OUT-M	210.20	1997.52	721.09	445.48	632.22	4006.52
OUT-H	548.52	2936.95	513.46	1102.77	796.07	5897.78

Table 8.10. Changes in Total Energy Consumption of Trips For Various Purposes Due to Scenario-I and II

		TRAVEL PURPOSE					
		SCHOOL	WORK	SHOPPING	SOCIAL	OTHER	TOTAL
SCENARIO-I							
DISTANCE	OUT-L	-0.062233	-0.828828	1.583170	-0.447198	-0.679352	-0.708815
	OUT-M	-0.578484	-0.687408	0.688070	-0.801020	-0.599626	-0.647209
	OUT-H	-0.510171	-0.675724	-0.670064	-0.727610	-0.280097	-0.636774
ENERGY	OUT-L	-0.416438	-0.602748	No Change	1.137449	-0.713050	-0.549195
	OUT-M	-0.712851	-0.626057	2.719086	-0.749040	-0.734757	-0.661905
	OUT-H	-0.497189	-0.661201	-0.664532	-0.728183	0.229520	-0.630360
SCENARIO-II							
DISTANCE	OUT-L	-0.062233	-0.828828	1.583170	-0.447198	-0.679352	-0.708815
	OUT-M	-0.578484	-0.687408	0.688070	-0.801020	-0.599626	-0.647209
	OUT-H	-0.510171	-0.675724	-0.670064	-0.727610	-0.280097	-0.636774
ENERGY	OUT-L	0.253873	-0.609423	No Change	2.176524	0.433801	-0.415582
	OUT-M	-0.565087	-0.518425	16.116249	-0.807600	-0.288803	-0.491408
	OUT-H	-0.628533	-0.683602	-0.751367	-0.735620	0.204641	-0.665966

In contrast to motorised modes, the total travel distances of walking trips are increased by Scenario-I. There is no difference in terms of total energy use by walking, since the energy consumption of walking is 0 MJ per km. The increase of travel distance by walking is the highest in OUT-H with 46 per cent. Even in OUT-L where the actual share of walking trips is already high, total travel distance by walking would have increased by 38 per cent if its residents were living in IN-L.

In addition to average travel distance changes, the effects of modal choice on travel distance and energy use by different modes are analysed through Scenario-II. For OUT-L's residents, total distance travelled by private modes increases from 77.6 km to 166.84 km. This increase is more than 100 per cent (Table 8.12). For OUT-M's and OUT-H's residents, on the other hand, there are considerable decreases in the distance travelled and energy consumed by private mode (44% for OUT-M and 67% for OUT-H). In the case of public transport modes, there is a sharp decrease which reaches 90 per cent in OUT-M. This decrease is 78 per cent in OUT-H where the lowest use of public modes is observed. In addition to public transport, travel distance and energy used by semi-public transport also decrease considerably in OUT-L. Due to modal split changes, walking distances for all out-of city districts increase even more than the increase caused by Scenario-I. This increase is particularly observed in OUT-H where it is more than 100 per cent. In spite of these changes, a shift from one modal to another does not cause any change in the energy use for walking, since a finite energy source is not required for walking.

It is obvious that if people were living in an inner city district, there would have been an important decrease in demand for motorised modes in terms of travel distance and energy use. Total distance by walking trips would increase while there would be no change in terms of total energy used by walking. In spite of the high increases of the total distance of walking trips, total travel distance by motorised modes decreases under Scenario-II.

Overall decreases of travel distance in these two Scenarios have similar tendencies and are higher than 60 per cent in all out-of city districts. This inevitably means moving residence from the out-of city districts to the inner city district might result in a decrease in total travel distance of at least 60 per cent. Reduction in total travel distance provides at least 54.9 per cent energy saving, as in OUT-L, and extends up to 66 per cent, as in the case of OUT-M. Modal split changes accelerate this saving, particularly for OUT-H's case.

Table 8.11. Two Scenarios for Total Energy Consumption of Trips by Various Modes

	TRAVEL MODES				
	PRIVATE	PUBLIC	SEMI PUBLIC	WALKING	TOTAL
TOTAL ENERGY USE PER DAY (MJ)					
IN-L	499.75	64.39	151.35	0.00	715.50
IN-M	2417.94	30.57	168.82	0.00	2617.32
IN-H	4270.06	41.18	292.26	0.00	4603.49
OUT-L	318.40	621.23	776.49	0.00	1716.11
OUT-M	6733.95	529.71	614.02	0.00	7877.67
OUT-H	16946.06	245.92	464.25	0.00	17656.24
TOTAL TRAVEL DISTANCE PER DAY (km)					
IN-L	121.8	213.6	228.8	121.4	685.6
IN-M	589.3	101.4	255.2	78.1	1024
IN-H	1040.7	136.6	441.8	64.1	1683.2
OUT-L	77.6	2060.8	1173.8	94.2	3406.4
OUT-M	1641.2	1757.2	928.2	75.2	4401.8
OUT-H	4130.1	815.8	701.8	33.7	5681.4
TOTAL NUMBER OF TRIPS PER DAY					
IN-L	29	36	41	165	271
IN-M	104	29	48	89	270
IN-H	204	33	50	61	348
OUT-L	15	114	72	196	397
OUT-M	111	134	63	93	401
OUT-H	293	54	42	44	433
AVERAGE TRIP DISTANCE (km)					
IN-L	4.20	5.93	5.58	0.74	2.53
IN-M	5.67	3.50	5.32	0.88	3.79
IN-H	5.10	4.14	8.84	1.05	4.84
PERCENTAGE DISTRIBUTION OF TRIPS (%)					
IN-L	10.70	13.28	15.13	60.89	100.00
IN-M	38.52	10.74	17.78	32.96	100.00
IN-H	58.62	9.48	14.37	17.53	100.00
SCENARIO-I					
TOTAL TRAVEL DISTANCE PER DAY (km)					
OUT-L	59.10	758.58	457.21	130.32	991.89
OUT-M	566.32	431.40	317.04	80.03	1552.91
OUT-H	1510.56	213.40	399.36	49.42	2063.63
TOTAL ENERGY USE PER DAY (MJ)					
OUT-L	242.51	228.67	302.45	0.00	773.63
OUT-M	2323.63	130.04	209.72	0.00	2663.40
OUT-H	6197.94	64.33	264.18	0.00	6526.45
SCENARIO-II					
MODAL SPLIT (TOTAL NUMBER OF TRIPS PER DAY)					
OUT-L	42	53	60	242	397
OUT-M	154	43	71	132	401
OUT-H	254	41	62	76	433
TOTAL TRAVEL DISTANCE PER DAY (km)					
OUT-L	166.84	307.11	341.34	176.61	991.89
OUT-M	902.73	159.30	384.77	106.11	1552.91
OUT-H	1350.69	174.84	458.23	79.87	2063.63
TOTAL ENERGY USE PER DAY (MJ)					
OUT-L	684.55	92.58	225.80	0.00	1002.93
OUT-M	3703.97	48.02	254.53	0.00	4006.52
OUT-H	5541.95	52.71	303.13	0.00	5897.78

Table 8.12. Changes in Total Energy Consumption of Trips by Various Modes Due to Scenario-I and II

		TRAVEL MODE				
		PRIVATE	PUBLIC	SEMI PUBLIC	WALKING	TOTAL
SCENARIO-I						
DISTANCE	OUT-L	-0.238340	-0.631901	-0.610491	0.383481	-0.708815
	OUT-M	-0.654937	-0.754497	-0.658440	0.064196	-0.647209
	OUT-H	-0.634254	-0.738420	-0.430953	0.466531	-0.636774
ENERGY	OUT-L	-0.238340	-0.631901	-0.610491	No Change	-0.549194
	OUT-M	-0.654937	-0.754497	-0.658440	No Change	-0.661905
	OUT-H	-0.634254	-0.738420	-0.430953	No Change	-0.630360
SCENARIO-II						
DISTANCE	OUT-L	1.149980	-0.850975	-0.709204	0.874810	-0.708815
	OUT-M	-0.449955	-0.909347	-0.585462	0.411084	-0.647209
	OUT-H	-0.672965	-0.785683	-0.347059	1.370060	-0.636774
ENERGY	OUT-L	1.149980	-0.850975	-0.709204	No Change	-0.415582
	OUT-M	-0.449955	-0.909347	-0.585462	No Change	-0.491407
	OUT-H	-0.672965	-0.785683	-0.347059	No Change	-0.665966

Any shift in modal split due to the out-of city residents living in an inner city area might result in the largest decrease of energy use in OUT-H. This decrease is even higher than the case of Scenario-I, which is changing travel distance. For OUT-M and OUT-L, energy saving due to changing modal split is lower than for OUT-H as a consequence of travel distance changes. In other words, out-of city residents sometimes have less energy intensive modal choices than the inner city ones.

The out-of city residents were asked about their most common previous and actual travel modes. It is evident that for daily regular trips their dependence on motorised modes increased after moving into the out-of city area (Table 8.13). The share of walking trips, on the other hand decreased in all districts including those of low income people. The increasing car usage is particularly obvious among high income people. When we add the increasing travel distance due to a continuing use of the inner city workplaces and schools, raised energy use of transport due to living in an out-of city area seems more probable.

Table 8.13. Most Common Previous and Actual Modes for School and Work Trips

	OUT-L		OUT-M		OUT-H	
	%	#	%	#	%	#
PREVIOUS MODES FOR WORK AND SCHOOL TRIPS						
Private	7.29	7	23.46	19	45.35	39
Public and Semi-Public	40.73	39	50.62	41	43.03	37
Walking	52.08	50	25.93	21	11.63	10
TOTAL	100.00	96	100.00	81	100.00	86
ACTUAL MODES FOR WORK AND SCHOOL TRIPS						
Private	3.7	11	24.4	60	63.8	157
Public and Semi-Public	53.5	160	55.3	136	27.7	68
Walking	42.8	128	20.3	50	8.5	21
TOTAL	100.00	299	100.00	246	100.00	246

The comparison of their previous most common modes for regular daily trips and the modal split of the inner city residents shows that out-of city residents used to have less energy intensive modal split before they moved out of the city. This means that there would be more energy saving than the calculated energy savings through two scenarios, if they had settled in the inner city.

VIII.6. Summary and Conclusions

The amount of energy required to move 1 passenger 1 kilometre multiplied by number of kilometres driven defines the energy use of transport. Modal choice and travel distance are two main factors influencing this energy use. There are also other factors which indirectly influence the energy use. Since the demand for transport is a derived demand, urban transport is a by-product of spatial and socio-economic relations within an urban environment. Thus socio-economic factors and spatial variables indirectly influence the energy use of transport. The purpose of trips, which define the travel route also influences the travel distance and the energy use.

The effects of all these factors on the energy use of transport are examined statistically. Socio-economic variables have a considerable influence on travel distance by private mode and walking. Increasing income level results in increasing travel distance by private mode whereas it results in decreasing travel distance by walking. The influence of income level for school and shopping trips is also evident. Travel distances for these trips are higher among high income people than low income people.

The location of residential place relative to the CBD particularly affects distance travelled for work trips, that is living away from the CBD usually means longer distance work trips. Those living away from the CBD are also forced to use public and semi-public modes of transport.

Both private modes and walking define transport energy use for all purposes. The effect of an extensive use of the car is positively, whereas walking is negatively correlated with the total energy use of transport.

Independent from the location of a residence, travel distance and energy use is highly correlated (Table 8.7) and this correlation is more obvious in the case of high income level (Table 8.8).

If the out-of city residents were living in one of the inner city districts, and if they had similar travel demand characteristics to inner city residents, they would spend less energy on transport. Total travel distance for most trips would decrease because of the lowered average trip distance and shifting modal split. In spite of minor increases in energy use, (for example the shopping trips by OUT-L and OUT-M's residents or the car trips by OUT-L's residents or all walking trips) living in an out-of city district causes at least 50 per cent more energy used in all trips. In other words, living near to the CBD might result in a 67 per cent energy saving for transport.

The out-of city residents were asked their reasons for moving into an out-of city area. Proximity to the main destination areas is not the most common reason (Table 8.14). For the higher income group "better living environment" is the dominating reason. It is also an important determinant for the middle income people's choice of residential location whereas social and economic reasons are more important for the low income group.

Table 8.14. Reasons for Moving into an Out-of City District

	OUT-L		OUT-M		OUT-H	
	%	#	%	#	%	#
Own House	40.00	20	24.00	12	8.00	4
Appropriate Rent Level	28.00	14	22.00	11	0.00	0
Better Living Environment Than Inner City	18.00	9	38.00	19	88.00	44
Family Relations (marriage, near to parents)	10.00	5	2.00	1	4.00	2
Proximity to Main Destinations	4.00	2	14.00	7	0.00	0
TOTAL	100.00	50	100.00	50	100.00	50

Proximity to main destinations is not widely considered among out-of city residents. It is obvious that these considerations might have positive impacts on their travel demand patterns, since they use more energy than others due to wider use of motorised modes and increasing travel distance. Increasing public awareness towards the travel demand reduction is, thus is an important area that should be considered.

The out-of city residents were asked to compare their previous and actual traveling conditions (Table 8.15). Most of them agree that it became more difficult to travel after moving out of city.

Table 8.15. Comparison of Previous and Actual Traveling Conditions by the Out-of City Residents

	OUT-L		OUT-M		OUT-H	
	%	#	%	#	%	#
Become Easier	27.03	40	25.00	32	23.70	32
Become Difficult	39.19	58	59.38	76	46.67	63
No Difference	33.78	50	15.63	20	29.63	40
TOTAL	100.00	148	100.00	128	100.00	135

This is obviously a result of long distance and uncomfortable daily routine trips to the inner city. When we add the additional energy consumed, noise and pollution generated by their actual daily travel patterns it is clear that these developments cost both for its residents and the city as a whole.

PART FIVE: DISCUSSION AND CONCLUSIONS

CHAPTER NINE: CONCLUSIONS AND DISCUSSIONS FOR MORE ENERGY EFFICIENT TRAVEL DEMAND PATTERNS IN ANKARA

IX.1. Introduction

The main aim of the research in this dissertation is to understand how far the energy used by urban transport can be minimised through urban planning decisions. This research has attempted to define the travel demand patterns of the inner and out-of city residents of Ankara and to discuss the factors affecting them. Beside this comparative analysis, there was an attempt to discover what the out-of city residents would do if they were living in the inner city districts. The possibilities of having more energy efficient travel demand patterns in the selected districts of Ankara were examined. The research has attempted to answer the following key questions:

1. What are the possible impacts of location of residence on daily travel demand patterns?
2. Why does the energy use of transport differ from one district to another and among people?
3. What would the out-of city residents do if they were living in the inner city?
4. Why do certain residential developments, presumably the out-of city ones, generate more energy intensive travel demand patterns than others?

The underlying assumption is that the planned out-of city housing developments, which occurred during the late 1980's and have been accelerating in recent years, have changed the travel demand characteristics of households in Ankara. Although most regular daily trips in Ankara are made either by public transport or on foot, moving out-of the city causes an intermodal shift from public transport to private transport and from walking (non-motorised) to motorised modes. Modal selection for irregular daily trips might also shift from less energy intensive modes to more energy intensive ones. Furthermore, an increasing average travel distance might add to the problem if destination areas are close to the CBD. There might be an increasing traffic volume in the CBD with resulting air pollution and noise level. Not only are the ties between workplace and residence affected, but relative distances to all other facilities such as shopping centres, schools, colleges, recreational areas (parks, sport centres, playgrounds, and etc) and hospitals also change. As argued by various authors (see chapter III) due to the disintegration of land uses, travel distance and dependence on motorised modes might rise if people continue to use such facilities located in the inner city area.

It was suggested that all the changes caused by the planned urban developments in Ankara would also affect the energy use of transport which is examined in this study.

To examine the aims and objectives of the study, use was made of primary sources of materials which consist mostly of the results of the field research conducted in Ankara. The survey was carried out in six districts at three different income levels. Two hundred and seventy households, 150 of which are living in the out-of city districts, were selected and a total population of 858 aged 7 and over were interviewed about their socio-economic structures and travel demand patterns. The comparison between the travel demand characteristics of the households living in the post-1985 out-of-city housing developments and in the existing inner city areas indicates possible changes in travel demand patterns due to the intra-urban migration. These changes in travel demand were converted into energy terms, that is total energy used by different modes of transport in each district. It was assumed that after moving into an out-of-city district, daily travel pattern changed. If the out-of city residents were living in an inner city area, they might have average travel distance for various purposes and modal split similar to the inner city residents. Depending on these assumptions, changes in the energy consumption of transport and possibilities of energy saving were discussed.

This last chapter discusses the research findings in the light of the research hypotheses (see section V.4.2.) and literature review (chapter II, III and IV). It looks at how far the research questions are answered, and whether the findings support or disprove the research hypotheses. Policy recommendations for more energy efficient travel demand patterns in Ankara will be discussed and implications for further researches will be suggested.

IX.2. Possible Impacts of the Location of a Residence on Daily Travel Patterns

The comparative analysis of travel demand patterns indicates that there are similarities and differences among the surveyed population. Considering the low sampling ratio, it is difficult to make generalisations from the findings. Nevertheless, this research shows some of the prerequisites and limitations for less energy intensive travel demand patterns together with some cases that might encourage lower energy consumption by transport.

This section summarises the survey findings in terms of similarities and differences of travel demand patterns of the inner and out-of city residents.

IX.2.1. Similarities Between the Travel Demand Patterns of the Inner and Out-of City Districts of Ankara

Some of the travel demand characteristics observed both among the inner and out-of city residents of Ankara are as follows:

- Dependency on motorised modes increasing with an income level.

Increasing income level accelerates the use of motorised modes. It also means increasing dependency on private modes due to high level of car ownership.

- Overall travel distances increasing with income level.

Whatever the location of their home, high income people can travel for longer distances. Not only total travel distance but also average trip length increases with income level.

As also argued by Modridge (1985) car ownership and use, as an indicator of income level, has a direct influence on travel distance. Another result supporting this situation is the high share of short distance trips among those who do not own a car.

- Dependency on motorised modes increasing with travel distance.

Separation of different land uses force people into the wider use of motorised modes. As mentioned by Hillman and Whalley (1983), dispersion of living patterns can easily lead to an extending travel distance and increasing use of private modes Proximity to a variety of land uses, on the other hand, encourages walking for daily regular trips.

- A high share of walking trips among low income people.

Walking is more common among low income people. Since the cost of public transport posses limitations to its use, they might prefer to walk. They also have limited opportunities for car ownership.

- A high share of walking and extensive use of car for irregular daily trips.

As Banister et al. (1990) mention irregular trips have an increasing share among all trips. Walking and car are the most popular mode of transport for these trips. All social trips excluding health, recreation and sport are usually either by walking or by car. This preference change depends on income levels that is, for high income people there is a wider use of the car; low income people prefer walking. Middle income people also prefer walking for irregular daily trips. For low income people, use of public transport modes is also possible.

- Two more effects of increasing income level and car ownership are diversification of the destination areas and increasing number of irregular trips.

- Increasing income level provides more opportunities to travel for longer distances for some purposes.

For example, it is quite common to expect a high percentage of short distance school trips but in some cases long distance school trips are also observed. The main reason behind this is the high income level and ability to pay the cost of long distance trips. In the case of low income people, most of the school trips and irregular daily trips are short distance ones within a district's boundaries.

- Travel time changes by income level as well as by modal choice and trip purpose.

Travel time by a private mode extends with an increasing income level. Use of public transport, on the other hand, usually means longer travel duration when compared with the private modes. Travel time by public transport extends more at low income level. A wider share of walking trips results in a lower travel duration.

Travel time also changes according to purpose of trip. For example, most of the work trips by high income people are less than half an hour. For school trips, travel time is usually less than 20 minutes at low and middle income level. In the case of shopping trips, it usually takes less than 10 minutes for low income people to reach their destination areas, but this increases with an increasing income level.

- Most of the trips that take less than 10 minutes are within a district's boundaries.

- In terms of the social structure of the surveyed population, short distance trips are more common among the youth. Most of the trips by women are also short distance.

Better occupational opportunities means travelling longer distances for daily activities. Those having a better educational background, that is university graduates, travel for various purposes within one day.

Evidently socio-economic characteristics shape daily travel habits. The above similarities between the travel demand patterns of the inner and out-of city residents usually result from corresponding socio-economic characteristics at similar income levels. Some of these similarities are consistent with theoretical truths. For example, changing travel time by travel mode that is trips by bus take longer than by car, or the effects of income level on modal spilt or number of trips: that is wider use of cars among high income people and extensive use of buses and walking preferences among lower income people.

These similarities are observed within income categories. The location of a residence does not have any influence on the issues above. Therefore travel demand has these the above characteristics independently from the location of a residence but rather depending on the socio-economic characteristics of residents.

IX.2.2. Differences Between the Travel Demand Patterns of Inner and Out-of City Districts of Ankara

Living in a certain part of the city, on the other hand, has a powerful influence on travel demand. The survey findings show that the location of a residence with reference to the CBD plays a potential role in the travel demand patterns of its residents. This section summarises the differences between the travel characteristics of inner and out-of city residents.

- One of the main differences is the higher number of trips per person (that is trip generation rate) among the out-of city residents. As mentioned by most scholars a concentration of different land uses like in the case of the inner city residences of Ankara lowers the travel demand (see Markovitz, 1971).

Since the number of trips to the CBD has a considerable share among the out-of city residents and all these trips are long distance ones, they try to link some of their trips. For example, at the end of a workday, they might go shopping and after shopping, they might visit their friends, have dinner in town or go to a cinema. The non-working population also tries to link their trips; they might go shopping before or after their social trips; and students might spend some time for sport or other recreational activities after school. The high share of non-home based trips as well as short distance trips within the inner city area also confirms this situation.

- In all inner city districts, walking has a higher share than in out-of city ones, since the residents have more opportunities to walk due to spatial forces. They have easy access on foot to central facilities including workplaces and schools. In IN-L, where low income people live in the inner city, walking is a popular mode of transport, in spite of the considerable distance to the CBD which lies 7.6 km from IN-L. The high share of walking trips here is an indicator of a wider use of local facilities, even for working trips. Since the area is located very near to the furniture manufacturing area where most of its residents work, working trips are usually on foot. Moreover, the share of pedestrian trips among working trips is higher for all inner city districts than for the out-of city districts. This situation supports Owens's (1991; p 24) argument about the physical integration of different land uses in order to increase the use of environmentally friendly modes like walking and cycling.

Dependence on motorised modes, on the other hand, is evident among all out-of city residents. Dispersal results in a wider use of motorised modes. The modal choice of motorised trips depends on income level.

Use of a private mode has the highest share in OUT-H where high income people live in the out-of city area. IN-H's residents, who have a socio-economic structure similar to OUT-H's residents do not use the car as widely as OUT-H's residents. This shows an accelerating effect of living in the out-of city area on the use of private modes.

- Both overall and average travel distances have higher values among the out-of city residents than among the inner city residents. This is a result of living in an out-of city area and using inner city facilities for daily activities. Sharpe's (1980) findings for Melbourne (where residents of outer areas make more trips to inner areas than the inner residents make the outer areas of the city) also supports this situation.

Long distance trips are common even among students at higher income levels. As in the case of OUT-M and OUT-H, local primary schools are supplied but the nearest secondary and high schools are not at walking distance.

Urban services, such as shopping centres or recreational areas, are at local scale with a low level of specialisation in the out-of city districts. It can be sometimes very difficult to find some necessities in these shops. Some of the local services, like health or sport centres, are not usually supplied or are insufficient and the residents thus have to use their nearest facilities which are not at walking distance, or they have to use the inner city facilities. In spite of accelerating effect of an increasing income level on travel distance, long distance trips are also observed among OUT-L's residents due to the above reasons.

The total travel distance for walking trips is longer in the case of the inner city residents than for the out-of city residents. Conversely, both the overall and average trip lengths by motorised modes have lower values for the inner city residents than for out-of city residents.

Increasing travel distance results in a dependence on motorised modes. Through an increasing income level, modal choice for long distance trips is made in favour of cars whereas among low income people public transport is used.

Among out-of city residents, motorised modes are also used for short distance trips. This results from the multi-purpose trips which are usually within the inner city area. As explained at the beginning of this section, multi-purpose trips have a considerable share among them.

- Most of the trips by the inner city residents, even those longer than 1 km, are either within their district boundaries or to a neighbouring district. There is also some degree of homogeneity of destination areas among the inner city residents. This homogeneity breaks down with an increasing income level. That is, increasing income level results in diversifying destination areas. The out-of city residents, on the other hand, usually travel into the inner city areas while their trips to nearby areas have a very low share in comparison to those of the inner city residents.

- Work trips on foot have a higher share among the inner city residents, whereas out-of city residents travelling to work widely use motorised modes. In addition to work trips, some school trips are also made by motorised modes.

For regular daily trips, modal choice is highly correlated with travel distance. In the case of the inner city residents, they do not have to walk for longer distances to get their destination areas since they are usually located within the inner city. For example in IN-L, most of the work trips are on foot since they live very near to their workplaces. Other inner city residents are not living near to their workplaces, but still within walking distance, so they can walk whenever they want. That is to say all inner city residents have at least a chance to walk to their workplaces.

In the case of the out-of city residents, there is a wide use of motorised modes for regular daily trips. For all out-of city residents, including OUT-L's residents, travel distance for work trips is longer than for the inner city residents at similar income levels. Thus they have to use motorised modes. In this case, public and semi-public transport are used, particularly by the

OUT-L's and OUT-M's residents. Cars, on the other hand, have a considerable share among work trips by the residents of OUT-H.

With increasing income level, the car is preferred even for school trips, as in the case of OUT-H's residents whose travel distance for a school trip sometimes extends up to 16 km and is usually longer than 1 km. School trips on foot have higher shares in OUT-M and OUT-L than in IN-M and IN-L. This indicates the more extensive use of local schooling facilities in these districts than in the inner city. Actually, when local services are well-supplied, walking (which is less energy intensive than all motorised modes) is widely preferred.

- For the inner city residents walking is also possible for irregular daily trips. They also use public transport. Here cars are not preferred as much as they are by out-of city people.

In case of the out-of city residents, the car is extensively used for irregular daily trips. Among all purposes, shopping trips by private modes are most common among OUT-H's residents. Shopping trips on foot have a considerable share among OUT-L's residents who have a propensity to use local facilities for daily shopping. OUT-L's and OUT-M's residents also use public transport for shopping.

Out-of city residents use the inner city area not only for work or school trips but also for social reasons. This is most common among OUT-H's residents. Others, on the other hand, rarely use the inner city areas for social reasons.

- In terms of peak hours, the only considerable finding is the earlier morning peak hour among OUT-L's and OUT-M's residents. This is due to the location of residence and using inner city workplaces and schools, as well as other facilities like health services. In many cases, the residents have to use public transport services. It is sometimes very difficult to get on buses without the waiting due to delays. Not only the travel time but also waiting time extends. Considering all these, the morning peak hour has to be considerably earlier than in IN-L and IN-M. In the case of OUT-H residents, their trips do not have to begin earlier since they usually use their cars.

- Among all inner city residents travel duration has the lowest value for IN-L's residents, since most of their trips are short distance. Among all out-of city residents, on the other hand, OUT-H's residents have the lowest travel duration. This time this is due not travel distance but to modal choice, which is car. Thus, living in an out-of city area might have very little impact on travel time if people have a better income level and a car.

All trips by inner city residents take less than 20 minutes whereas trips taking more than 30 minutes have a high share among the out-of city residents. Travel duration for the out-of city residents sometimes exceeds an hour. It increases with decreasing income level if public transport modes are being used. This is true in cases of low level of public transport services and lack or insufficiency of local facilities. Conversely, extensive use of a car as in the case of OUT-H, results in decreasing travel time.

Most of the trips by public transport modes take less than 30 minutes for the inner city residents while this duration extends up to an hour for the out-of city residents. A similar situation is observed for semi-public transport modes.

Travel duration by walking extends to an hour only among OUT-L's residents since they are living within walking distance of an out-of city sub-centre. With increasing income level, it decreases due to decreasing travel distance. It is also necessary to mention the possible effects of spatial factors. In the case of OUT-L, the area is still under-construction and walk ways within easy access nevertheless these resident may walk for 40 minutes due to monetary limitations. In OUT-M, the area is well-designed for walking. There are pedestrian crossings providing easy access to schools as well as to local shops. In the case of OUT-H, all commonly purchased facilities are located at centrally, so they are within easy reach of all residents.

For the work trips, travel time is usually less than 20 minutes for the inner city residents but, might exceed an hour for the out-of city residents.

Travel time for school trips usually ranges between 10 to 30 minutes for all residents. For the out-of city residents, travel time for a school trip might exceed an hour, like in OUT-M and OUT-L. The reason for this may be an insufficiency or lack of local schooling facilities.

Social trips by the inner city residents usually take less than 30 minutes. This might extend up to an hour in the case of the out-of city residents. Similarly, travel time for shopping trips might increase due to location of residence and spatial structure as explained above.

IX.2.3. Conclusions

The spatial linkage between different types of activities in the urban area, or the physical separation of activities with different functions, shapes travel demand.

The research results indicate that "the location within urban region where the next small increment of population and employment growth should be located (Clark, 1976; p 63)" affects travel demand patterns.

In the case of Ankara and its post-1985 out-of city residential developments, people are forced into long distance trips, being more dependent on motorised modes and walking is not usually preferred.

An isolation of residential areas from the existing city, as in the case of Ankara, results in more energy intensive daily travel patterns. The next section will summarise the research findings in terms of transport energy consumption.

IX.3. Changes in Transport Energy Use due to the Location of a Residence

The energy use of transport is dependent on two main variables: travel distance and modal choice. Although there are socio-economic or spatial factors affecting it, these two shape energy use directly. For example extensive use of cars directly results in an increasing energy use of transport. Inversely, increasing the number of walking trips results in a lower energy use. If we consider that the energy source of walking (food) is both renewable and non-polluting, then the energy use of transport for walking trips is zero in terms of non-renewable resources.

It is evident from the survey results that transport energy use changes due to the location of a residence relative to the CBD. For example, living in an out-of city area means travelling for longer distances and a wider use of motorised modes.

Living near to the central facilities encourages walking trips. Trips by motorised modes also have a considerable share, but the travel distance is not as long as in the out-of city case.

Additionally, dependence on cars has been accelerating through the increasing distance of residence from the central inner city facilities.

Increasing dependency on a motorised mode is a result of insufficient local facilities. Actually, maintaining a certain degree of concentration of different urban services within district boundaries might result in short distance trips which can be made on foot. Similarly, the existence of local shopping centres or open markets, as in the case of OUT-L, encourages short distance shopping trips on foot. All these changes in travel mode and distance in turn mean changing energy used by transport. Sustaining certain local facilities might result in decreasing travel distance and a higher number of pedestrian trips as well as a lower consumption of transport energy.

Insufficiency of certain services, particularly those for education, force people to travel for longer distance. Even for primary school, they might prefer facilities located in districts that are sometimes far from the residence. These trips have to be motorised, which means higher energy use of transport.

Long distance trips result in a wider use of motorised modes. Those who can not afford the cost of private transport use public transport for long distance trips. A higher dependence on the car might be due not only to car ownership but also to low level of public transport service.

Following the assumption that the previous residence of out-of city residents was the inner city, the comparison of previous and actual travel demand patterns indicates that inner-city residents used to have less energy intensive travel demand patterns. The analysis carried out in chapter VIII shows that living in an out-of city area results in an increasing energy use due to an extensive use of motorised modes and longer travel distances. Possible energy saving due to the location of a residence is calculated as 55 per cent with lowering average travel distance. This saving might reach to 71 per cent due to modal split changes. Newman and Kenworthy (1989b; p 28)) suggested that "there is a potential fuel saving of some 20 to 30 per cent in cities like Houston and Phoenix, if they were become something more like Boston or Washington urban structure".

The research findings for six selected districts of Ankara are consistent with the Banister's findings for South Oxfordshire (see Banister, 1993). First of all, most energy efficient pattern is a place where there is "a good provision of local facilities, services and public transport, with shorter trip lengths and higher proportion of walk trips... The least energy efficient form is a remote settlement with limited facilities and services, and with poor public transport... (and) where travel by car is essential to reach work and facilities, and these journeys are long because of its remoteness." (Banister, 1993; p 170). In case of Ankara IN-L and OUT-H are at these two extremes respectively.

The main reason behind the urban decentralisation policy was to reduce the air pollution level in Ankara. Research findings, however, confirms that increasing travel demand together with transport energy consumption are negative outcomes of this policy. Although the proposed developments have not been fully realised yet, their residents are contributing the environmental problems through wider use of motorised modes and long distance trips. Their negative impacts are not only due to higher transport energy consumption but also through air pollution created by huge volume of traffic coming into the inner city. It is out of question whether the planning objectives have been reached or not through the urban decentralisation measures or what should be the additional measures or policies to contribute sustainable urban development process.

As Rickaby et al. (1993) show in their experimental study on modal shift and travel distance changes, the location of new development may have only slight implications for the energy use of passenger transport. What ever the impacts of these developments, it is evident that "in the absence of other policy measures, to discourage car use such as higher taxation of private vehicles or fuel, or central area traffic restriction, ... the planned development in itself is unlikely to encourage modal shift and travel distance reduction." (Rickaby et al., 1993; p 195).

In addition to this, Breheny and Rookwood (1993) argues that urban development policies have long term perspective and thus they are unrealistic for energy saving. The research findings, on the other, shows that the post-1985 residential developments increase the energy consumption of transport.

IX.4. Possible Measures for Reducing Transport Energy Use

As reviewed in chapter IV, decentralisation of urban land uses has been supported since the late 1970's in Ankara. One reason behind this policy was to reduce the air pollution resulting from the topography. Decentralisation of population and employment were supposed to lower the pressure on the existing city and to contribute to the quality of life.

In many aspects, these out-of city residential developments contribute to the quality of life (see chapter VI). For example, they provide an alternative for squatter settlements. In the case of the low income residential area, the infrastructure and some urban services, such as playgrounds, local library and primary schools are well-supplied. Nevertheless, it has some drawbacks in terms of travel demand since its residents have to travel for longer distances and they are more dependent on motorised modes than their inner city counterparts. Similarly, for all other out-of city residents the living environment is better than that of the inner city but they usually have to cope with the daily traffic congestion problem to get to the inner city. In the case of high income people, this problem might be reduced by changing their peak hour, since they are usually car-owners. For others, they have to use public buses which are at a low level of service.

Since out-of city residents did not consider their main destination areas, there is a weak association between their residence, workplaces and school as well as other facilities such as shopping or entertainment centres.

This may be one of the drawbacks of the decentralisation policy. Although it comprised not only the decentralisation of residence but also the decentralisation of workplace, these two main urban developments were not simultaneously effected. Additionally, residential developments have not been followed by urban transport improvements. The metro project is still under construction and the line connecting the out-of city developments to the inner city has not yet been tendered.

It is evident that the out-of city residences are energy intensive from a transport point of view but they offer a pleasant living environment. Therefore these settlements can be well-supported by an improved public transport network, namely by rail. The realisation of the second phase of the metro line which will link the out-of city developments to the inner city will also help to reduce the energy use of transport through intermodal shifts from cars to the metro.

Additionally some land use arrangements can be considered like the establishment of more specialised shopping centres, entertainment and recreational facilities, so that residents become less dependent on the inner city. For workplaces and schools there is little to do. When the decentralisation of workplaces is actualised as Bademli (1987) suggested, travel distance for a work trip might decrease. All these factors also provide better opportunities for walking as well as cycling.

In addition to these measures for the existing out-of city residential developments, further developments should also be planned in the light of possible energy saving measures.

There is a need for an increasing awareness of the energy utilisation impacts of further developments on travel demand changes. In the case of Ankara, it is obvious that the increasing pressure on the existing city should be reduced and decentralisation is a necessary tool. However, the possibilities within the hinterland of the existing city can be re-examined since they might save fuel in transport while improving accessibility (Rickaby, 1987).

As Elkin et al (1991) suggested, urban development should avoid over-centralisation while providing integrated land-use which will reduce the travel demand. Providing a safe and attractive environment for walking and cycling is one of the crucial issues in planning. Public transport facilities should also be well-supplied with low fares and a high quality of service.

"Urban areas with a relatively high degree of self-containment are potentially energy efficient. But this will only be the case if people are content to use local facilities which will reduce travel requirements (Owens, 1991; p 13)". Thus, it is also necessary to encourage the people to consider the travel implications of their residential choice and if possible to enable them to live in locations with low travel requirements.

Two of the important policies for urban development might be

" * restricting or at least slowing urban development at the urban fringe and concentrating on redevelopment,

* to expand the inner city area type of development slowly (mixed and more intense) to the outer area and building up densities

around rapid transit routes (Newman and Kenworthy, 1991; pp 267-268)".

In spite of all possible constraints on the achievement of energy efficiency such as the multiplicity of planning objectives, the limited effectiveness of planning policies in achieving the desired land-use patterns, and the failure of individuals to behave in an energy efficient manner even when the built environment gives them the opportunity to do so, planning policies should consider energy consumption of transport in all urban land use and transport policies. As Breheny (1995) argues urban development policies might be effective in long range and they might have partial effects on energy savings from passenger transport.

IX.5. The Role of Planning and Planner

Controlling the spatial linkage between different types of activities in urban areas or physical separation of activities with different functions is helpful in controlling the need for transport as well as the amount of energy consumed in transport. Ideal structures are probably difficult to achieve but this does not mean that there is no possibility to identify the least energy intensive development patterns. This should be one of the main concern of planning activity.

Since planning and planners influence spatial structure, it is difficult to accept that they continue to ignore the energy implications of plans and policies.

Planners can contribute to energy conservation through plans and attempts to achieve more rational use of non-renewable resources (Owens, 1984).

"The most appropriate way to develop experience in the integration of energy management considerations into the planning process would be to engage in specific exercises in a few particular local authority areas. Several counties, metropolitan districts or districts could be selected, based on the active co-operation of their planning authorities, as case studies. The objective would be to document the energy budget of these areas, to identify the points at which planning intervention might influence energy requirements, to consider energy implications of alternative plans and policies and, where appropriate, to show how existing policies might be modified to take better account of potential energy constraints. Although such policies would need to be tailored to specific local conditions, the practical experience gained should permit development of a set of guidelines for more general application." (Owens, 1984; p 237).

Less energy intensive urban forms and spatial structures sustaining a minimum amount of travel should be considered as important concerns of the urban planning activity. "Energy efficient urban form" does not mean urban areas where travel demand is zero. It should be in the form where maximum accessibility can be achieved with minimum amount of energy consumption. It is impossible to mark some patterns as energy efficient, but some patterns have considerable advantage when compared with the others, as in the case of Ankara.

This study covers only a small portion of the urban area. Thus, it can only provide some hints for planners. In order to increase knowledge on energy efficient urban forms and travel demand patterns, one further step may be to increase the sample size so that, in the light of more representative data, accurate generalisations can be made. It is also possible to carry out similar studies not only from the residential location point of view but also from that of destination area, for example shopping centres, hospitals, industrial estates, universities and public buildings

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APPENDICES

APPENDIX A. QUESTIONNAIRE

REPUBLIC OF TURKEY
PRIME MINISTRY
STATE PLANNING ORGANISATION
NECATIBEY CAD. NO: 108
06100 TURKEY

URBAN PLANNING
UNIVERSITY OF NOTTINGHAM
UNIVERSITY PARK, NOTTINGHAM
NG7 2RD ENGLAND

The aim of this research is to define the travel demand characteristics of household in various districts of Ankara. It would greatly assist our research, if you could complete the enclosed questionnaire with the help of interviewer. All answers will be treated confidentially and will be used for statistical analysis only.

Your faithfully, Sema Bayazit

QUESTIONNAIRE

(This part is filled once for each household before visiting the household by interviewer)

Survey Form Number : ....

Data of interview : ...(day)/....(month)/1994
Region no: ....

Neighbourhood Name:............

Street Name:.................

Apartment / Flat No :.............

Type of residence :

House ......
Flat ......
Squatter ......
Lodging ......
Other ......

Number of storeys: ....

If the household were not interviewed, the reason for this :

They were not there ....
They did not want to be interviewed ....
Other (mention the reason) (3) ....

PART I

(This part will be completed for each household through the assistance of mature members of households)

1.1. How many people live in this house? .... [ ]

1.2. Number of people over 6 .... [ ]

1.3. How many people work in this household? ...... [ ]

1.4. Number of students in this household .... [ ]

1.5. Do you have vehicle? [ ]
Yes (1) ...... No (2) ....(go to 1.7)

1.6. What is the type and number of vehicle(s)? (go to 1.9)

	Type	Number
Private car	[ ]	[ ]
Taxi	[ ]	[ ]
Minibus	[ ]	[ ]
Lorry	[ ]	[ ]
Other	[ ]	[ ]

1.7. Have you ever had one before? [ ]
Yes (1) ..... No (2) ...... (go to 1.9)

1.8. Give date of most recent car owned ...../...... [month/year]

1.9. Is there any vehicle given for the use of any of your family members?

	Type	Number
Private car	[ ]	[ ]
Official car	[ ]	[ ]
Firm car	[ ]	[ ]
Taxi	[ ]	[ ]
Minibus	[ ]	[ ]
Lorry	[ ]	[ ]
Other	[ ]	[ ]

1.10. How much rent do you pay for this house? [ ]
(1) - 500.000
(2) 501.000 - 1.000.000
(3) 1.000.001 - 3.000.000
(4) 3.000.001 - 5.000.000
(5) 5.000.001 +
(6) I'm living in a lodging
(7) I own this house

1.11. When did you move into this property? [ ]
...../...... [month/year]

1.12. The reason for moving this house :
....

1.13. Location of previous residence :
.... [street name]
................[neighbourhood name]

PART II.

(This part is for each person in the household aged 7 and over)

Personal code .... [ ]

2.1. Relation to the household head (person answered the questions in the first part)

1. Head of household himself......
2. Partner of head of household....
3. Son ......
4. Daughter....
5. Mother....
6. Father....
7. Daughter-in-law....
8. Son-in-law.....
9. Grandchild.....
10. Other......

2.2. What is your age? .... [ ]

2.3. Is the subject? Male...... Female...... [ ]

2.4. Please tell me about your journeys yesterday?

Start of Trip Address	Start of Travel Time	Method of Travel (*)	Reason(s) for Trips	End of Trip Address	End Time

(*) Suburban Train; Municipality Bus Services (EGO); Private Bus; Service Bus; Minibus; Taxi; Private Car; Bicycle; No mode used (pedestrian)

2.5. After settling in this area, your transport

1. Becomes easier ......
2. Becomes difficult ......
3. No difference ......

2.6. Please indicate your educational level

1. Primary
2. Junior High School
3. High School
4. University
5. Illiterate
6. School unattended and incomplete

2.7. Have you been working during the last week?

Yes (1) ...... No (2) .... (go to 2.10.)

2.8. What is your occupation? ....

2.9. Which of the following is your position at work?

1. Employee ....
2. Employer .....
3. Self Employed .....
4. Unpaid family worker .....
5. Other (indicate) ......

2.10. Which of the following is the reason for not working? [ ]

(1) Student .....
(2) Retired......(go to 2.14.)
(3) Unemployed....(go to 2.14.)
(4) Housewife.....(go to 2.14.)
(5) Disable ......(go to 2.14.)
(6) Other (mentioned) .....(go to 2.14.)

(questions between 2.11-2.16. are for working people and students)

2.11. What is the address of your workplace ( ) What is the address of your school ( )

Street name .... Neighbourhood name ....

2.12. Before moving into this house, during your journeys to school/workplace (delete as appropriate) what was the estimated time to go to the school / workplace?

.....hrs..... min

2.13. Before moving into this house, during your journeys to school/workplace (delete as appropriate) which mode(s) were you using in travels to school/workplace?

(1) Private mode....
(2) Taxi.....
(3) Bus.....
(4) Dolmus.....
(5) Company bus....
(6) School bus....
(7) Walking.....
(8) Other(mention).....

2.8. Which of the following mode(s) did you use during last week, and if so, for what purposes?

	Work-School	Recreation and sport	Shopping	Other
Bus	(11)	(12)	(13)	(14)
Car	(21)	(22)	(23)	(24)
Taxi	(31)	(32)	(33)	(34)
Dolmus	(41)	(42)	(43)	(44)
Bicycle	(51)	(52)	(53)	(54)
Walking	(61)	(62)	(63)	(64)

APPENDIX B. ADDITIONAL TABLES FOR CHAPTER SEVEN

Table B.1. Modal Spilit of Travel by Districts According to Car Ownership Levels

TRANSPORT MODE	NUMBER CARS PER HOUSEHOLD																														
	INNER CITY											OUT-OF CITY													TOTAL					
	IN-L			IN-M				IN-H					OUT-L			OUT-M				OUT-H											
	0	1	Total	0	1	2	Total	0	1	2	3	Total	0	1	Total	0	1	2	Total	0	1	2	3	4	Total	0	1	2	3	4	TOTAL
PRIVATE	12	17	29	10	69	25	104	12	86	98	8	204	5	10	15	20	87	4	111	2	127	112	22	30	293	61	396	239	30	30	756
SEMI-PUBLIC	27	14	41	16	26	6	48	6	26	14	4	50	55	14	69	24	39	0	63	0	27	12	3	0	42	128	146	32	7	0	313
PUBLIC	19	17	36	15	13	1	29	12	11	10	0	33	92	22	114	86	48	0	134	2	35	12	4	1	54	226	146	23	4	1	400
WALKING	117	48	165	41	33	15	89	9	28	18	6	61	159	40	199	42	51	0	93	0	29	10	4	1	44	368	229	43	10	1	651
TOTAL	**175**	**96**	271	**82**	**141**	47	270	39	**151**	**140**	**18**	**348**	311	86	397	172	225	4	401	4	218	146	33	32	433	783	917	337	51	32	2120

TRANSPORT MODE	NUMBER CARS PER HOUSEHOLD																														
	INNER CITY											OUT OF CITY													TOTAL					
	IN-L			IN-M				IN-H					OUT-L			OUT-M				OUT-H											
	0	1	Total	0	1	2	Total	0	1	2	3	Total	0	1	Total	0	1	2	Total	0	1	2	3	4	Total	0	1	2	3	4	TOTAL
PRIVATE	41.4	58.6	100.0	9.6	66.3	24.0	100.0	5.9	42.2	48.0	3.9	100.0	33.3	66.7	100.0	18.0	78.4	3.6	100.0	0.7	43.3	38.2	7.5	10.2	100.0	8.1	52.4	31.6	4.0	4.0	100.0
SEMI-PUBLIC	65.9	34.1	100.0	33.3	54.2	12.5	100.0	12.0	52.0	28.0	8.0	100.0	79.7	20.3	100.0	38.1	61.9	0.0	100.0	0.0	64.3	28.6	7.1	0.0	100.0	40.9	46.6	10.2	2.2	0.0	100.0
PUBLIC	52.8	47.2	100.0	51.7	44.8	3.4	100.0	36.4	33.3	30.3	0.0	100.0	80.7	19.3	100.0	64.2	35.8	0.0	100.0	3.7	64.8	22.2	7.4	1.9	100.0	56.5	36.5	5.8	1.0	0.3	100.0
WALKING	70.9	29.1	100.0	46.1	37.1	16.9	100.0	14.8	45.9	29.5	9.8	100.0	79.9	20.1	100.0	45.2	54.8	0.0	100.0	0.0	65.9	22.7	9.1	2.3	100.0	56.5	35.2	6.6	1.5	0.2	100.0
TOTAL	**64.6**	**35.4**	**100.0**	**30.4**	**52.2**	**17.4**	**100.0**	**11.2**	**43.4**	**40.2**	**5.2**	**100.0**	**78.3**	**21.7**	**100.0**	**42.9**	**56.1**	**1.0**	**100.0**	**0.9**	**50.3**	**33.7**	**7.6**	**7.4**	**100.0**	**36.9**	**43.3**	**15.9**	**2.4**	**1.5**	**100.0**

Table B.2. Modal Split of Travel by Districts According to Age Groups

	TRANSPORT MODE	7-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	TOTAL
INNER CITY	**IN-L**														
	PRIVATE	0.0	0.0	3.4	10.3	6.9	31.0	20.7	13.8	6.9	0.0	0.0	0.0	6.9	100.0
	PUBLIC	0.0	22.2	33.3	16.7	5.6	8.3	13.9	0.0	0.0	0.0	0.0	0.0	0.0	100.0
	SEMI-PUBLIC	9.8	24.4	14.6	4.9	9.8	9.8	9.8	12.2	4.9	0.0	0.0	0.0	0.0	100.0
	WALKING	13.3	25.5	5.5	9.1	10.9	15.2	7.3	4.8	6.1	1.2	1.2	0.0	0.0	100.0
	TOTAL	9.6	22.1	10.3	9.6	9.6	15.1	10.0	6.3	5.2	0.7	0.7	0.0	0.7	100.0
	IN-M														
	PRIVATE	0.0	1.9	4.8	2.9	8.7	15.4	9.6	15.4	11.5	4.8	6.7	5.8	12.5	100.0
	PUBLIC	0.0	6.9	13.8	13.8	13.8	6.9	0.0	20.7	3.4	6.9	0.0	3.4	10.3	100.0
	SEMI-PUBLIC	8.3	18.8	20.8	4.2	2.1	12.5	16.7	0.0	6.3	2.1	0.0	0.0	8.3	100.0
	WALKING	2.2	12.4	19.1	5.6	5.6	3.4	9.0	11.2	4.5	6.7	0.0	4.5	15.7	100.0
	TOTAL	2.2	8.9	13.3	5.2	7.0	10.0	9.6	11.9	7.4	5.2	2.6	4.1	12.6	100.0
	IN-H														
	PRIVATE	2.9	0.5	8.8	7.8	8.3	10.8	20.1	7.8	6.4	18.1	2.9	4.4	1.0	100.0
	PUBLIC	0.0	0.0	39.4	6.1	0.0	0.0	0.0	0.0	3.0	6.1	27.3	12.1	6.1	100.0
	SEMI-PUBLIC	20.0	32.0	26.0	6.0	0.0	0.0	0.0	0.0	0.0	8.0	8.0	0.0	0.0	100.0
	WALKING	6.6	4.9	19.7	9.8	3.3	9.8	3.3	3.3	9.8	21.3	4.9	3.3	0.0	100.0
	TOTAL	5.7	5.7	16.1	7.8	5.5	8.0	12.4	5.2	5.7	16.1	6.3	4.3	1.1	100.0
OUT OF CITY	**OUT-L**														
	PRIVATE	6.7	6.7	13.3	0.0	13.3	53.3	6.7	0.0	0.0	0.0	0.0	0.0	0.0	100.0
	PUBLIC	0.0	1.8	19.3	24.6	2.6	19.3	11.4	10.5	7.0	3.5	0.0	0.0	0.0	100.0
	SEMI-PUBLIC	0.0	2.9	10.1	7.2	2.9	27.5	26.1	11.6	8.7	2.9	0.0	0.0	0.0	100.0
	WALKING	17.6	29.6	16.1	5.5	9.0	8.0	5.5	4.5	2.0	1.0	0.0	1.0	0.0	100.0
	TOTAL	9.1	16.1	15.9	11.1	6.3	16.4	10.8	7.3	4.5	2.0	0.0	0.5	0.0	100.0
	OUT-M														
	PRIVATE	0.0	0.9	6.3	10.8	20.7	6.3	25.2	16.2	5.4	1.8	2.7	0.0	3.6	100.0
	PUBLIC	0.0	1.5	23.9	9.0	9.7	9.7	10.4	9.0	4.5	1.5	6.0	13.4	1.5	100.0
	SEMI-PUBLIC	0.0	9.5	9.5	14.3	15.9	23.8	12.7	9.5	4.8	0.0	0.0	0.0	0.0	100.0
	WALKING	10.8	18.3	23.7	11.8	7.5	5.4	9.7	3.2	0.0	2.2	2.2	3.2	2.2	100.0
	TOTAL	2.5	6.5	16.7	11.0	13.2	10.0	14.7	9.7	3.7	1.5	3.2	5.2	2.0	100.0
	OUT-H														
	PRIVATE	0.0	1.4	2.0	10.9	5.8	10.9	8.2	11.6	17.1	16.7	8.5	6.1	0.7	100.0
	PUBLIC	0.0	1.9	18.5	22.2	1.9	5.6	7.4	9.3	7.4	3.7	14.8	3.7	3.7	100.0
	SEMI-PUBLIC	4.8	21.4	42.9	4.8	4.8	2.4	0.0	9.5	4.8	4.8	0.0	0.0	0.0	100.0
	WALKING	13.6	13.6	9.1	11.4	0.0	9.1	2.3	11.4	9.1	9.1	0.0	2.3	9.1	100.0
	TOTAL	1.8	4.6	8.8	11.8	4.6	9.2	6.7	11.1	13.9	13.2	7.6	4.8	1.8	100.0
	TOTAL														
	PRIVATE	0.9	1.2	5.2	8.7	9.3	12.4	14.6	11.6	11.0	12.3	5.4	4.4	3.0	100.0
	PUBLIC	0.0	3.8	23.3	16.0	5.8	10.8	9.0	8.8	5.0	3.0	6.3	6.3	2.3	100.0
	SEMI-PUBLIC	6.4	16.6	19.2	7.3	6.1	14.4	12.1	7.3	5.1	2.9	1.3	0.0	1.3	100.0
	WALKING	12.1	21.2	14.7	8.1	7.7	9.1	6.6	5.7	4.3	4.5	1.1	1.8	3.1	100.0
	TOTAL	5.0	10.1	13.6	9.7	7.6	11.4	10.7	8.6	6.9	6.7	3.6	3.3	2.6	100.0

Table B.3. Modal Split of Travel by Districts According to Being at Work or Not

	TRANSPORT MODE	AT WORK #	AT WORK %	NOT AT WORK #	NOT AT WORK %	TOTAL #	TOTAL %
INNER CITY				IN-L			
	PRIVATE	24	20.0	5	3.3	29	10.7
	PUBLIC	12	10.0	24	15.9	36	13.3
	SEMI-PUBLIC	17	14.2	24	15.9	41	15.1
	WALKING	67	55.8	98	64.9	165	60.9
	TOTAL	120	100.0	151	100.0	271	100.0
				IN-M			
	PRIVATE	67	52.3	37	26.1	104	38.5
	PUBLIC	11	8.6	18	12.7	29	10.7
	SEMI-PUBLIC	18	14.1	30	21.1	48	17.8
	WALKING	32	25.0	57	40.1	89	33.0
	TOTAL	128	100.0	142	100.0	270	100.0
				IN-H			
	PRIVATE	121	76.6	83	43.7	204	58.6
	PUBLIC	12	7.6	21	11.1	33	9.5
	SEMI-PUBLIC	6	3.8	44	23.2	50	14.4
	WALKING	19	12.0	42	22.1	61	17.5
	TOTAL	158	100.0	190	100.0	348	100.0
OUT OF CITY				OUT-L			
	PRIVATE	12	6.5	3	1.4	15	3.8
	PUBLIC	81	43.8	33	15.6	114	28.7
	SEMI-PUBLIC	60	32.4	9	4.2	69	17.4
	WALKING	32	17.3	167	78.8	199	50.1
	TOTAL	185	100.0	212	100.0	397	100.0
				OUT-M			
	PRIVATE	84	37.2	27	15.4	111	27.7
	PUBLIC	70	31.0	64	36.6	134	33.4
	SEMI-PUBLIC	45	19.9	18	10.3	63	15.7
	WALKING	27	11.9	66	37.7	93	23.2
	TOTAL	226	100.0	175	100.0	401	100.0
				OUT-H			
	PRIVATE	195	82.6	98	49.7	293	67.7
	PUBLIC	16	6.8	38	19.3	54	12.5
	SEMI-PUBLIC	10	4.2	32	16.2	42	9.7
	WALKING	15	6.4	29	14.7	44	10.2
	TOTAL	236	100.0	197	100.0	433	100.0
				TOTAL			
	PRIVATE	503	47.8	253	23.7	756	35.7
	PUBLIC	202	19.2	198	18.6	400	18.9
	SEMI-PUBLIC	156	14.8	157	14.7	313	14.8
	WALKING	192	18.2	459	43.0	651	30.7
	TOTAL	**1053**	**100.0**	**1067**	**100.0**	**2120**	**100.0**

Table B.4. Modal Split of Travel by Districts According to Occupation of Population

Mode	Occupation	Student	Retired	Unemployed	Housewife	Disable	Scientific, Tech., Professional	Administ. Managerial	Clerial and Related	Commer. and Sales	Service	Nonagricult. Prod. & Workers	TOTAL
P	IN-L	0.0	0.0	0.0	17.2	0.0	13.8	0.0	0.0	13.8	0.0	55.2	100.0
R	IN-M	7.7	18.3	0.0	9.6	0.0	34.6	9.6	3.8	16.3	0.0	0.0	100.0
I	IN-H	18.6	6.4	0.0	15.7	0.0	35.8	12.3	2.9	4.4	3.9	0.0	100.0
V	OUT-L	13.3	0.0	0.0	6.7	0.0	26.7	0.0	0.0	0.0	6.7	46.7	100.0
A	OUT-M	8.1	0.9	2.7	12.6	0.0	38.7	14.4	6.3	7.2	4.5	4.5	100.0
T	OUT-H	15.4	6.5	1.0	10.6	0.0	52.2	13.0	0.0	1.4	0.0	0.0	100.0
E	TOTAL	13.5	6.9	0.8	12.3	0.0	41.4	11.8	2.2	5.6	1.9	3.7	100.0
P	IN-L	55.6	0.0	5.6	0.0	5.6	0.0	0.0	5.6	5.6	11.1	11.1	100.0
U	IN-M	34.5	10.3	0.0	17.2	0.0	27.6	3.4	6.9	0.0	0.0	0.0	100.0
B	IN-H	45.5	6.1	0.0	12.1	0.0	30.3	0.0	6.1	0.0	0.0	0.0	100.0
L	OUT-L	13.2	0.0	3.5	12.3	0.0	6.1	0.0	7.0	12.3	21.9	23.7	100.0
I	OUT-M	26.9	4.5	0.0	14.9	1.5	35.8	1.5	9.7	0.0	5.2	0.0	100.0
C	OUT-H	42.6	9.3	0.0	18.5	0.0	29.6	0.0	0.0	0.0	0.0	0.0	100.0
	TOTAL	29.8	4.0	1.5	13.3	1.0	22.3	0.8	6.8	4.0	9.0	7.8	100.0
SEMI	IN-L	48.8	0.0	0.0	9.8	0.0	4.9	0.0	4.9	0.0	4.9	26.8	100.0
P	IN-M	52.1	6.3	0.0	4.2	0.0	22.9	6.3	4.2	4.2	0.0	0.0	100.0
U	IN-H	84.0	0.0	0.0	4.0	0.0	8.0	4.0	0.0	0.0	0.0	0.0	100.0
B	OUT-L	13.0	0.0	0.0	0.0	0.0	8.7	0.0	11.6	10.1	40.6	15.9	100.0
L	OUT-M	22.2	0.0	0.0	6.3	0.0	49.2	0.0	11.1	9.5	0.0	1.6	100.0
I	OUT-H	73.8	0.0	0.0	2.4	0.0	23.8	0.0	0.0	0.0	0.0	0.0	100.0
C	TOTAL	45.0	1.0	0.0	4.2	0.0	20.4	1.6	6.1	4.8	9.6	7.3	100.0
W	IN-L	40.0	0.0	3.0	16.4	0.0	2.4	0.0	0.0	1.2	4.8	32.1	100.0
A	IN-M	36.0	14.6	0.0	13.5	0.0	9.0	4.5	9.0	4.5	2.2	6.7	100.0
L	IN-H	37.7	3.3	0.0	27.9	0.0	16.4	11.5	3.3	0.0	0.0	0.0	100.0
K	OUT-L	59.8	2.0	2.0	20.1	0.0	4.0	0.0	3.0	2.5	5.0	1.5	100.0
I	OUT-M	48.4	7.5	2.2	10.8	2.2	20.4	2.2	5.4	0.0	1.1	0.0	100.0
N	OUT-H	47.7	9.1	0.0	9.1	0.0	34.1	0.0	0.0	0.0	0.0	0.0	100.0
G	TOTAL	47.0	4.6	1.7	16.9	0.3	9.8	2.0	3.2	1.7	3.2	9.5	100.0
	IN-L	39.1	0.0	2.6	13.3	0.7	3.7	0.0	1.5	3.0	5.2	31.0	100.0
T	IN-M	27.8	14.1	0.0	10.7	0.0	23.3	6.7	5.9	8.5	0.7	2.2	100.0
O	IN-H	33.9	4.9	0.0	15.8	0.0	27.9	9.8	2.9	2.6	2.3	0.0	100.0
T	OUT-L	36.5	1.0	2.0	13.9	0.0	6.3	0.0	5.5	6.5	16.1	12.1	100.0
A	OUT-M	25.9	3.5	1.2	12.0	1.0	35.2	5.0	8.0	3.5	3.2	1.5	100.0
L	OUT-H	27.7	6.5	0.7	10.6	0.0	44.8	8.8	0.0	0.9	0.0	0.0	100.0
	TOTAL	**31.5**	**4.8**	**1.1**	**12.7**	**0.3**	**25.0**	**5.2**	**4.0**	**4.0**	**4.8**	**6.8**	**100.0**

Table B.5. Modal Split of Trips by Working Population According to Position at Work

		POSITION AT WORK									
		EMPLOYEE		EMPLOYER		SELF-EMPLOYED		UNPAID FAMILY WORKER		TOTAL	
		#	%	#	%	#	%	#	%	#	%
P	IN-L	13	25.0	7	18.4	4	20.0	0	0.0	24	20.0
R	IN-M	46	48.4	12	60.0	4	50.0	5	100.0	67	52.3
I	IN-H	65	66.3	35	100.0	15	78.9	6	100.0	121	76.6
V	OUT-L	8	4.6	4	50.0	0	0.0	0	0.0	12	6.5
A	OUT-M	65	32.0	11	100.0	0	0.0	8	66.7	84	37.2
T	OUT-H	139	79.9	30	96.8	23	85.2	3	75.0	195	82.6
E	TOTAL	336	42.3	99	69.2	46	62.2	22	53.7	503	47.8
P	IN-L	9	17.3	1	2.6	2	10.0	0	0.0	12	10.0
U	IN-M	11	11.6	0	0.0	0	0.0	0	0.0	11	8.6
B	IN-H	12	12.2	0	0.0	0	0.0	0	0.0	12	7.6
L	OUT-L	73	42.2	4	50.0	0	0.0	4	100.0	81	43.8
I	OUT-M	69	34.0	0	0.0	0	0.0	1	8.3	70	31.0
C	OUT-H	11	6.3	0	0.0	4	14.8	1	25.0	16	6.8
	TOTAL	185	23.3	5	3.5	6	8.1	6	14.6	202	19.2
SEMI	IN-L	5	9.6	8	21.1	2	10.0	2	20.0	17	14.2
P	IN-M	18	18.9	0	0.0	0	0.0	0	0.0	18	14.1
U	IN-H	6	6.1	0	0.0	0	0.0	0	0.0	6	3.8
B	OUT-L	60	34.7	0	0.0	0	0.0	0	0.0	60	32.4
L	OUT-M	45	22.2	0	0.0	0	0.0	0	0.0	45	19.3
I	OUT-H	10	5.7	0	0.0	0	0.0	0	0.0	10	4.2
C	TOTAL	144	18.1	8	5.6	2	2.7	2	4.9	156	14.8
W	IN-L	25	48.1	22	57.9	12	60.0	8	80.0	67	55.8
A	IN-M	20	21.1	8	40.0	4	50.0	0	0.0	32	25.0
L	IN-H	15	15.3	0	0.0	4	21.1	0	0.0	19	12.0
K	OUT-L	32	18.5	0	0.0	0	0.0	0	0.0	32	17.3
I	OUT-M	24	11.8	0	0.0	0	0.0	3	25.0	27	11.9
N	OUT-H	14	8.0	1	3.2	0	0.0	0	0.0	15	6.4
G	TOTAL	130	16.4	31	21.7	20	27.0	11	26.8	192	18.2
	IN-L	52	100.0	38	100.0	20	100.0	10	100.0	120	100.0
T	IN-M	95	100.0	20	100.0	8	100.0	5	100.0	128	100.0
O	IN-H	98	100.0	35	100.0	19	100.0	6	100.0	158	100.0
T	OUT-L	173	100.0	8	100.0	0	100.0	4	100.0	185	100.0
A	OUT-M	203	100.0	11	100.0	0	100.0	12	100.0	226	100.0
L	OUT-H	174	100.0	31	100.0	27	100.0	4	100.0	236	100.0
	TOTAL	795	100.0	143	100.0	74	100.0	41	100.0	1053	100.0

Table B.6. Modal Split of Trips by Districts According to Educational Background of Population

	Education	Illiterate	School Unattended-Incomplete	Primary School Graduates	Junior High School Graduates	High School Graduates	University Graduates	TOTAL
P	IN-L	66.7	0.0	7.5	2.4	28.6	57.1	10.7
R	IN-M	0.0	12.5	3.7	23.3	31.0	57.1	38.5
I	IN-H	0.0	25.0	0.0	29.6	55.9	75.3	58.6
V	OUT-L	0.0	2.9	6.8	0.0	1.3	13.8	3.8
A	OUT-M	50.0	0.0	6.8	25.0	20.0	39.9	27.7
T	OUT-H	0.0	14.3	15.8	17.6	67.4	80.3	67.7
E	TOTAL	50.0	6.3	7.1	13.0	37.1	63.6	35.7
	IN-L	0.0	0.0	11.3	36.6	28.6	0.0	13.3
P	IN-M	0.0	0.0	11.1	0.0	19.7	9.5	10.7
U	IN-H	0.0	0.0	0.0	0.0	16.5	7.6	9.5
B	OUT-L	0.0	2.9	19.5	43.4	49.4	24.1	28.7
L	OUT-M	50.0	0.0	45.5	30.9	37.0	31.2	33.4
I	OUT-H	0.0	0.0	5.3	29.4	18.5	9.5	12.5
C	TOTAL	16.7	1.0	17.6	29.8	27.3	14.3	18.9
SEMI	IN-L	0.0	21.4	12.0	19.5	14.3	14.3	15.1
P	IN-M	0.0	50.0	37.0	10.0	16.9	11.9	17.8
U	IN-H	0.0	50.0	100.0	33.3	8.7	3.8	14.4
B	OUT-L	0.0	8.6	11.9	17.2	32.9	20.7	17.4
L	OUT-M	0.0	0.0	4.5	19.1	20.0	16.2	15.7
I	OUT-H	0.0	14.3	68.4	41.2	2.2	4.0	9.7
C	TOTAL	0.0	20.8	19.0	21.4	15.1	8.8	14.8
W	IN-L	33.3	78.6	69.2	41.5	28.6	28.6	60.9
A	IN-M	0.0	37.5	48.1	66.7	32.4	21.4	33.0
L	IN-H	0.0	25.0	0.0	37.0	18.9	13.3	17.5
K	OUT-L	100.0	85.7	61.9	39.4	16.5	41.4	50.1
I	OUT-M	0.0	100.0	43.2	25.0	23.0	12.7	23.2
N	OUT-H	0.0	71.4	10.5	11.8	12.0	6.2	10.2
G	TOTAL	33.3	71.9	56.4	35.8	20.4	13.3	30.7
	IN-L	100.0	100.0	100.0	100.0	100.0	100.0	100.0
T	IN-M	100.0	100.0	100.0	100.0	100.0	100.0	100.0
O	IN-H	100.0	100.0	100.0	100.0	100.0	100.0	100.0
T	OUT-L	100.0	100.0	100.0	100.0	100.0	100.0	100.0
A	OUT-M	100.0	100.0	100.0	100.0	100.0	100.0	100.0
L	OUT-H	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	TOTAL	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table B.7. Travel Distances by Districts According to Destination Zones

	TRAVEL DISTANCE RANGES[1]																																									
	IN-L						IN-M						IN-H						OUT-L						OUT-M						OUT-H						TOTAL					
Region	1	2	3	4	5	Total	1	2	3	4	5	Total	1	2	3	4	5	Total	1	2	3	4	5	Total	1	2	3	4	5	Total	1	2	3	4	5	Total	1	2	3	4	5	Total
I	0	0	8	2	0	10	1	0	6	1	0	8	0	0	1	1	0	2	0	1	1	1	5	8	2	7	4	2	29	44	0	2	2	0	3	7	3	10	22	7	37	79
II	0	7	16	2	0	25	7	40	14	5	0	66	6	26	46	8	0	86	2	13	9	3	29	56	11	30	10	3	36	90	11	14	23	4	57	109	37	130	118	25	122	432
III	120	54	28	7	0	209	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	2	3	120	54	28	11	2	215
IV	4	7	2	0	0	13	0	0	3	0	0	3	0	1	4	1	0	6	0	2	2	1	0	5	0	2	0	0	3	5	0	0	1	0	2	3	4	12	12	2	5	35
V	0	6	1	0	0	7	39	61	46	11	1	158	45	64	71	18	6	204	0	1	6	1	1	9	0	5	3	0	14	22	2	5	15	4	28	54	86	142	142	34	50	454
VI	0	0	0	0	0	0	0	1	14	5	0	20	2	5	7	13	1	28	0	0	3	11	12	26	0	1	6	8	10	25	2	4	11	29	9	55	4	11	41	66	32	154
VII	0	0	3	1	1	5	0	0	0	1	0	1	0	0	1	4	0	5	0	0	1	1	3	5	0	3	1	8	1	13	0	0	0	2	2	4	0	3	6	17	7	33
VIII	0	0	0	2	0	2	0	2	0	2	0	4	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	1	2	5	0	0	1	0	0	1	0	2	4	5	2	13
X	0	0	0	0	0	0	0	0	0	4	0	4	0	0	1	3	1	5	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	3	3	0	0	2	7	4	13
XI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
XII	0	0	0	0	0	0	0	0	0	3	1	4	0	0	0	6	0	6	0	0	0	1	1	2	0	0	0	1	1	2	24	6	10	47	102	189	24	6	10	58	105	203
XV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	11	0	2	15	0	0	0	0	0	0	0	0	0	0	0	0	1	1	11	0	2	15
XVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	179	17	15	8	49	268	54	15	5	18	95	187	0	0	0	1	0	1	233	32	20	27	144	456
XVIII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	1
XIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	5	0	5	0	0	0	0	2	2	0	0	0	5	3	8
XXI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	1	1	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	5	5
XXII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	2
TOTAL	**124**	**74**	**58**	**14**	**1**	**271**	**47**	**104**	**83**	**34**	**2**	**270**	**53**	**96**	**131**	**54**	**14**	**348**	**182**	**35**	**49**	**28**	**103**	**397**	**67**	**63**	**32**	**46**	**193**	**401**	**39**	**31**	**63**	**88**	**212**	**433**	**512**	**403**	**416**	**264**	**525**	**2120**

(1) 1: -1 km
2: 1-2 km
3: 3-6 km
4: 7-15 km
5: 16+ km

Table B.8. Travel Distances by Districts According to Car Ownership Levels

NUMBER OF CARS PER HOUSEHOLD		TRAVEL DISTANCE RANGES (KM)											
		-1		1-2		3-6		7-15		16+		TOTAL	
		#	%	#	%	#	%	#	%	#	%	#	%
NON	IN-L	90	72.6	42	56.8	32	55.2	10	71.4	1	100.0	175	64.6
	IN-M	21	44.7	36	34.6	24	28.9	1	2.9			82	30.4
	IN-H	6	11.3	7	7.3	21	16.0	5	9.3			39	11.2
	OUT-L	148	81.3	26	74.3	32	65.3	24	85.7	81	78.6	311	78.3
	OUT-M	24	35.8	30	47.6	13	40.6	20	43.5	85	44.0	172	42.9
	OUT-H					2				2		4	
	TOTAL	289	56.4	141	35.0	124	29.8	60	22.7	169	32.2	783	36.9
1	IN-L	34	27.4	32	43.2	26	44.8	4	28.6			96	35.4
	IN-M	21	44.7	48	46.2	53	63.9	19	55.9			141	52.2
	IN-H	19	35.8	44	45.8	49	37.4	31	57.4	8	57.1	151	43.4
	OUT-L	34	18.7	9	25.7	17	34.7	4	14.3	22	21.4	86	21.7
	OUT-M	41	61.2	33	52.4	19	59.4	26	56.5	106	54.9	225	56.1
	OUT-H	30	76.9	15	48.4	30	47.6	33	37.5	110	51.9	218	50.3
	TOTAL	179	35.0	181	44.9	194	46.6	117	44.3	246	46.9	917	43.3
2	IN-L												
	IN-M	5	10.6	20	19.2	6	7.2	14	41.2	2	100.0	47	17.4
	IN-H	22	41.5	43	44.8	55	42.0	14	25.9	6	42.9	140	40.2
	OUT-L												
	OUT-M	2	3.0							2	1.0	4	1.0
	OUT-H	8	20.5	10	32.3	20	31.7	37	42.0	71	33.5	146	33.7
	TOTAL	37	7.2	73	18.1	81	19.5	65	24.6	81	15.4	337	15.9
3	IN-L												
	IN-M												
	IN-H	6	11.3	2	2.1	6	4.6	4	7.4			18	5.2
	OUT-L												
	OUT-M												
	OUT-H			5	16.1	4	6.3	7	8.0	17	8.0	33	7.6
	TOTAL	6	1.2	7	1.7	10	2.4	11	4.2	17	3.2	51	2.4
4	IN-L												
	IN-M												
	IN-H												
	OUT-L												
	OUT-M												
	OUT-H	1	2.6	1	3.2	7	11.1	11	12.5	12	5.7	32	7.4
	TOTAL	1	0.2	1	0.2	7	1.7	11	4.2	12	2.3	32	1.5
TOTAL	IN-L	124	100.0	74	100.0	58	100.0	14	100.0	1	100.0	271	100.0
	IN-M	47	100.0	104	100.0	83	100.0	34	100.0	2	100.0	270	100.0
	IN-H	53	100.0	96	100.0	131	100.0	54	100.0	14	100.0	348	100.0
	OUT-L	182	100.0	35	100.0	49	100.0	28	100.0	103	100.0	397	100.0
	OUT-M	67	100.0	63	100.0	32	100.0	46	100.0	193	100.0	401	100.0
	OUT-H	39	100.0	31	100.0	63	100.0	88	100.0	212	100.0	433	100.0
	TOTAL	512	100.0	403	100.0	416	100.0	264	100.0	525	100.0	2120	100.0

Table B.9. Travel Distances by Districts According to Age Groups

	TRAVEL DISTANCE RANGES (KM)	AGE GROUPS													
		7-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	TOTAL
IN-L	-1	17.7	21.0	4.8	8.9	9.7	15.3	4.8	6.5	8.1	1.6	1.6	0.0	0.0	100.0
	1-2	5.4	32.4	9.5	9.5	10.8	14.9	12.2	2.7	2.7	0.0	0.0	0.0	0.0	100.0
	3-6	0.0	13.8	22.4	13.8	6.9	15.5	19.0	5.2	3.4	0.0	0.0	0.0	0.0	100.0
	7-15	0.0	14.3	14.3	0.0	14.3	14.3	0.0	28.6	0.0	0.0	14.3	0.0	0.0	100.0
	16+	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
	TOTAL	9.6	22.1	10.3	9.6	9.6	15.1	10.0	6.3	5.2	0.7	1.5	0.0	0.0	100.0
IN-M	-1	4.3	19.1	6.4	6.4	8.5	2.1	8.5	8.5	4.3	6.4	0.0	4.3	21.3	100.0
	1-2	0.0	8.7	20.2	5.8	9.6	3.8	7.7	17.3	5.8	6.7	3.8	3.8	6.7	100.0
	3-6	2.4	4.8	9.6	3.6	4.8	12.0	14.5	7.2	12.0	2.4	2.4	4.8	19.3	100.0
	7-15	5.9	5.9	11.8	5.9	2.9	35.3	5.9	11.8	0.0	5.9	2.9	2.9	2.9	100.0
	16+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0
	TOTAL	2.2	8.9	13.3	5.2	7.0	10.0	9.6	11.9	7.4	5.2	2.6	4.1	12.6	100.0
IN-H	-1	15.1	3.8	17.0	1.9	3.8	15.1	5.7	3.8	7.5	22.6	3.8	0.0	0.0	100.0
	1-2	6.3	4.2	15.6	12.5	6.3	4.2	16.7	4.2	8.3	15.6	2.1	4.2	0.0	100.0
	3-6	3.1	6.1	9.9	6.1	5.3	9.2	13.0	9.2	4.6	14.5	10.7	5.3	3.1	100.0
	7-15	0.0	3.7	35.2	7.4	3.7	3.7	13.0	0.0	3.7	14.8	7.4	7.4	0.0	100.0
	16+	14.3	28.6	0.0	14.3	14.3	14.3	0.0	0.0	0.0	14.3	0.0	0.0	0.0	100.0
	TOTAL	5.7	5.7	16.1	7.8	5.5	8.0	12.4	5.2	5.7	16.1	6.3	4.3	1.1	100.0
OUT-L	-1	19.8	31.9	9.9	5.5	8.8	9.3	6.6	3.8	2.2	1.1	0.0	1.1	0.0	100.0
	1-2	0.0	5.7	60.0	11.4	5.7	5.7	0.0	5.7	0.0	5.7	0.0	0.0	0.0	100.0
	3-6	0.0	8.2	20.4	24.5	0.0	28.6	10.2	4.1	4.1	0.0	0.0	0.0	0.0	100.0
	7-15	0.0	0.0	0.0	7.1	14.3	28.6	21.4	28.6	0.0	0.0	0.0	0.0	0.0	100.0
	16+	0.0	0.0	13.6	15.5	2.9	23.3	19.4	9.7	11.7	3.9	0.0	0.0	0.0	100.0
	TOTAL	9.1	16.1	15.9	11.1	6.3	16.4	10.8	7.3	4.5	2.0	0.0	0.5	0.0	100.0
OUT-M	-1	14.9	23.9	14.9	7.5	11.9	4.5	6.0	3.0	0.0	3.0	3.0	4.5	3.0	100.0
	1-2	0.0	1.6	28.6	12.7	9.5	11.1	17.5	9.5	3.2	0.0	3.2	0.0	3.2	100.0
	3-6	0.0	3.1	3.1	9.4	6.3	12.5	28.1	6.3	3.1	6.3	3.1	18.8	0.0	100.0
	7-15	0.0	6.5	15.2	17.4	15.2	8.7	10.9	17.4	4.3	4.3	0.0	0.0	0.0	100.0
	16+	0.0	2.6	16.1	10.4	15.5	11.4	15.5	10.9	5.2	0.0	4.1	6.2	2.1	100.0
	TOTAL	2.5	6.5	16.7	11.0	13.2	10.0	14.7	9.7	3.7	1.5	3.2	5.2	2.0	100.0
OUT-H	-1	15.4	15.4	5.1	10.3	0.0	10.3	7.7	12.8	10.3	5.1	0.0	2.6	5.1	100.0
	1-2	0.0	0.0	3.2	16.1	0.0	6.5	6.5	12.9	6.5	22.6	12.9	6.5	6.5	100.0
	3-6	0.0	0.0	7.9	17.5	4.8	15.9	6.3	6.3	14.3	14.3	7.9	4.8	0.0	100.0
	7-15	0.0	4.5	14.8	17.0	4.5	11.4	5.7	8.0	11.4	11.4	5.7	5.7	0.0	100.0
	16+	0.9	4.7	8.0	7.5	6.1	6.6	7.1	13.2	16.5	13.7	9.0	4.7	1.9	100.0
	TOTAL	1.8	4.6	8.8	11.8	4.6	9.2	6.7	11.1	13.9	13.2	7.6	4.8	1.8	100.0
TOTAL	-1	16.4	22.9	9.4	6.6	8.2	10.2	6.3	5.5	4.7	4.5	1.2	1.6	2.7	100.0
	1-2	2.5	9.9	20.6	10.4	7.9	7.4	11.4	8.9	5.0	7.7	3.0	2.5	2.7	100.0
	3-6	1.4	6.0	12.0	10.8	4.8	14.2	13.9	7.0	7.2	7.7	5.3	4.8	4.8	100.0
	7-15	0.8	4.9	17.0	11.7	7.6	14.4	9.5	11.7	5.3	8.3	4.5	3.8	0.4	100.0
	16+	0.8	3.6	11.8	10.3	9.1	11.8	12.6	11.2	11.2	6.7	5.1	4.2	1.5	100.0
	TOTAL	**5.0**	**10.1**	**13.6**	**9.7**	**7.6**	**11.4**	**10.7**	**8.6**	**6.9**	**6.7**	**3.7**	**3.3**	**2.5**	**100.0**

Table B.10. Travel Distances by Districts According to Gender

		TRAVEL DISTANCE RANGES (KM)										TOTAL	
		-1		1-2		3-6		7-15		16+			
		#	%	#	%	#	%	#	%	#	%	#	%
F	IN-L	51	54.3	20	21.3	17	18.1	6	6.4		0.0	94	100.0
E	IN-M	20	17.4	48	41.7	35	30.4	12	10.4		0.0	115	100.0
M	IN-H	28	15.5	59	32.6	62	34.3	28	15.5	4	2.2	181	100.0
A	OUT-L	91	60.7	18	12.0	16	10.7	2	1.3	23	15.3	150	100.0
L	OUT-M	40	19.5	30	14.6	16	7.8	22	10.7	97	47.3	205	100.0
E	OUT-H	23	10.7	17	7.9	30	14.0	43	20.1	101	47.2	214	100.0
	TOTAL	253	26.4	192	20.0	176	18.4	113	11.8	225	23.5	959	100.0
M	IN-L	73	41.2	54	30.5	41	23.2	8	4.5	1	0.6	177	100.0
A	IN-M	27	17.4	56	36.1	48	31.0	22	14.2	2	1.3	155	100.0
L	IN-H	25	15.0	37	22.2	69	41.3	26	15.6	10	6.0	167	100.0
E	OUT-L	91	36.8	17	6.9	33	13.4	26	10.5	80	32.4	247	100.0
	OUT-M	27	13.8	33	16.8	16	8.2	24	12.2	96	49.0	196	100.0
	OUT-H	16	7.3	14	6.4	33	15.1	45	20.5	111	50.7	219	100.0
	TOTAL	259	22.3	211	18.2	240	20.7	151	13.0	300	25.8	1161	100.0
T	IN-L	124	45.8	74	27.3	58	21.4	14	5.2	1	0.4	271	100.0
O	IN-M	47	17.4	104	38.5	83	30.7	34	12.6	2	0.7	270	100.0
T	IN-H	53	15.2	96	27.6	131	37.6	54	15.5	14	4.0	348	100.0
A	OUT-L	182	45.8	35	8.8	49	12.3	28	7.1	103	25.9	397	100.0
L	OUT-M	67	16.7	63	15.7	32	8.0	46	11.5	193	48.1	401	100.0
	OUT-H	39	9.0	31	7.2	63	14.5	88	20.3	212	49.0	433	100.0
	TOTAL	**512**	**24.2**	**403**	**19.0**	**416**	**19.6**	**264**	**12.5**	**525**	**24.8**	**2120**	**100.0**

Table B.11. Travel Distances by Districts According to to Occupation of Population

		Student	Retired	Housewife	Unemployed	Other	Professional and Related Workers	Administrative Managerial Workers	Clerical and Related Workers	Commercial and Sales Workers	Service Workers	Nonagricultural Production & Related Workers Transport Equipment Operators	TOTAL
	-1	45.3	71.4	75.0			40.0			25.0	42.9	38.1	45.8
	1-2	31.1		8.3			10.0			12.5	14.3	40.5	27.3
IN-L	3-6	19.8	28.6	11.1	100.0		10.0		50.0	62.5	42.9	17.9	21.4
	7-15	3.8		5.6			40.0		50.0			2.4	5.2
	16+											1.2	0.4
	TOTAL	100.0	100.0	100.0	100.0		100.0		100.0	100.0	100.0	100.0	100.0
	-1	18.7	28.9		9.5		4.8	11.1	25.0	8.7		66.7	17.3
	1-2	45.3	10.5		18.9		41.3	44.4	37.5	34.8	100.0	33.3	38.4
IN-M	3-6	22.7	52.6		5.4		44.4	33.3	12.5	26.1			30.6
	7-15	13.3	7.9		5.4		6.3	11.1	25.0	30.4			12.5
	16+				0.0		3.2		0.0				0.7
	TOTAL	100.0	100.0		39.2		100.0	100.0	100.0	100.0	100.0	100.0	100.0
	-1	16.9			25.5		10.3	23.5	10.0				15.2
	1-2	27.1	33.3	100.0	25.5		18.6	35.3	70.0	22.2	50.0		27.6
IN-H	3-6	28.0	66.7		40.0		47.4	35.3	20.0	66.7			37.6
	7-15	21.2			9.1		17.5	5.9		11.1	50.0		15.5
	16+	6.8					6.2						4.0
	TOTAL	100.0	100.0	100.0	100.0		100.0	100.0	100.0	100.0	100.0		100.0
	-1	74.5	100.0	50.0	70.9		32.0		18.2	15.4	12.5	6.3	45.8
	1-2	11.7			3.6				9.1	15.4	9.4	8.3	8.8
OUT-L	3-6	8.3			14.5		24.0		18.2	23.1	6.3	18.8	12.3
	7-15			25.0			16.0			7.7	15.6	20.8	7.1
	16+	5.5		25.0	10.9		28.0		54.5	38.5	56.3	45.8	25.9
	TOTAL	100.0	100.0	100.0	100.0		100.0	0.0	100.0	100.0	100.0	100.0	100.0
	-1	32.7	35.7		29.2	50.0	7.1		6.3				16.7
	1-2	16.3	14.3	40.0	4.2		17.7	20.0	25.0	14.3	7.7		15.7
OUT-M	3-6	1.9	7.1		14.6		8.5	10.0	12.5		30.8		8.0
	7-15	12.5			4.2		14.2	10.0	3.1	42.9	15.4		11.5
	16+	36.5	42.9	60.0	47.9	50.0	52.5	60.0	53.1	42.9	46.2	100.0	48.1
	TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	-1	15.0	7.1		8.7		7.7						9.0
	1-2	5.0	32.1		2.2		5.7	10.5					7.2
OUT-H	3-6	13.3	7.1	33.3	17.4		14.9	18.4					14.5
	7-15	28.3	3.6		26.1		18.6	13.2					20.3
	16+	38.3	50.0	66.7	45.7		53.1	57.9		100.0			49.0
	TOTAL	100.0	100.0	100.0	100.0		100.0	100.0		100.0			100.0
	-1	36.2	25.5	57.4	33.2	50.0	9.4	9.1	13.1	9.5	13.9	27.1	24.2
	1-2	20.8	18.9	13.0	14.0		15.3	25.5	27.4	20.2	14.9	27.8	19.0
TOTAL	3-6	15.1	33.0	9.3	21.7		23.0	24.5	16.7	27.4	13.9	16.7	19.6
	7-15	12.9	3.8	7.4	9.8		16.0	10.0	8.3	19.0	15.8	8.3	12.5
	16+	15.0	18.9	13.0	21.3	50.0	36.2	30.9	34.5	23.8	41.6	20.1	24.8
	TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table B.12. Travel Distances of Working Population According to Position at Work (%)

POSITION AT WORK		TRAVEL DISTANCE RANGES (KM) -1	1-2	3-6	7-15	16+	TOTAL
EMPLOYEE	IN-L	16	28.8	23.1	15.4	1.9	100.0
	IN-M	9	37.9	40.0	10.5	2.1	100.0
	IN-H	13	28.6	39.8	14.3	4.1	100.0
	OUT-L	27	9.2	15.6	11.6	48.0	100.0
	OUT-M	12	17.2	9.9	13.3	53.7	100.0
	OUT-H	14	5.7	14.9	18.4	52.9	100.0
	TOTAL	91	17.6	20.4	14.0	36.6	100.0
EMPLOYER	IN-L	12	47.4	21.1	0.0	0.0	100.0
	IN-M	4	40.0	10.0	30.0	0.0	100.0
	IN-H	2	31.4	42.9	20.0	0.0	100.0
	OUT-L		0.0	0.0	75.0	25.0	100.0
	OUT-M		18.2	9.1	27.3	45.5	100.0
	OUT-H	1	3.2	12.9	16.1	64.5	100.0
	TOTAL	19	28.0	21.0	18.9	18.9	100.0
SELF EMPLOYED	IN-L	10	15.0	35.0	0.0	0.0	100.0
	IN-M	2	75.0	0.0	0.0	0.0	100.0
	IN-H	4	21.1	42.1	15.8	0.0	100.0
	OUT-L						
	OUT-M						
	OUT-H		14.8	22.2	7.4	55.6	100.0
	TOTAL	16	23.0	28.4	6.8	20.3	100.0
UNPAID FAMILY WORKER	IN-L	6	20.0	20.0	0.0	0.0	100.0
	IN-M		40.0	40.0	20.0	0.0	100.0
	IN-H		0.0	66.7	0.0	33.3	100.0
	OUT-L		0.0	50.0	0.0	50.0	100.0
	OUT-M		25.0	8.3	8.3	58.3	100.0
	OUT-H		0.0	0.0	50.0	50.0	100.0
	TOTAL	6	17.1	26.8	9.8	31.7	100.0
TOTAL	IN-L	44	31.7	24.2	6.7	0.8	100.0
	IN-M	15	40.6	32.8	13.3	1.6	100.0
	IN-H	19	27.2	41.8	15.2	3.8	100.0
	OUT-L	27	8.6	15.7	14.1	47.0	100.0
	OUT-M	12	17.7	9.7	13.7	53.5	100.0
	OUT-H	15	6.4	15.3	17.4	54.7	100.0
	TOTAL	**132**	**19.4**	**21.3**	**14.0**	**32.9**	**100.0**

Table B.13. Travel Distance by Districts According to Educational Background of Population (%)

	TRAVEL DISTANCE RANGES (KM)	EDUCATIONAL BACKGROUND						TOTAL
		Illiterate	School Unattended-Incomplete	Primary School Graduates	Junior High School Graduates	High School Graduates	University Graduates	
IN-L	-1	33.3	75.0	49.6	14.6	19.0	28.6	45.8
	1-2	33.3	17.9	30.8	36.6	14.3	21.4	27.3
	3-6		7.1	18.0	41.5	47.6	21.4	21.4
	7-15	33.3		1.5	4.9	19.0	28.6	5.2
	16+				2.4			0.4
	TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0
IN-M	-1		37.5	33.3	16.7	15.5	12.7	17.4
	1-2		25.0	37.0	66.7	36.6	34.9	38.5
	3-6		12.5	29.6	13.3	26.8	39.7	30.7
	7-15		25.0		3.3	21.1	11.1	12.6
	16+						1.6	0.7
	TOTAL		100.0	100.0	100.0	100.0	100.0	100.0
IN-H	-1		41.7		14.8	16.5	11.4	15.2
	1-2		25.0		40.7	29.9	25.9	27.6
	3-6		25.0	50.0	22.2	33.9	44.3	37.6
	7-15			16.7	22.2	18.1	14.6	15.5
	16+		8.3	33.3		1.6	3.8	4.0
	TOTAL		100.0	100.0	100.0	100.0	100.0	100.0
OUT-L	-1	100.0	88.6	60.2	26.3	11.4	41.4	45.8
	1-2			6.8	17.2	12.7		8.8
	3-6		2.9	11.0	14.1	17.7	20.7	12.3
	7-15		2.9	8.5	8.1	5.1	13.8	7.1
	16+		5.7	13.6	34.3	53.2	24.1	25.9
	TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0
OUT-M	-1		100.0	36.4	19.1	16.0	5.8	16.7
	1-2			11.4	14.7	15.0	19.1	15.7
	3-6			15.9	4.4	9.0	7.5	8.0
	7-15			2.3	16.2	10.0	13.9	11.5
	16+	100.0		34.1	45.6	50.0	53.8	48.1
	TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0
OUT-H	-1		71.4	10.5	5.9	10.9	5.5	9.0
	1-2				2.9	5.4	9.1	7.2
	3-6				11.8	19.6	15.0	14.5
	7-15		14.3	36.8	26.5	29.3	15.7	20.3
	16+		14.3	52.6	52.9	34.8	54.7	49.0
	TOTAL		100.0	100.0	100.0	100.0	100.0	100.0
TOTAL	-1	33.3	74.0	46.5	18.7	14.5	9.7	24.2
	1-2	16.7	10.4	18.1	24.7	19.8	18.9	19.0
	3-6	0.0	7.3	16.4	16.1	23.1	23.6	19.6
	7-15	16.7	4.2	6.2	12.4	16.9	14.5	12.5
	16+	33.3	4.2	12.7	28.1	25.7	33.3	24.8
	TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 7.14. Travel Purposes by Districts According to Travel Distance (Column %)

	TRAVEL DISTANCE RANGES (KM)											
	-1		1-2		3-6		7-15		16+		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%
PURPOSE												
SCHOOL												
IN-L	40	32.3	23	31.1	11	19.0	4	28.6			78	28.8
IN-M	9	19.1	20	19.2	13	15.7	2	5.9			44	16.3
IN-H	10	18.9	7	7.3	20	15.3	17	31.5	6	42.9	60	17.2
OUT-L	101	55.5	12	34.3	8	16.3			2	1.9	123	31.0
OUT-M	28	41.8	5	7.9			5	10.9	18	9.3	56	14.0
OUT-H	11	28.2	1	3.2	1	1.6	24	27.3	30	14.2	67	15.5
TOTAL	199	38.9	68	16.9	53	12.7	52	19.7	56	10.7	428	20.2
WORK												
IN-L	41	33.1	36	48.6	24	41.4	6	42.9	1	100.0	108	39.9
IN-M	16	34.0	37	35.6	38	45.8	13	38.2	2	100.0	106	39.3
IN-H	12	22.6	33	34.4	63	48.1	21	38.9	2	14.3	131	37.6
OUT-L	8	4.4	5	14.3	12	24.5	12	42.9	49	47.6	86	21.7
OUT-M	3	4.5	10	15.9	11	34.4	21	45.7	68	35.2	113	28.2
OUT-H	6	15.4	6	19.4	20	31.7	21	23.9	104	49.1	157	36.3
TOTAL	86	16.8	127	31.5	168	40.4	94	35.6	226	43.0	701	33.1
SHOPPING												
IN-L	12	9.7			2	3.4					14	5.2
IN-M	5	10.6	4	3.8	5	6.0	8	23.5			22	8.1
IN-H	5	9.4	8	8.3	15	11.5	3	5.6			31	8.9
OUT-L	33	18.1									33	8.3
OUT-M	16	23.9	5	7.9	1	3.1			5	2.6	27	6.7
OUT-H	10	25.6	8	25.8	9	14.3	8	9.1	22	10.4	57	13.2
TOTAL	81	15.8	25	6.2	32	7.7	19	7.2	27	5.1	184	8.7
SOCIAL												
IN-L	31	25.0	7	9.5	3	5.2	2	14.3			43	15.9
IN-M	16	34.0	29	27.9	14	16.9	2	5.9			61	22.6
IN-H	21	39.6	40	41.7	19	14.5	5	9.3	2	14.3	87	25.0
OUT-L	39	21.4	2	5.7	6	12.2			3	2.9	50	12.6
OUT-M	13	19.4	14	22.2	3	9.4	3	6.5	41	21.2	74	18.5
OUT-H	9	23.1	12	38.7	20	31.7	27	30.7	36	17.0	104	24.0
TOTAL	129	25.2	104	25.8	65	15.6	39	14.8	82	15.6	419	19.8
OTHER												
IN-L					8	13.8	2	14.3			10	3.7
IN-M			4	3.8	9	10.8	1	2.9			14	5.2
IN-H	4	7.5			5	3.8			4	28.6	13	3.7
OUT-L									2	1.9	2	0.5
OUT-M	1	1.5			1	3.1	2	4.3	8	4.1	12	3.0
OUT-H					2	3.2	6	6.8	1	0.5	9	2.1
TOTAL	5	1.0	4	1.0	25	6.0	11	4.2	15	2.9	60	2.8
TRANSFER TO MODE FOR SCHOOL												
IN-L			7	9.5	9	15.5					16	5.9
IN-M			9	8.7	1	1.2	6	17.6			16	5.9
IN-H			8	8.3	4	3.1	7	13.0			19	5.5
OUT-L			5	14.3	4	8.2			7	6.8	16	4.0
OUT-M			5	7.9			8	17.4	8	4.1	21	5.2
OUT-H	3	7.7			3	4.8			4	1.9	10	2.3
TOTAL	3	0.6	34	8.4	21	5.0	21	8.0	19	3.6	98	4.6
TRANSFER TO MODE FOR WORK												
IN-L											0	0.0
IN-M											0	0.0
IN-H					1	0.8	1	1.9			2	0.6
OUT-L			11	31.4	14	28.6	16	57.1	33	32.0	74	18.6
OUT-M	1	1.5	17	27.0	8	25.0	5	10.9	25	13.0	56	14.0
OUT-H			2	6.5	2	3.2	1	1.1	7	3.3	12	2.8
TOTAL	1	0.2	30	7.4	25	6.0	23	8.7	65	12.4	144	6.8
TRANSFER TO MODE												
IN-L			1	1.4	1	1.7					2	0.7
IN-M	1	2.1	1	1.0	3	3.6	2	5.9			7	2.6
IN-H	1	1.9			4	3.1					5	1.4
OUT-L	1	0.5			5	10.2			7	6.8	13	3.3
OUT-M	5	7.5	7	11.1	8	25.0	2	4.3	20	10.4	42	10.5
OUT-H			2	6.5	6	9.5	1	1.1	8	3.8	17	3.9
TOTAL	8	1.6	11	2.7	27	6.5	5	1.9	35	6.7	86	4.1
TOTAL												
IN-L	124	100.0	74	100.0	58	100.0	14	100.0	1	100.0	271	100.0
IN-M	47	100.0	104	100.0	83	100.0	34	100.0	2	100.0	270	100.0
IN-H	53	100.0	96	100.0	131	100.0	54	100.0	14	100.0	348	100.0
OUT-L	182	100.0	35	100.0	49	100.0	28	100.0	103	100.0	397	100.0
OUT-M	67	100.0	63	100.0	32	100.0	46	100.0	193	100.0	401	100.0
OUT-H	39	100.0	31	100.0	63	100.0	88	100.0	212	100.0	433	100.0
TOTAL	512	100.0	403	100.0	416	100.0	264	100.0	526	100.0	2120	100.0

Table B.15. Travel Purposes by Districts According to Car Ownership Levels

NUMBER OF CARS PER HOUSEHOLD		SCHOOL #	SCHOOL %	WORK #	WORK %	SHOPPING #	SHOPPING %	SOCIAL #	SOCIAL %	OTHER #	OTHER %	TRANSFER TO MODE FOR SCHOOL #	TRANSFER TO MODE FOR SCHOOL %	TRANSFER TO MODE FOR WORK #	TRANSFER TO MODE FOR WORK %	TRANSFER TO MODE #	TRANSFER TO MODE %	TOTAL #	TOTAL %
	IN-L	44	25.1	76	43.4	8	4.6	34	19.4	9	5.1	4	2.3					175	100.0
	IN-M	11	13.4	37	45.1	4	4.9	24	29.3	2	2.4	2	2.4			2	2.4	82	100.0
NON OWNERS	IN-H	8	20.5	14	35.9	7	17.9	6	15.4					2	5.1	2	5.1	39	100.0
	OUT-L	91	29.3	60	19.3	27	8.7	46	14.8	2	0.6	12	3.9	60	19.3	13	4.2	311	100.0
	OUT-M	21	12.2	41	23.8	15	8.7	29	16.9			10	5.8	34	19.8	22	12.8	172	100.0
	OUT-H							2	50.0							2	50.0	4	100.0
	TOTAL	175	22.3	228	29.1	61	7.8	141	18.0	13	1.7	28	3.6	96	12.3	41	5.2	783	100.0
	IN-L	34	35.4	32	33.3	6	6.3	9	9.4	1	1.0	12	12.5			2	2.1	96	100.0
	IN-M	28	19.9	48	34.0	14	9.9	33	23.4	11	7.8	2	1.4			5	3.5	141	100.0
1	IN-H	30	19.9	63	41.7	12	7.9	29	19.2	7	4.6	10	6.6					151	100.0
	OUT-L	32	37.2	26	30.2	6	7.0	4	4.7			4	4.7	14	16.3			86	100.0
	OUT-M	35	15.6	70	31.1	12	5.3	43	19.1	12	5.3	11	4.9	22	9.8	20	8.9	225	100.0
	OUT-H	37	17.0	74	33.9	35	16.1	50	22.9	1	0.5	6	2.8	8	3.7	7	3.2	218	100.0
	TOTAL	196	21.4	313	34.1	85	9.3	168	18.3	32	3.5	45	4.9	44	4.8	34	3.7	917	100.0
	IN-L																	0	100.0
	IN-M	5	10.6	21	44.7	4	8.5	4	8.5	1	2.1	12	25.5					47	100.0
2	IN-H	18	12.9	49	35.0	10	7.1	47	33.6	4	2.9	9	6.4			3	2.1	140	100.0
	OUT-L																	0	100.0
	OUT-M			2	50.0			2	50.0									4	100.0
	OUT-H	20	13.7	58	39.7	12	8.2	36	24.7	6	4.1	4	2.7	4	2.7	6	4.1	146	100.0
	TOTAL	43	12.8	130	38.6	26	7.7	89	26.4	11	3.3	25	7.4	4	1.2	9	2.7	337	100.0
	IN-L																	0	100.0
	IN-M																	0	100.0
3	IN-H	4	22.2	5	27.8	2	11.1	5	27.8	2	11.1							18	100.0
	OUT-L																	0	100.0
	OUT-M																	0	100.0
	OUT-H	8	24.2	12	36.4			11	33.3							2	6.1	33	100.0
	TOTAL	12	23.5	17	33.3	2	3.9	16	31.4	2	3.9					2	3.9	51	100.0
	IN-L																	0	100.0
	IN-M																	0	100.0
4	IN-H																	0	100.0
	OUT-L																	0	100.0
	OUT-M																	0	100.0
	OUT-H	2	6.3	13	40.6	10	31.3	5	15.6	2	6.3							32	100.0
	TOTAL	2	6.3	13	40.6	10	31.3	5	15.6	2	6.3							32	100.0
	IN-L	78	28.8	108	39.9	14	5.2	43	15.9	10	3.7	16	5.9	0	0.0	2	0.7	271	100.0
	IN-M	44	16.3	106	39.3	22	8.1	61	22.6	14	5.2	16	5.9	0	0.0	7	2.6	270	100.0
	IN-H	60	17.2	131	37.6	31	8.9	87	25.0	13	3.7	19	5.5	2	0.6	5	1.4	348	100.0
TOTAL	OUT-L	123	31.0	86	21.7	33	8.3	50	12.6	2	0.5	16	4.0	74	18.6	13	3.3	397	100.0
	OUT-M	56	14.0	113	28.2	27	6.7	74	18.5	12	3.0	21	5.2	56	14.0	42	10.5	401	100.0
	OUT-H	67	15.5	157	36.3	57	13.2	104	24.0	9	2.1	10	2.3	12	2.8	17	3.9	433	100.0
	TOTAL	428	20.2	701	33.1	184	8.7	419	19.8	60	2.8	98	4.6	144	6.8	86	4.1	2120	100.0

Table B.16-a. Travel Purposes According to Destination Areas - IN-L's Residents

DESTINATION REGIONS	SCHOOL #	SCHOOL %	WORK #	WORK %	SHOPPING #	SHOPPING %	SOCIAL #	SOCIAL %	OTHER #	OTHER %	TRANSFER TO MODE FOR SCHOOL #	TRANSFER TO MODE FOR SCHOOL %	TRANSFER TO MODE FOR WORK #	TRANSFER TO MODE FOR WORK %	TRANSFER TO MODE #	TRANSFER TO MODE %	TOTAL #	TOTAL %
I (ULUS)	2	20.0	6	60.0	1	10.0	0	0.0	0	0.0	1	10.0	0	0.0	0	0.0	10	100.0
II (KIZILAY)	4	16.0	6	24.0	0	0.0	2	8.0	4	16.0	8	32.0	0	0.0	1	4.0	25	100.0
III (AYDINLIK-SITELER)	58	27.8	92	44.0	11	5.3	39	18.7	4	1.9	4	1.9	0	0.0	1	0.5	209	100.0
IV (CEBECI)	8	61.5	0	0.0	2	15.4	0	0.0	0	0.0	3	23.1	0	0.0	0	0.0	13	100.0
V (CANKAYA-GOP)	5	71.4	0	0.0	0	0.0	2	28.6	0	0.0	0	0.0	0	0.0	0	0.0	7	100.0
VI (EMEK-ODTU-DEMET)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
VII (Y.MAHALLE-BATIKENT)	0	0.0	3	60.0	0	0.0	0	0.0	2	40.0	0	0.0	0	0.0	0	0.0	5	100.0
VIII (KECIOREN-A.EGLENCE)	1	50.0	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
IX																		
X (DIKMEN-GOLBASI)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XI (TASPINAR)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XII (ESKISEHIR YOLU)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XIII																		
XIV																		
XV (SINCAN)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XVI (ETIMESGUT)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XVII (OSMANIYE)																		
XVIII (YENIKENT)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XIX (SUSUZ-MURTED)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XX (KAZAN)																		
XXI (HAVAALANI)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
TOTAL	78	28.8	108	39.9	14	5.2	43	15.9	10	3.7	16	5.9	0	0.0	2	0.7	271	100.0

(Columns SCHOOL through TRANSFER TO MODE FOR SCHOOL grouped under IN-L.)

Table B.16-b. Travel Purposes According to Destination Areas - IN-M's Residents

							IN-M											
DESTINATION REGIONS	SCHOOL		WORK		SHOPPING		SOCIAL		OTHER		TRANSFER TO MODE FOR SCHOOL		TRANSFER TO MODE FOR WORK		TRANSFER TO MODE		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
I (ULUS)	0	0.0	5	62.5	0	0.0	1	12.5	0	0.0	0	0.0	0	0.0	2	25.0	8	100.0
II (KIZILAY)	11	16.7	27	40.9	7	10.6	9	13.6	2	3.0	8	12.1	0	0.0	2	3.0	66	100.0
III (AYDINLIK-SITELER)	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
IV (CEBECI)	0	0.0	1	33.3	0	0.0	1	33.3	1	33.3	0	0.0	0	0.0	0	0.0	3	100.0
V (CANKAYA-GOP)	28	17.7	58	36.7	10	6.3	49	31.0	7	4.4	4	2.5	0	0.0	2	1.3	158	100.0
VI (EMEK-ODTU-DEMET)	5	25.0	10	50.0	2	10.0	0	0.0	2	10.0	1	5.0	0	0.0	0	0.0	20	100.0
VII (Y.MAHALLE-BATIKENT)	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0
VIII (KECIOREN-A.EGLENCE)	0	0.0	1	25.0	0	0.0	1	25.0	2	50.0	0	0.0	0	0.0	0	0.0	4	100.0
IX																		
X (DIKMEN-GOLBASI)	0	0.0	0	0.0	3	75.0	0	0.0	0	0.0	0	0.0	0	0.0	1	25.0	4	100.0
XI (TASPINAR)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XII (ESKISEHIR YOLU)	0	0.0	1	25.0	0	0.0	0	0.0	0	0.0	3	75.0	0	0.0	0	0.0	4	100.0
XIII																		
XIV																		
XV (SINCAN)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XVI (ETIMESGUT)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XVII (OSMANIYE)																		
XVIII (YENIKENT)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XIX (SUSUZ-MURTED)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XX (KAZAN)																		
XXI (HAVAALANI)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
TOTAL	**44**	**16.3**	**106**	**39.3**	**22**	**8.1**	**61**	**22.6**	**14**	**5.2**	**16**	**5.9**	**0**	**0.0**	**7**	**2.6**	**270**	**100.0**

Table B.16-c. Travel Purposes According to Destination Areas - IN-H's Residents

DESTINATION REGIONS	SCHOOL		WORK		SHOPPING		SOCIAL		OTHER		TRANSFER TO MODE FOR SCHOOL		TRANSFER TO MODE FOR WORK		TRANSFER TO MODE		TOTAL	
IN-H	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
I (ULUS)	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
II (KIZILAY)	10	11.6	41	47.7	10	11.6	12	14.0	1	1.2	10	11.6	1	1.2	1	1.2	86	100.0
III (AYDINLIK-SITELER)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
IV (CEBECI)	1	16.7	1	16.7	0	0.0	3	50.0	0	0.0	1	16.7	0	0.0	0	0.0	6	100.0
V (CANKAYA-GOP)	37	18.1	68	33.3	18	8.8	65	31.9	10	4.9	3	1.5	0	0.0	3	1.5	204	100.0
VI (EMEK-ODTU-DEMET)	9	32.1	10	35.7	2	7.1	5	17.9	0	0.0	1	3.6	0	0.0	1	3.6	28	100.0
VII (Y.MAHALLE-BATIKENT)	0	0.0	4	80.0	0	0.0	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0	5	100.0
VIII (KECIOREN-A.EGLENCE)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
IX																		
X (DIKMEN-GOLBASI)	1	16.7	3	50.0	1	16.7	1	16.7	0	0.0	0	0.0	0	0.0	0	0.0	6	100.0
XI (TASPINAR)	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
XII (ESKISEHIR YOLU)	0	0.0	1	16.7	0	0.0	0	0.0	0	0.0	4	66.7	1	16.7	0	0.0	6	100.0
XIII																		
XIV																		
XV (SINCAN)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XVI (ETIMESGUT)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XVII (OSMANIYE)																		
XVIII (YENIKENT)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XIX (SUSUZ-MURTED)	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0
XX (KAZAN)																		
XXI (HAVAALANI)	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0	2	100.0
TOTAL	**60**	**17.2**	**131**	**37.6**	**31**	**8.9**	**87**	**25.0**	**13**	**3.7**	**19**	**5.5**	**2**	**0.6**	**5**	**1.4**	**348**	**100.0**

Table B.16-d. Travel Purposes According to Destination Areas - OUT-L's Residents

					OUT-L													
DESTINATION REGIONS	SCHOOL		WORK		SHOPPING		SOCIAL		OTHER		TRANSFER TO MODE FOR SCHOOL		TRANSFER TO MODE FOR WORK		TRANSFER TO MODE		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
I (ULUS)	1	12.5	3	37.5	0	0.0	0	0.0	0	0.0	2	25.0	2	25.0	0	0.0	8	100.0
II (KIZILAY)	0	0.0	11	19.6	1	1.8	1	1.8	1	1.8	5	8.9	31	55.4	6	10.7	56	100.0
III (AYDINLIK-SITELER)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	1	100.0
IV (CEBECI)	0	0.0	0	0.0	0	0.0	1	20.0	0	0.0	2	40.0	1	20.0	1	20.0	5	100.0
V (CANKAYA-GOP)	0	0.0	1	11.1	0	0.0	0	0.0	0	0.0	1	11.1	7	77.8	0	0.0	9	100.0
VI (EMEK-ODTU-DEMET)	1	3.8	15	57.7	0	0.0	0	0.0	0	0.0	0	0.0	10	38.5	0	0.0	26	100.0
VII (Y.MAHALLE-BATIKENT)	0	0.0	3	60.0	0	0.0	0	0.0	0	0.0	0	0.0	2	40.0	0	0.0	5	100.0
VIII (KECIOREN-A.EGLENCE)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0	1	100.0
IX																		
X (DIKMEN-GOLBASI)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XI (TASPINAR)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XII (ESKISEHIR YOLU)	0	0.0	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	1	50.0	0	0.0	2	100.0
XIII																		
XIV																		
XV (SINCAN)	3	20.0	7	46.7	0	0.0	3	20.0	0	0.0	1	6.7	0	0.0	1	6.7	15	100.0
XVI (ETIMESGUT)	118	44.0	44	16.4	32	11.9	45	16.8	1	0.4	5	1.9	19	7.1	4	1.5	268	100.0
XVII (OSMANIYE)																		
XVIII (YENIKENT)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XIX (SUSUZ-MURTED)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XX (KAZAN)																		
XXI (HAVAALANI)	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0
TOTAL	**123**	**31.0**	**86**	**21.7**	**33**	**8.3**	**50**	**12.6**	**2**	**0.5**	**16**	**4.0**	**74**	**18.6**	**13**	**3.3**	**397**	**100.0**

Table B.16-e. Travel Purposes According to Destination Areas - OUT-M's Residents

DESTINATION REGIONS	SCHOOL		WORK		SHOPPING		SOCIAL		OTHER		TRANSFER TO MODE FOR SCHOOL		TRANSFER TO MODE FOR WORK		TRANSFER TO MODE		TOTAL	
	OUT-M																	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
I (ULUS)	1	2.3	13	29.5	2	4.5	6	13.6	1	2.3	5	11.4	10	22.7	6	13.6	44	100.0
II (KIZILAY)	5	5.6	26	28.9	6	6.7	10	11.1	3	3.3	7	7.8	19	21.1	14	15.6	90	100.0
III (AYDINLIK-SITELER)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
IV (CEBECI)	0	0.0	1	20.0	0	0.0	2	40.0	0	0.0	1	20.0	1	20.0	0	0.0	5	100.0
V (CANKAYA-GOP)	2	9.1	7	31.8	0	0.0	9	40.9	0	0.0	0	0.0	1	4.5	3	13.6	22	100.0
VI (EMEK-ODTU-DEMET)	4	16.0	8	32.0	0	0.0	0	0.0	2	8.0	0	0.0	8	32.0	3	12.0	25	100.0
VII (Y.MAHALLE-BATIKENT)	0	0.0	3	23.1	0	0.0	3	23.1	0	0.0	3	23.1	4	30.8	0	0.0	13	100.0
VIII (KECIOREN-A.EGLENCE)	1	20.0	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0	1	20.0	2	40.0	5	100.0
IX																		
X (DIKMEN-GOLBASI)	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0
XI (TASPINAR)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XII (ESKISEHIR YOLU)	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	1	50.0	0	0.0	0	0.0	2	100.0
XIII																		
XIV																		
XV (SINCAN)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XVI (ETIMESGUT)	42	22.5	48	25.7	19	10.2	42	22.5	6	3.2	4	2.1	12	6.4	14	7.5	187	100.0
XVII (OSMANIYE)																		
XVIII (YENIKENT)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XIX (SUSUZ-MURTED)	0	0.0	5	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	100.0
XX (KAZAN)																		
XXI (HAVAALANI)	0	0.0	0	0.0	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
TOTAL	**56**	**14.0**	**113**	**28.2**	**27**	**6.7**	**74**	**18.5**	**12**	**3.0**	**21**	**5.2**	**56**	**14.0**	**42**	**10.5**	**401**	**100.0**

Table B.16-f. Travel Purposes According to Destination Areas - OUT-H's Residents

DESTINATION REGIONS	OUT-H																	
	SCHOOL		WORK		SHOPPING		SOCIAL		OTHER		TRANSFER TO MODE FOR SCHOOL		TRANSFER TO MODE FOR WORK		TRANSFER TO MODE		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
I (ULUS)	1	14.3	5	71.4	0	0.0	0	0.0	0	0.0	1	14.3	0	0.0	0	0.0	7	100.0
II (KIZILAY)	11	10.1	45	41.3	18	16.5	16	14.7	0	0.0	6	5.5	6	5.5	7	6.4	109	100.0
III (AYDINLIK-SITELER)	0	0.0	1	33.3	2	66.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	100.0
IV (CEBECI)	1	33.3	1	33.3	0	0.0	1	33.3	0	0.0	0	0.0	0	0.0	0	0.0	3	100.0
V (CANKAYA-GOP)	2	3.7	27	50.0	5	9.3	19	35.2	0	0.0	0	0.0	1	1.9	0	0.0	54	100.0
VI (EMEK-ODTU-DEMET)	11	20.0	15	27.3	5	9.1	17	30.9	3	5.5	0	0.0	1	1.8	3	5.5	55	100.0
VII (Y.MAHALLE-BATIKENT)	0	0.0	4	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	100.0
VIII (KECIOREN-A.EGLENCE)	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0
IX																		
X (DIKMEN-GOLBASI)	0	0.0	3	75.0	0	0.0	0	0.0	0	0.0	0	0.0	1	25.0	0	0.0	4	100.0
XI (TASPINAR)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XII (ESKISEHIR YOLU)	41	21.7	52	27.5	27	14.3	50	26.5	6	3.2	3	1.6	3	1.6	7	3.7	189	100.0
XIII																		
XIV																		
XV (SINCAN)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
XVI (ETIMESGUT)	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0
XVII (OSMANIYE)																		
XVIII (YENIKENT)	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0
XIX (SUSUZ-MURTED)	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
XX (KAZAN)																		
XXI (HAVAALANI)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0
TOTAL	**67**	**15.5**	**157**	**36.3**	**57**	**13.2**	**104**	**24.0**	**9**	**2.1**	**10**	**2.3**	**12**	**2.8**	**17**	**3.9**	**433**	**100.0**

Table B.17. Travel Purposes by Districts According to Age Groups

	7-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	TOTAL
IN-L														
SCHOOL	30.8	53.8	15.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
WORK	0.0	3.7	7.4	13.0	17.6	27.8	17.6	8.3	4.6	0.0	0.0	0.0	0.0	100.0
SHOPPING	0.0	28.6	0.0	0.0	14.3	0.0	14.3	14.3	14.3	0.0	14.3	0.0	0.0	100.0
SOCIAL	4.7	4.7	0.0	18.6	9.3	25.6	4.7	14.0	14.0	4.7	0.0	0.0	0.0	100.0
OTHER	0.0	0.0	20.0	0.0	10.0	0.0	40.0	0.0	10.0	0.0	0.0	0.0	20.0	100.0
TRANSFER TO MODE FOR SCHOOL	0.0	50.0	25.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
TRANSFER TO MODE FOR WORK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
TRANSFER TO MODE	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
TOTAL	9.6	22.1	10.3	9.6	9.6	15.1	10.0	6.3	5.2	0.7	0.7	0.0	0.7	100.0
IN-M														
SCHOOL	9.1	43.2	40.9	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
WORK	0.0	0.0	0.0	2.8	12.3	19.8	17.0	20.8	12.3	3.8	1.9	5.7	3.8	100.0
SHOPPING	0.0	9.1	4.5	9.1	0.0	18.2	0.0	27.3	9.1	4.5	0.0	0.0	18.2	100.0
SOCIAL	3.3	4.9	11.5	0.0	3.3	3.3	13.1	6.6	6.6	4.9	8.2	8.2	26.2	100.0
OTHER	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	7.1	21.4	0.0	0.0	57.1	100.0
TRANSFER TO MODE FOR SCHOOL	0.0	0.0	62.5	37.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
TRANSFER TO MODE FOR WORK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
TRANSFER TO MODE	0.0	0.0	0.0	0.0	28.6	0.0	0.0	0.0	0.0	42.9	0.0	0.0	28.6	100.0
TOTAL	2.2	8.9	13.3	5.2	7.0	10.0	9.6	11.9	7.4	5.2	2.6	4.1	12.6	100.0
IN-H														
SCHOOL	26.7	30.0	33.3	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
WORK	0.0	0.0	0.8	5.3	8.4	9.2	19.1	10.7	12.2	17.6	9.9	5.3	1.5	100.0
SHOPPING	0.0	0.0	6.5	6.5	3.2	12.9	12.9	6.5	0.0	35.5	9.7	0.0	6.5	100.0
SOCIAL	4.6	2.3	18.4	9.2	2.3	4.6	16.1	2.3	4.6	25.3	3.4	6.9	0.0	100.0
OTHER	0.0	0.0	0.0	0.0	30.8	61.5	0.0	0.0	0.0	7.7	0.0	0.0	0.0	100.0
TRANSFER TO MODE FOR SCHOOL	0.0	0.0	78.9	21.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
TRANSFER TO MODE FOR WORK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0
TRANSFER TO MODE	0.0	0.0	40.0	0.0	20.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0	0.0	100.0
TOTAL	5.7	5.7	16.1	7.8	5.5	8.0	12.4	5.2	5.7	17.0	5.5	4.3	1.1	100.0
OUT-L														
SCHOOL	27.6	46.3	26.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
WORK	0.0	1.2	5.8	8.1	7.0	38.4	24.4	4.7	8.1	2.3	0.0	0.0	0.0	100.0
SHOPPING	0.0	6.1	0.0	0.0	30.3	12.1	24.2	18.2	9.1	0.0	0.0	0.0	0.0	100.0
SOCIAL	4.0	8.0	8.0	22.0	8.0	24.0	12.0	6.0	0.0	4.0	0.0	4.0	0.0	100.0
OTHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0
TRANSFER TO MODE FOR SCHOOL	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
TRANSFER TO MODE FOR WORK	0.0	0.0	8.1	21.6	5.4	21.6	10.8	21.6	5.4	5.4	0.0	0.0	0.0	100.0
TRANSFER TO MODE	0.0	0.0	0.0	76.9	7.7	0.0	0.0	0.0	15.4	0.0	0.0	0.0	0.0	100.0
TOTAL	9.1	16.1	15.9	11.1	6.3	16.4	10.8	7.3	4.5	2.0	0.0	0.5	0.0	100.0
OUT-M														
SCHOOL	17.9	37.5	39.3	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
WORK	0.0	0.0	0.9	9.7	17.7	15.9	28.3	9.7	8.8	1.8	5.3	1.8	0.0	100.0
SHOPPING	0.0	3.7	7.4	14.8	0.0	14.8	14.8	14.8	0.0	7.4	7.4	7.4	7.4	100.0
SOCIAL	0.0	2.7	13.5	12.2	24.3	2.7	14.9	13.5	1.4	2.7	0.0	4.1	8.1	100.0
OTHER	0.0	0.0	8.3	8.3	8.3	0.0	16.7	16.7	16.7	0.0	8.3	16.7	0.0	100.0
TRANSFER TO MODE FOR SCHOOL	0.0	0.0	66.7	14.3	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
TRANSFER TO MODE FOR WORK	0.0	0.0	3.6	14.3	10.7	25.0	17.9	14.3	0.0	0.0	7.1	7.1	0.0	100.0
TRANSFER TO MODE	0.0	4.8	35.7	11.9	9.5	4.8	0.0	9.5	4.8	0.0	0.0	19.0	0.0	100.0
TOTAL	2.5	6.5	16.7	11.0	13.2	10.0	14.7	9.7	3.7	1.5	3.2	5.2	2.0	100.0
OUT-H														
SCHOOL	11.9	25.4	35.8	25.4	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
WORK	0.0	0.0	0.0	1.3	7.0	10.2	9.6	17.2	20.4	15.3	10.2	7.6	1.3	100.0
SHOPPING	0.0	1.8	1.8	10.5	5.3	14.0	7.0	15.8	10.5	15.8	10.5	5.3	1.8	100.0
SOCIAL	0.0	1.9	4.8	15.4	4.8	8.7	7.7	9.6	17.3	17.3	6.7	2.9	2.9	100.0
OTHER	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0	22.2	44.4	0.0	0.0	100.0
TRANSFER TO MODE FOR SCHOOL	0.0	0.0	40.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
TRANSFER TO MODE FOR WORK	0.0	0.0	0.0	0.0	0.0	16.7	16.7	0.0	33.3	33.3	0.0	0.0	0.0	100.0
TRANSFER TO MODE	0.0	0.0	23.5	23.5	0.0	11.8	0.0	11.8	0.0	0.0	0.0	17.6	11.8	100.0
TOTAL	1.8	4.6	8.8	11.8	4.6	9.2	6.7	11.1	13.9	13.2	7.6	4.8	1.8	100.0
TOTAL														
SCHOOL	22.4	40.7	29.9	6.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
WORK	0.0	0.7	2.1	6.3	11.4	18.5	18.5	12.4	11.8	7.8	5.3	3.8	1.1	100.0
SHOPPING	0.0	5.4	3.3	7.6	8.7	13.0	12.0	15.8	7.1	12.5	7.1	2.7	4.9	100.0
SOCIAL	2.4	3.6	10.0	12.4	8.4	9.5	11.7	8.4	7.9	11.7	3.6	4.5	6.0	100.0
OTHER	0.0	0.0	5.0	1.7	13.3	18.3	10.0	3.3	10.0	10.0	8.3	3.3	16.7	100.0
TRANSFER TO MODE FOR SCHOOL	0.0	8.2	64.3	23.5	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
TRANSFER TO MODE FOR WORK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
TRANSFER TO MODE	0.0	2.3	26.7	22.1	9.3	4.7	0.0	7.0	4.7	5.8	0.0	12.8	4.7	100.0
TOTAL	8.0	10.1	13.6	9.7	7.6	11.4	10.7	8.6	6.9	6.9	3.5	3.3	2.6	100.0

Table B.18. Travel Purposes by Districts According to Gender

		SCHOOL		WORK		SHOPPING		SOCIAL		OTHER		TRANSFER TO MODE FOR SCHOOL		TRANSFER TO MODE FOR WORK		TRANSFER TO MODE		TOTAL	
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
F	IN-L	33	35.1	14	14.9	7	7.4	24	25.5	8	8.5	8	8.5					94	100.0
E	IN-M	22	19.1	33	28.7	14	12.2	29	25.2	6	5.2	4	3.5			7	6.1	115	100.0
M	IN-H	37	20.4	40	22.1	20	11.0	57	31.5	7	3.9	15	8.3			5	2.8	181	100.0
A	OUT-L	62	41.3	8	5.3	22	14.7	23	15.3	2	1.3	8	5.3	16	10.7	9	6.0	150	100.0
L	OUT-M	24	11.7	39	19.0	21	10.2	42	20.5	3	1.5	16	7.8	32	15.6	28	13.7	205	100.0
E	OUT-H	34	15.9	52	24.3	38	17.8	58	27.1	5	2.3	2	0.9	12	5.6	13	6.1	214	100.0
	TOTAL	212	22.1	186	19.4	122	12.7	233	24.3	31	3.2	53	5.5	60	6.3	62	6.5	959	100.0
	IN-L	45	25.4	94	53.1	7	4.0	19	10.7	2	1.1	8	4.5			2	1.1	177	100.0
M	IN-M	22	14.2	73	47.1	8	5.2	32	20.6	8	5.2	12	7.7					155	100.0
A	IN-H	23	13.8	91	54.5	11	6.6	30	18.0	6	3.6	4	2.4	2	1.2			167	100.0
L	OUT-L	61	24.7	78	31.6	11	4.5	27	10.9			8	3.2	58	23.5	4	1.6	247	100.0
E	OUT-M	32	16.3	74	37.8	6	3.1	32	16.3	9	4.6	5	2.6	24	12.2	14	7.1	196	100.0
	OUT-H	33	15.1	105	47.9	19	8.7	46	21.0	4	1.8	8	3.7			4	1.8	219	100.0
	TOTAL	216	18.6	515	44.4	62	5.3	186	16.0	29	2.5	45	3.9	84	7.2	24	2.1	1161	100.0
	IN-L	78	28.8	108	39.9	14	5.2	43	15.9	10	3.7	16	5.9			2	0.7	271	100.0
T	IN-M	44	16.3	106	39.3	22	8.1	61	22.6	14	5.2	16	5.9			7	2.6	270	100.0
O	IN-H	60	17.2	131	37.6	31	8.9	87	25.0	13	3.7	19	5.5	2	0.6	5	1.4	348	100.0
T	OUT-L	123	31.0	86	21.7	33	8.3	50	12.6	2	0.5	16	4.0	74	18.6	13	3.3	397	100.0
A	OUT-M	56	14.0	113	28.2	27	6.7	74	18.5	12	3.0	21	5.2	56	14.0	42	10.5	401	100.0
L	OUT-H	67	15.5	157	36.3	57	13.2	104	24.0	9	2.1	10	2.3	12	2.8	17	3.9	433	100.0
	TOTAL	**428**	**20.2**	**701**	**33.1**	**184**	**8.7**	**419**	**19.8**	**60**	**2.8**	**98**	**4.6**	**144**	**6.8**	**86**	**4.1**	**2120**	**100.0**

Table B.19. Travel Purposes by Districts According to Being at Work or Not

		SCHOOL		WORK		SHOPPING		SOCIAL		OTHER		TRANSFER TO MODE FOR SCHOOL		TRANSFER TO MODE FOR WORK		TRANSFER TO MODE		TOTAL	
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
	IN-L			105	87.5	4	3.3	9	7.5	2	1.7							120	100.0
AT	IN-M			101	78.9	6	4.7	18	14.1	3	2.3							128	100.0
W	IN-H			119	75.3	10	6.3	19	12.0	7	4.4			2	1.3	1	0.6	158	100.0
O	OUT-L	1	0.5	85	45.9	7	3.8	17	9.2					70	37.8	5	2.7	185	100.0
R	OUT-M			113	50.0	8	3.5	30	13.3	9	4.0	4	1.8	56	24.8	6	2.7	226	100.0
K	OUT-H			151	64.0	23	9.7	45	19.1	5	2.1			12	5.1			236	100.0
	TOTAL	1	0.1	674	64.0	58	5.5	138	13.1	26	2.5	4	0.4	140	13.3	12	1.1	1053	100.0
NOT	IN-L	78	51.7	3	2.0	10	6.6	34	22.5	8	5.3	16	10.6			2	1.3	151	100.0
AT	IN-M	44	31.0	5	3.5	16	11.3	43	30.3	11	7.7	16	11.3			7	4.9	142	100.0
W	IN-H	60	31.6	12	6.3	21	11.1	68	35.8	6	3.2	19	10.0			4	2.1	190	100.0
O	OUT-L	122	57.5	1	0.5	26	12.3	33	15.6	2	0.9	16	7.5	4	1.9	8	3.8	212	100.0
R	OUT-M	56	32.0			19	10.9	44	25.1	3	1.7	17	9.7			36	20.6	175	100.0
K	OUT-H	67	34.0	6	3.0	34	17.3	59	29.9	4	2.0	10	5.1			17	8.6	197	100.0
	TOTAL	427	40.0	27	2.5	126	11.8	281	26.3	34	3.2	94	8.8	4	0.4	74	6.9	1067	100.0
	IN-L	78	28.8	108	39.9	14	5.2	43	15.9	10	3.7	16	5.9			2	0.7	271	100.0
T	IN-M	44	16.3	106	39.3	22	8.1	61	22.6	14	5.2	16	5.9			7	2.6	270	100.0
O	IN-H	60	17.2	131	37.6	31	8.9	87	25.0	13	3.7	19	5.5	2	0.6	5	1.4	348	100.0
T	OUT-L	123	31.0	86	21.7	33	8.3	50	12.6	2	0.5	16	4.0	74	18.6	13	3.3	397	100.0
A	OUT-M	56	14.0	113	28.2	27	6.7	74	18.5	12	3.0	21	5.2	56	14.0	42	10.5	401	100.0
L	OUT-H	67	15.5	157	36.3	57	13.2	104	24.0	9	2.1	10	2.3	12	2.8	17	3.9	433	100.0
	TOTAL	**428**	**20.2**	**701**	**33.1**	**184**	**8.7**	**419**	**19.8**	**60**	**2.8**	**98**	**4.6**	**144**	**6.8**	**86**	**4.1**	**2120**	**100.0**

Table B.20. Travel Purposes by Districts According to Occupation of Population (%)

	OCCUPATION											
	Student	Retired	Unemployed	Housewife	Disable	Professional and Related Workers	Administrative Managerial Workers	Clerial and Related Workers	Commercial and Sales Workers	Service Workers	Related Workers Transport Equipment Operators	TOTAL
SCHOOL												
IN-L	100.0											100.0
IN-M	100.0											100.0
IN-H	100.0											100.0
OUT-L	99.2									0.8		100.0
OUT-M	100.0											100.0
OUT-H	100.0											100.0
TOTAL	99.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	100.0
WORK												
IN-L	1.9	0.9				6.5		3.7	7.4	11.1	68.5	100.0
IN-M	0.0			4.7		48.1	11.3	10.4	17.9	1.9	5.7	100.0
IN-H	5.3	1.5		2.3		58.8	17.6	4.6	5.3	4.6		100.0
OUT-L	1.2					18.6	0.0	10.5	10.5	31.4	27.9	100.0
OUT-M						65.5	8.8	8.8	7.1	4.4	5.3	100.0
OUT-H	1.3	2.5				79.0	14.6		2.5			100.0
TOTAL	1.7	1.0	0.0	1.1	0.0	49.8	9.7	5.7	7.8	7.4	15.7	100.0
SHOPPING												
IN-L	28.6		42.9								28.6	100.0
IN-M	13.6	27.3		31.8		13.6		13.6				100.0
IN-H	6.5	12.9		48.4		6.5	6.5	12.9	6.5			100.0
OUT-L	6.1		6.1	66.7				9.1		12.1		100.0
OUT-M	11.1	14.8	7.4	37.0		29.6						100.0
OUT-H	14.0	19.3	1.8	24.6		40.4						100.0
TOTAL	12.0	13.6	6.0	37.0	0.0	19.6	1.1	5.4	1.1	2.2	2.2	100.0
SOCIAL												
IN-L	9.3		14.0	55.8		7.0				4.7	9.3	100.0
IN-M	19.7	29.5		21.3		9.8	9.8	3.3	6.6			100.0
IN-H	32.2	10.3	2.3	33.3		12.6	6.9			2.3		100.0
OUT-L	8.0	8.0	4.0	46.0		8.0			6.0	12.0	8.0	100.0
OUT-M	10.8	8.1	2.7	32.4	5.4	16.2	5.4	16.2	2.7			100.0
OUT-H	24.0	7.7	1.9	23.1		28.8	14.4					100.0
TOTAL	19.3	10.7	3.3	32.7	1.0	15.8	7.4	3.3	2.1	2.4	1.9	100.0
OTHER												
IN-L				60.0	20.0						20.0	100.0
IN-M		78.6				21.4						100.0
IN-H				46.2		53.8						100.0
OUT-L				100.0								100.0
OUT-M		16.7	8.3			41.7	16.7			16.7		100.0
OUT-H				44.4		55.6						100.0
TOTAL	0.0	21.7	1.7	30.0	3.3	33.3	3.3	0.0	0.0	3.3	3.3	100.0
TRANSFER TO MODE FOR SCHOOL												
IN-L	100.0											100.0
IN-M	100.0											100.0
IN-H	100.0											100.0
OUT-L	100.0											100.0
OUT-M	81.0					19.0						100.0
OUT-H	100.0											100.0
TOTAL	95.9	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0	0.0	0.0	100.0
TRANSFER TO MODE FOR WORK												
IN-L												100.0
IN-M												100.0
IN-H							100.0					100.0
OUT-L			5.4			5.4		10.8	16.2	35.1	27.0	100.0
OUT-M						60.7	7.1	14.3	7.1	10.7		100.0
OUT-H						100.0						100.0
TOTAL	0.0	0.0	2.8	0.0	0.0	34.7	4.2	11.1	11.1	22.2	13.9	100.0
TRANSFER TO MODE												
IN-L	100.0			0.0								100.0
IN-M		42.9		57.1								100.0
IN-H	40.0			40.0			20.0					100.0
OUT-L				61.5		7.7		15.4	15.4			100.0
OUT-M	47.6	4.8		33.3		9.5		4.8				100.0
OUT-H	47.1	29.4		23.5								100.0
TOTAL	37.2	11.6	0.0	37.2	0.0	5.8	1.2	4.7	2.3	0.0	0.0	100.0
TOTAL												
IN-L	39.1	0.4	4.4	11.1	0.7	3.7	0.0	1.5	3.0	5.2	31.0	100.0
IN-M	27.8	14.1	0.0	10.7	0.0	23.3	6.7	5.9	8.5	0.7	2.2	100.0
IN-H	33.9	4.3	0.6	15.8	0.0	27.9	9.8	2.9	2.6	2.3	0.0	100.0
OUT-L	36.5	1.0	2.0	13.9	0.0	6.3	0.0	5.5	6.5	16.1	12.1	100.0
OUT-M	25.9	3.5	1.2	12.0	1.0	35.2	5.0	8.0	3.5	3.2	1.5	100.0
OUT-H	27.7	6.5	0.7	10.6	0.0	44.8	8.8	0.0	0.9	0.0	0.0	100.0
TOTAL	31.5	4.7	1.4	12.4	0.3	26.0	5.2	4.0	4.0	4.8	6.8	100.0

Table B.21. Travel Purposes of Working Population According to Position at Work

POSITION AT WORK		SCHOOL #	SCHOOL %	WORK #	WORK %	SHOPPING #	SHOPPING %	SOCIAL #	SOCIAL %	OTHER #	OTHER %	TRANSFER TO MODE FOR SCHOOL #	TRANSFER TO MODE FOR SCHOOL %	TRANSFER TO MODE FOR WORK #	TRANSFER TO MODE FOR WORK %	TRANSFER TO MODE #	TRANSFER TO MODE %	TOTAL #	TOTAL %
	IN-L			45	86.5	2	3.8	5	9.6									52	100.0
	IN-M			74	77.9	6	6.3	12	12.6	3	3.2							95	100.0
	IN-H			77	78.6	8	8.2	7	7.1	3	3.1			2	2.0	1	1.0	98	100.0
EMPLOYEE	OUT-L	1	0.6	81	46.8	7	4.0	17	9.8					62	35.8	5	2.9	173	100.0
	OUT-M			96	47.3	8	3.9	28	13.8	7	3.4	4	2.0	54	26.6	6	3.0	203	100.0
	OUT-H			101	58.0	20	11.5	38	21.8	3	1.7			12	6.9			174	100.0
	TOTAL	1	0.1	474	59.6	51	6.4	107	13.5	16	2.0	4	0.5	130	16.4	12	1.5	795	100.0
	IN-L			34	89.5			2	5.3	2	5.3							38	100.0
	IN-M			18	90.0			2	10.0									20	100.0
	IN-H			29	82.9			6	17.1									35	100.0
EMPLOYER	OUT-L			4	50.0									4	50.0			8	100.0
	OUT-M			10	90.9					1	9.1							11	100.0
	OUT-H			27	87.1			2	6.5	2	6.5							31	100.0
	TOTAL	0	0.0	122	85.3	0	0.0	12	8.4	5	3.5	0	0.0	4	2.8	0	0.0	143	100.0
	IN-L			18	90.0			2	10.0									20	100.0
	IN-M			6	75.0			2	25.0									8	100.0
SELF	IN-H			13	68.4	2	10.5	4	21.1									19	100.0
EMPLOYED	OUT-L																	0	100.0
	OUT-M				0.0													0	100.0
	OUT-H			22	81.5	1	3.7	4	14.8									27	100.0
	TOTAL	0	0.0	59	79.7	3	4.1	12	16.2	0	0.0	0	0.0	0	0.0	0	0.0	74	100.0
	IN-L			8	80.0	2	20.0											10	100.0
	IN-M			3	60.0			2	40.0									5	100.0
UNPAID	IN-H							2	33.3	4	66.7							6	100.0
FAMILY	OUT-L													4	100.0			4	100.0
WORKER	OUT-M			7	58.3			2	16.7	1	8.3			2	16.7			12	100.0
	OUT-H			1	25.0	2	50.0	1	25.0									4	100.0
	TOTAL	0	0.0	19	46.3	4	9.8	7	17.1	5	12.2	0	0.0	6	14.6	0	0.0	41	100.0
	IN-L	0	0.0	105	87.5	4	3.3	9	7.5	2	1.7	0	0.0	0	0.0	0	0.0	120	100.0
	IN-M	0	0.0	101	78.9	6	4.7	18	14.1	3	2.3	0	0.0	0	0.0	0	0.0	128	100.0
	IN-H	0	0.0	119	75.3	10	6.3	19	12.0	7	4.4	0	0.0	2	1.3	1	0.6	158	100.0
TOTAL	OUT-L	1	0.5	85	45.9	7	3.8	17	9.2	0	0.0	0	0.0	70	37.8	5	2.7	185	100.0
	OUT-M	0	0.0	113	50.0	8	3.5	30	13.3	9	4.0	4	1.8	56	24.8	6	2.7	226	100.0
	OUT-H	0	0.0	151	64.0	23	9.7	45	19.1	5	2.1	0	0.0	12	5.1	0	0.0	236	100.0
	TOTAL	1	0.1	674	64.0	58	5.5	138	13.1	26	2.5	4	0.4	140	13.3	12	1.1	1053	100.0

Table B.22. Travel Purposes by Districts According to Educational Background of Population (%)

	Illiterate	School Unattended-Incomplete	Primary School Graduates	Junior High School Graduates	High School Graduates	University Graduates	TOTAL
SCHOOL							
IN-L		56.4	30.8	12.8			100.0
IN-M		27.3	29.5	29.5	13.6		100.0
IN-H		33.3	20.0	18.3	28.3		100.0
OUT-L		48.8	26.0	25.2			100.0
OUT-M		21.4	26.8	37.5	14.3		100.0
OUT-H		16.4	26.9	26.9	29.9		100.0
TOTAL	0.0	37.1	26.6	24.3	11.9	0.0	100.0
WORK							
IN-L			52.8	21.3	15.7	10.2	100.0
IN-M			7.5	1.9	19.8	70.8	100.0
IN-H				2.3	16.0	81.7	100.0
OUT-L		2.3	24.4	18.6	33.7	20.9	100.0
OUT-M				4.4	23.0	72.6	100.0
OUT-H					2.5	97.5	100.0
TOTAL	0.0	0.3	12.3	7.0	16.8	63.6	100.0
SHOPPING							
IN-L	14.3	28.6	57.1				100.0
IN-M		9.1	4.5	4.5	50.0	31.8	100.0
IN-H					61.3	38.7	100.0
OUT-L	6.1		54.5	18.2	15.2	6.1	100.0
OUT-M			18.5	22.2	14.8	44.4	100.0
OUT-H		1.8		1.8	31.6	64.9	100.0
TOTAL	2.2	3.8	17.4	7.6	31.0	38.0	100.0
SOCIAL							
IN-L	4.7	14.0	69.8	4.7		7.0	100.0
IN-M		3.3	8.2	23.0	21.3	44.3	100.0
IN-H		4.6		14.9	47.1	33.3	100.0
OUT-L		8.0	62.0	12.0	10.0	8.0	100.0
OUT-M	5.4		13.5	13.5	39.2	28.4	100.0
OUT-H		1.9	1.0	6.7	32.7	57.7	100.0
TOTAL	1.4	4.3	18.4	12.4	29.1	34.4	100.0
OTHER							
IN-L	20.0	20.0	60.0				100.0
IN-M					14.3	85.7	100.0
IN-H				46.2		53.8	100.0
OUT-L				100.0			100.0
OUT-M				8.3	8.3	83.3	100.0
OUT-H					44.4	55.6	100.0
TOTAL	3.3	3.3	10.0	15.0	11.7	56.7	100.0
TRANSFER TO MODE FOR SCHOOL							
IN-L			50.0	25.0	25.0		100.0
IN-M					100.0		100.0
IN-H					100.0		100.0
OUT-L				100.0			100.0
OUT-M			19.0	28.6	33.3	19.0	100.0
OUT-H				40.0	60.0		100.0
TOTAL	0.0	0.0	12.2	30.6	53.1	4.1	100.0
TRANSFER TO MODE FOR WORK							
IN-L							100.0
IN-M							100.0
IN-H						100.0	100.0
OUT-L		5.4	21.6	24.3	43.2	5.4	100.0
OUT-M				10.7	17.9	71.4	100.0
OUT-H						100.0	100.0
TOTAL	0.0	2.8	11.1	16.7	29.2	40.3	100.0
TRANSFER TO MODE							
IN-L				100.0			100.0
IN-M					28.6	71.4	100.0
IN-H					80.0	20.0	100.0
OUT-L				30.8	61.5	7.7	100.0
OUT-M			23.8	31.0	35.7	9.5	100.0
OUT-H				23.5	35.3	41.2	100.0
TOTAL	0.0	0.0	11.6	26.7	40.7	20.9	100.0
TOTAL							
IN-L	2.2	20.7	49.1	15.1	7.7	5.2	100.0
IN-M	0.0	5.9	10.0	11.1	26.3	46.7	100.0
IN-H	0.0	6.9	3.4	9.5	34.8	45.4	100.0
OUT-L	0.5	17.6	29.7	24.9	19.9	7.3	100.0
OUT-M	1.0	3.0	11.0	17.0	24.9	43.1	100.0
OUT-H	0.0	3.2	4.4	7.9	21.2	63.3	100.0
TOTAL	0.6	9.1	16.7	14.4	22.8	36.5	100.0

Table B.23. Starting Time of Trips by Districts

STARTING TIME	IN-L #	IN-L %	IN-M #	IN-M %	IN-H #	IN-H %	OUT-L #	OUT-L %	OUT-M #	OUT-M %	OUT-H #	OUT-H %	TOTAL #	TOTAL %
-5.59					7	2.0	3	0.8			4	0.9	14	0.7
6.00-6.59	3	1.1			3	0.9	15	3.8	6	1.5	2	0.5	29	1.4
7.00-7.59	24	8.9	27	10.0	18	5.2	65	16.4	63	15.7	29	6.7	226	10.7
8.00-8.59	41	15.1	31	11.5	45	12.9	30	7.6	39	9.7	58	13.4	244	11.5
9.00-9.59	6	2.2	20	7.4	13	3.7	3	0.8	17	4.2	17	3.9	76	3.6
10.00-10.59	10	3.7	14	5.2	8	2.3	5	1.3	10	2.5	24	5.5	71	3.3
11.00-11.59	9	3.3	11	4.1	13	3.7	10	2.5	14	3.5	11	2.5	68	3.2
12.00-12.59	39	14.4	15	5.6	38	10.9	41	10.3	31	7.7	21	4.8	185	8.7
13.00-13.59	15	5.5	7	2.6	19	5.5	23	5.8	14	3.5	23	5.3	101	4.8
14.00-14.59	13	4.8	13	4.8	17	4.9	11	2.8	11	2.7	26	6.0	91	4.3
15.00-15.59	4	1.5	18	6.7	29	8.3	25	6.3	21	5.2	29	6.7	126	5.9
16.00-16.59	22	8.1	21	7.8	26	7.5	26	6.5	16	4.0	32	7.4	143	6.7
17.00-17.59	19	7.0	25	9.3	40	11.5	33	8.3	53	13.2	49	11.3	219	10.3
18.00-18.59	25	9.2	31	11.5	25	7.2	42	10.6	36	9.0	37	8.5	196	9.2
19.00-19.59	17	6.3	8	3.0	12	3.4	24	6.0	29	7.2	29	6.7	119	5.6
20.00-20.59	15	5.5	10	3.7	12	3.4	20	5.0	10	2.5	14	3.2	81	3.8
21.00-21.59	1	0.4	4	1.5	9	2.6	2	0.5	7	1.7	7	1.6	30	1.4
22.00-22.59	6	2.2	6	2.2	3	0.9	10	2.5	7	1.7	5	1.2	37	1.7
23.00-23.59	2	0.7	7	2.6	7	2.0	8	2.0	17	4.2	14	3.2	55	2.6
24+			2	0.7	4	1.1	1	0.3			2	0.5	9	0.4
TOTAL	**271**	**100.0**	**270**	**100.0**	**348**	**100.0**	**397**	**100.0**	**401**	**100.0**	**433**	**100.0**	**2120**	**100.0**

Table B.24. Travel Time by Districts (raw data in numbers and percentages)

	TRAVEL TIME (Minutes)																						
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	120	TOTAL
IN-L	77	70	36	35	11	32	5	4						1									271
IN-M	22	71	60	50	14	36	3	7	3			3			1								270
IN-H	47	109	64	42	23	34	3	11	7	4		4											348
OUT-L	87	80	45	38	14	29	6	7	14	6	6	24	6	19	8	2	1	1	1	1	1	1	397
OUT-M	60	46	39	32	18	45	25	27	44	23	8	21	5	6	2								401
OUT-H	29	67	54	63	35	88	25	28	30	5	2	3	2	2									433
TOTAL	**322**	**443**	**298**	**260**	**115**	**264**	**67**	**84**	**98**	**38**	**16**	**55**	**13**	**28**	**11**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2120**

	TRAVEL TIME (Minutes)																						
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	120	TOTAL
IN-L	28.4	25.8	13.3	12.9	4.1	11.8	1.8	1.5						0.4									100.0
IN-M	8.1	26.3	22.2	18.5	5.2	13.3	1.1	2.6	1.1			1.1			0.4								100.0
IN-H	13.5	31.3	18.4	12.1	6.6	9.8	0.9	3.2	2.0	1.1		1.1											100.0
OUT-L	21.9	20.2	11.3	9.6	3.5	7.3	1.5	1.8	3.5	1.5	1.5	6.0	1.5	4.8	2.0	0.5	0.3	0.3	0.3	0.3	0.3	0.3	100.0
OUT-M	15.0	11.5	9.7	8.0	4.5	11.2	6.2	6.7	11.0	5.7	2.0	5.2	1.2	1.5	0.5								100.0
OUT-H	6.7	15.5	12.5	14.5	8.1	20.3	5.8	6.5	6.9	1.2	0.5	0.7	0.5	0.5									100.0
TOTAL	**15.2**	**20.9**	**14.1**	**12.3**	**5.4**	**12.5**	**3.2**	**4.0**	**4.6**	**1.8**	**0.8**	**2.6**	**0.6**	**1.3**	**0.5**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**100.0**

Table B.25. Travel Time by Districts According to Travel Mode (Column %)

		TRAVEL TIME (Minutes)														TOTAL	
		5-10		15-20		25-30		35-40		45-50		55-60		65+			
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
P	IN-L	20	13.6	4	5.6	4	9.3	1	11.1							29	10.7
R	IN-M	34	36.6	41	37.3	21	42.0	6	60.0	2	50.0					104	38.5
I	IN-H	116	74.4	59	55.7	19	33.3	3	21.4	5	45.5	2	50.0			204	58.6
V	OUT-L	10	6.0	5	6.0											15	3.8
A	OUT-M	15	14.2	21	29.6	42	66.7	17	32.7	7	10.4	8	27.6	1	7.7	111	27.7
T	OUT-H	55	57.3	90	76.9	96	78.0	30	56.6	18	51.4	2	40.0	2	50.0	293	67.7
E	TOTAL	250	32.7	220	39.4	182	48.0	57	37.7	32	23.4	12	17.1	3	5.0	756	35.7
P	IN-L	4	2.7	9	12.7	18	41.9	5	55.6							36	13.3
U	IN-M	3	3.2	13	11.8	11	22.0	1	10.0			1	50.0			29	10.7
B	IN-H	11	7.1	12	11.3	6	10.5	3	21.4	1	9.1					33	9.5
L	OUT-L	5	3.0	26	31.3	16	37.2	10	76.9	10	50.0	18	60.0	29	70.7	114	28.7
I	OUT-M	18	17.0	20	28.2	9	14.3	18	34.6	46	68.7	12	41.4	11	84.6	134	33.4
C	OUT-H	4	4.2	6	5.1	17	13.8	11	20.8	12	34.3	2	40.0	2	50.0	54	12.5
	TOTAL	45	5.9	86	15.4	77	20.3	48	31.8	69	50.4	33	47.1	42	70.0	400	18.9
SEMI	IN-L	2	1.4	23	32.4	13	30.2	2	22.2					1	100.0	41	15.1
P	IN-M	7	7.5	22	20.0	15	30.0	2	20.0	2	50.0					48	17.8
U	IN-H			15	14.2	23	40.4	6	42.9	5	45.5	1	25.0			50	14.4
B	OUT-L	142	85.0	42	50.6	11	25.6					1	3.3	3	7.3	199	50.1
L	OUT-M	2	1.9	13	18.3	9	14.3	15	28.8	14	20.9	9	31.0	1	7.7	63	15.7
I	OUT-H	3	3.1	13	11.1	10	8.1	11	20.8	4	11.4	1	20.0			42	9.7
C	TOTAL	156	20.4	128	22.9	81	21.4	36	23.8	25	18.2	12	17.1	5	8.3	443	20.9
W	IN-L	121	82.3	35	49.3	8	18.6	1	11.1							165	60.9
A	IN-M	49	52.7	34	30.9	3	6.0	1	10.0			1	50.0	1	100.0	89	33.0
L	IN-H	29	18.6	20	18.9	9	15.8	2	14.3			1	25.0			61	17.5
K	OUT-L	10	6.0	10	12.0	16	37.2	3	23.1	10	50.0	11	36.7	9	22.0	69	17.4
I	OUT-M	71	67.0	17	23.9	3	4.8	2	3.8							93	23.2
N	OUT-H	34	35.4	8	6.8			1	1.9	1	2.9					44	10.2
G	TOTAL	314	41.0	124	22.2	39	10.3	10	6.6	11	8.0	13	18.6	10	16.7	521	24.6
	IN-L	147	100.0	71	100.0	43	100.0	9	100.0	0	100.0	0	100.0	1	100.0	271	100.0
T	IN-M	93	100.0	110	100.0	50	100.0	10	100.0	4	100.0	2	100.0	1	100.0	270	100.0
O	IN-H	156	100.0	106	100.0	57	100.0	14	100.0	11	100.0	4	100.0	0	100.0	348	100.0
T	OUT-L	167	100.0	83	100.0	43	100.0	13	100.0	20	100.0	30	100.0	41	100.0	397	100.0
A	OUT-M	106	100.0	71	100.0	63	100.0	52	100.0	67	100.0	29	100.0	13	100.0	401	100.0
L	OUT-H	96	100.0	117	100.0	123	100.0	53	100.0	35	100.0	5	100.0	4	100.0	433	100.0
	TOTAL	765	100.0	558	100.0	379	100.0	151	100.0	137	100.0	70	100.0	60	100.0	2120	100.0

Table B.26. Travel Time by Districts According to Travel Purposes (Column %)

	TRAVEL TIME (Minutes)															
	5-10		15-20		25-30		35-40		45-50		55-60		65+		TOTAL	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
WORK																
IN-L	65	44.2	23	32.4	16	37.2	4	44.4							108	39.9
IN-M	29	31.2	46	41.8	23	46.0	5	50.0	1	33.3	2	66.7			106	39.3
IN-H	65	41.7	41	38.7	16	28.1	4	28.6	5	45.5					131	37.6
OUT-L	13	7.8	18	21.7	11	25.6	6	46.2	11	55.0	15	50.0	12	29.3	86	21.7
OUT-M	12	11.3	23	32.4	27	42.9	19	36.5	21	31.3	7	24.1	4	30.8	113	28.2
OUT-H	19	19.8	36	30.8	59	48.0	22	41.5	17	48.6	4	80.0		0.0	157	36.3
TOTAL	203	26.5	187	33.5	152	40.1	60	39.7	55	40.4	28	39.4	16	26.7	701	33.1
SCHOOL																
IN-L	41	27.9	21	29.6	12	27.9	3	33.3					1	100.0	78	28.8
IN-M	14	15.1	20	18.2	8	16.0	2	20.0							44	16.3
IN-H	10	6.4	23	21.7	18	31.6	6	42.9	3	27.3	1	25.0			61	17.5
OUT-L	91	54.5	19	22.9	7	16.3					2	6.7	4	9.8	123	31.0
OUT-M	33	31.1	4	5.6	3	4.8	3	5.8	6	9.0	4	13.8	3	23.1	56	14.0
OUT-H	16	16.7	23	19.7	10	8.1	12	22.6	5	14.3	1	20.0		0.0	67	15.5
TOTAL	205	26.8	110	19.7	58	15.3	26	17.2	14	10.3	8	11.3	8	13.3	429	20.2
SHOPPING																
IN-L	12	8.2			2	4.7									14	5.2
IN-M	8	8.6	6	5.5	6	12.0	2	20.0							22	8.1
IN-H	12	7.7	12	11.3	5	8.8	1	7.1	1	9.1					31	8.9
OUT-L	25	15.0	7	8.4	1	2.3									33	8.3
OUT-M	18	17.0	4	5.6			2	3.8			2	6.9	1	7.7	27	6.7
OUT-H	19	19.8	8	6.8	19	15.4	9	17.0	2	5.7					57	13.2
TOTAL	94	12.3	37	6.6	33	8.7	14	9.3	3	2.2	2	2.8	1	1.7	184	8.7
SOCIAL																
IN-L	28	19.0	12	16.9	3	7.0									43	15.9
IN-M	27	29.0	26	23.6	5	10.0	1	10.0			1	33.3	1	100.0	61	22.6
IN-H	54	34.6	23	21.7	7	12.3	2	14.3			1	25.0			87	25.0
OUT-L	29	17.4	11	13.3	6	14.0					2	6.7	2	4.9	50	12.6
OUT-M	17	16.0	15	21.1	16	25.4	12	23.1	10	14.9	4	13.8			74	18.5
OUT-H	33	34.4	35	29.9	24	19.5	6	11.3	4	11.4			2	50.0	104	24.0
TOTAL	188	24.6	122	21.9	61	16.1	21	13.9	14	10.3	8	11.3	5	8.3	419	19.8
OTHER																
IN-L			4	5.6	5	11.6	1	11.1							10	3.7
IN-M	6	6.5	5	4.5	2	4.0			1	33.3					14	5.2
IN-H	8	5.1					1	7.1	2	18.2	2	50.0			13	3.7
OUT-L										0.0	2	6.7			2	0.5
OUT-M	1	0.9			3	4.8	2	3.8	5	7.5	1	3.4			12	3.0
OUT-H	2	2.1	6	5.1					1	2.9					9	2.1
TOTAL	17	2.2	15	2.7	10	2.6	4	2.6	9	6.6	5	7.0	0	0.0	60	2.8
TRANSFER TO OTHER MODE FOR SCHOOL																
IN-L			10	14.1	5	11.6	1	11.1							16	5.9
IN-M	8	8.6	4	3.6	3	6.0			1	33.3					16	5.9
IN-H	6	3.8	4	3.8	9	15.8									19	5.5
OUT-L	1	0.6	6	7.2	3	7.0			1	5.0	2	6.7	3	7.3	16	4.0
OUT-M	2	1.9	5	7.0	2	3.2	3	5.8	5	7.5	3	10.3	1	7.7	21	5.2
OUT-H	2	2.1	2	1.7	3	2.4			3	8.6					10	2.3
TOTAL	19	2.5	31	5.6	25	6.6	4	2.6	10	7.4	5	7.0	4	6.7	98	4.6
TRANSFER TO OTHER MODE FOR WORK																
IN-L															0	0.0
IN-M															0	0.0
IN-H					2	3.5									2	0.6
OUT-L	6	3.6	19	22.9	14	32.6	4	30.8	8	40.0	7	23.3	16	39.0	74	18.6
OUT-M	13	12.3	13	18.3	6	9.5	5	9.6	11	16.4	4	13.8	4	30.8	56	14.0
OUT-H	2	2.1	2	1.7	4	3.3	1	1.9	2	5.7		0.0	1	25.0	12	2.8
TOTAL	21	2.7	34	6.1	26	6.9	10	6.6	21	15.4	11	15.5	21	35.0	144	6.8
TRANSFER TO OTHER MODE																
IN-L	1	0.7	1	1.4											2	0.7
IN-M	1	1.1	3	2.7	3	6.0									7	2.6
IN-H	1	0.6	3	2.8											4	1.1
OUT-L	2	1.2	3	3.6	1	2.3	3	23.1					4	9.8	13	3.3
OUT-M	10	9.4	7	9.9	6	9.5	6	11.5	9	13.4	4	13.8			42	10.5
OUT-H	3	3.1	5	4.3	4	3.3	3	5.7	1	2.9		0.0	1	25.0	17	3.9
TOTAL	18	2.4	22	3.9	14	3.7	12	7.9	10	7.4	4	5.6	5	8.3	86	4.0
TOTAL																
IN-L	147	100.0	71	100.0	43	100.0	9	100.0	0	100.0	0	100.0	1	100.0	271	100.0
IN-M	93	100.0	110	100.0	50	100.0	10	100.0	3	100.0	3	100.0	1	100.0	270	100.0
IN-H	156	100.0	106	100.0	57	100.0	14	100.0	11	100.0	4	100.0	0	100.0	348	100.0
OUT-L	167	100.0	83	100.0	43	100.0	13	100.0	20	100.0	30	100.0	41	100.0	397	100.0
OUT-M	106	100.0	71	100.0	63	100.0	52	100.0	67	100.0	29	100.0	13	100.0	401	100.0
OUT-H	96	100.0	117	100.0	123	100.0	53	100.0	35	100.0	5	100.0	4	100.0	433	100.0
TOTAL	765	100.0	558	100.0	379	100.0	151	100.0	136	100.0	71	100.0	60	100.0	2120	100.0

APPENDIX C. COMPUTER OUTPUTS OF ANALYSIS OF VARIANCE

ONDER - IN-L

```
-> ONEWAY
->  distan1 enerji BY mode1(1 4)
->  /HARMONIC NONE
->  /STATISTICS DESCRIPTIVES
->  /FORMAT NOLABELS
->  /MISSING ANALYSIS .
------- ----------O N E W A Y----------------
```

Variable DISTAN1 By Variable MODE1

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	1410.5645	470.1882	120.2051	.0000
Within Groups	267	1044.3834	3.9115		
Total	270	2454.9479			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	29	4.2000	3.8630	.7173	2.7306	TO	5.6694
Grp 2	36	5.9333	3.2313	.5385	4.8400	TO	7.0266
Grp 3	165	.7358	.6278	.0489	.6393	TO	.8323
Grp 4	41	5.5805	2.2162	.3461	4.8810	TO	6.2800
Total	271	2.5299	3.0154	.1832	2.1693	TO	2.8905

GROUP	MINIMUM	MAXIMUM
Grp 1	1.0000	14.2000
Grp 2	1.2000	21.6000
Grp 3	.2000	6.4000
Grp 4	2.8000	10.4000
TOTAL	.2000	21.6000

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------- ----------O N E W A Y----------------
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Variable ENERJI By Variable MODE1

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	412621951.8	137540650.6	89.9331	.0000
Within Groups	267	408340986.4	1529366.990		
Total	270	820962938.3			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	29	4116.0000	3785.7512	702.9963	2675.9772	TO	5556.0228
Grp 2	36	427.2000	232.6519	38.7753	348.4819	TO	505.9181
Grp 3	165	45.6170	38.9240	3.0302	39.6337	TO	51.6003
Grp 4	41	881.7171	350.1620	54.6861	771.1923	TO	992.2418
Total	271	658.3779	1743.7326	105.9242	449.8354	TO	866.9203

GROUP	MINIMUM	MAXIMUM
Grp 1	980.0000	13916.0000
Grp 2	86.4000	1555.2000
Grp 3	12.4000	396.8000
Grp 4	442.4000	1643.2000
TOTAL	12.4000	13916.0000

ESAT - IN-M

```
-> ONEWAY
->  distan1 enerji BY mode1(1 4)
->  /HARMONIC NONE
->  /STATISTICS DESCRIPTIVES
->  /FORMAT NOLABELS
->  /MISSING ANALYSIS .
```

------- ----------O N E W A Y----------------

Variable DISTAN1 By Variable MODE1

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	1235.4616	411.8205	42.3323	.0000
Within Groups	266	2587.7236	9.7283		
Total	269	3823.1852			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	104	5.6663	4.3103	.4227	4.8281	TO	6.5046
Grp 2	29	3.4966	1.4732	.2736	2.9362	TO	4.0569
Grp 3	89	.8775	.4237	.0449	.7883	TO	.9668
Grp 4	48	5.3167	3.5658	.5147	4.2813	TO	6.3521
Total	270	3.7926	3.7700	.2294	3.3409	TO	4.2443

GROUP	MINIMUM	MAXIMUM
Grp 1	1.2000	21.4000
Grp 2	1.4000	5.8000
Grp 3	.1000	2.0000
Grp 4	1.2000	12.0000
TOTAL	.1000	21.4000

------- ----------O N E W A Y----------------

Variable ENERJI By Variable MODE1

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	1773019138	591006379.5	84.8355	.0000
Within Groups	266	1853088652	6966498.690		
Total	269	3626107790			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	104	5553.0192	4224.0582	414.2030	4731.5453	TO	6374.4932
Grp 2	29	251.7517	106.0710	19.6969	211.4045	TO	292.0990
Grp 3	89	54.4067	26.2670	2.7843	48.8735	TO	59.9400
Grp 4	48	840.0333	563.3893	81.3182	676.4421	TO	1003.6245
Total	270	2333.2541	3671.5058	223.4407	1893.3391	TO	2773.1691

GROUP	MINIMUM	MAXIMUM
Grp 1	1176.0000	20972.0000
Grp 2	100.8000	417.6000
Grp 3	6.2000	124.0000
Grp 4	189.6000	1896.0000
TOTAL	6.2000	20972.0000

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-> ONEWAY
->  distan1 enerji BY mode1(1 4)
->  /HARMONIC NONE
->  /STATISTICS DESCRIPTIVES
->  /FORMAT NOLABELS
->  /MISSING ANALYSIS .
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------- ----------O N E W A Y----------------

Variable DISTAN1 By Variable MODE1

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	1704.3732	568.1244	26.9930	.0000
Within Groups	344	7240.1960	21.0471		
Total	347	8944.5692			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	204	5.1015	4.5743	.3203	4.4700	TO	5.7329
Grp 2	33	4.1394	2.1792	.3793	3.3667	TO	4.9121
Grp 3	61	1.0508	.9686	.1240	.8027	TO	1.2989
Grp 4	50	8.8360	7.5381	1.0660	6.6937	TO	10.9783
Total	348	4.8368	5.0771	.2722	4.3015	TO	5.3721

GROUP	MINIMUM	MAXIMUM
Grp 1	.1000	25.4000
Grp 2	1.2000	12.0000
Grp 3	.1000	4.8000
Grp 4	.2000	34.0000
TOTAL	.1000	34.0000

------- ----------O N E W A Y----------------

Variable ENERJI By Variable MODE1

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	1700331455	566777151.6	46.9816	.0000
Within Groups	344	4149953924	12063819.55		
Total	347	5850285379			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	204	4999.4412	4482.8313	313.8610	4380.5956	TO	5618.2868
Grp 2	33	298.0364	156.8991	27.3126	242.4024	TO	353.6704
Grp 3	61	65.1508	60.0539	7.6891	49.7703	TO	80.5313
Grp 4	50	1396.0880	1191.0135	168.4347	1057.6057	TO	1734.5703
Total	348	3170.9764	4106.0458	220.1072	2738.0644	TO	3603.8885

GROUP	MINIMUM	MAXIMUM
Grp 1	98.0000	24892.0000
Grp 2	86.4000	864.0000
Grp 3	6.2000	297.6000
Grp 4	31.6000	5372.0000
TOTAL	6.2000	24892.0000

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-> ONEWAY
->  distan1 enerji BY mode1(1 4)
->  /HARMONIC NONE
->  /STATISTICS DESCRIPTIVES
->  /FORMAT NOLABELS
->  /MISSING ANALYSIS .
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------- ---------- O N E W A Y ----------------

Variable DISTAN1 By Variable MODE1

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	28274.7228	9424.9076	163.3577	.0000
Within Groups	393	22674.1039	57.6949		
Total	396	50948.8268			

Group	Count	Standard Mean	Standard Deviation	Error	95 Pct Conf Int for Mean		
Grp 1	15	5.1733	5.0709	1.3093	2.3652	TO	7.9815
Grp 2	114	18.0772	11.5869	1.0852	15.9272	TO	20.2272
Grp 3	199	.4985	.4551	.0323	.4349	TO	.5621
Grp 4	69	16.9391	10.2197	1.2303	14.4841	TO	19.3942
Total	397	8.5804	11.3428	.5693	7.4612	TO	9.6995

GROUP	MINIMUM	MAXIMUM
Grp 1	.8000	13.0000
Grp 2	1.0000	32.4000
Grp 3	.1000	4.0000
Grp 4	.8000	38.0000
TOTAL	.1000	38.0000

------- ---------- O N E W A Y ----------------

Variable ENERJI By Variable MODE1

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	638782574.0	212927524.7	139.0427	.0000
Within Groups	393	601833214.6	1531382.225		
Total	396	1240615789			

Group	Coun	Standard Mean	Standard Deviation	Error	95 Pct Conf Int for Mean		
Grp 1	15	5069.8667	4969.4334	1283.1022	2317.8862	TO	7821.8471
Grp 2	114	1301.5579	834.2602	78.1356	1146.7571	TO	1456.3587
Grp 3	199	30.9065	28.2164	2.0002	26.9621	TO	34.8510
Grp 4	69	2676.3826	1614.7069	194.3879	2288.4876	TO	3064.2776
Total	397	1045.9607	1769.9910	88.8333	871.3169	TO	1220.6045

GROUP	MINIMUM	MAXIMUM
Grp 1	784.0000	12740.0000
Grp 2	72.0000	2332.8000
Grp 3	6.2000	248.0000
Grp 4	126.4000	6004.0000
TOTAL	6.2000	12740.0000

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-> ONEWAY
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->  /HARMONIC NONE
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->  /FORMAT NOLABELS
->  /MISSING ANALYSIS .
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------- ----------- O N E W A Y -----------------

Variable DISTAN1 By Variable MODE1

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	12726.5031	4242.1677	112.3022	.0000
Within Groups	397	14996.5059	37.7746		
Total	400	27723.0089			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	111	14.7856	8.0087	.7602	13.2791	TO	16.2920
Grp 2	134	13.1134	6.4947	.5611	12.0037	TO	14.2232
Grp 3	93	.8086	.5658	.0587	.6921	TO	.9251
Grp 4	63	14.7333	6.0928	.7676	13.1989	TO	16.2678
Total	401	10.9771	8.3251	.4157	10.1598	TO	11.7944

GROUP	MINIMUM	MAXIMUM
Grp 1	.6000	36.2000
Grp 2	1.0000	21.0000
Grp 3	.2000	3.4000
Grp 4	1.6000	25.6000
TOTAL	.2000	36.2000

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Variable ENERJI By Variable MODE1

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	14893936061	4964645354	287.2038	.0000
Within Groups	397	6862598795	17286143.06		
Total	400	21756534856			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	111	14489.8739	7848.5352	744.9500	13013.5578	TO	15966.1900
Grp 2	134	944.1672	467.6195	40.3962	864.2651	TO	1024.0692
Grp 3	93	50.1333	35.0803	3.6377	42.9086	TO	57.3580
Grp 4	63	2327.8667	962.6672	121.2847	2085.4221	TO	2570.3113
Total	401	4703.7716	7375.0483	368.2923	3979.7411	TO	5427.8020

GROUP	MINIMUM	MAXIMUM
Grp 1	588.0000	35476.0000
Grp 2	72.0000	1512.0000
Grp 3	12.4000	210.8000
Grp 4	252.8000	4044.8000
TOTAL	12.4000	35476.0000

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-> ONEWAY
->  distan1 enerji BY mode1(1 4)
->  /HARMONIC NONE
->  /STATISTICS DESCRIPTIVES
->  /FORMAT NOLABELS
->  /MISSING ANALYSIS .
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------- ----------O N E W A Y----------------

Variable DISTAN1 By Variable MODE1

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	7748.9316	2582.9772	55.3759	.0000
Within Groups	429	20010.4472	46.6444		
Total	432	27759.3788			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	293	14.0959	7.6305	.4458	13.2186	TO	14.9733
Grp 2	54	15.1074	5.7160	.7779	13.5472	TO	16.6676
Grp 3	44	.7659	.5730	.0864	.5917	TO	.9401
Grp 4	42	16.7095	5.5500	.8564	14.9800	TO	18.4390
Total	433	13.1210	8.0161	.3852	12.3639	TO	13.8782

GROUP	MINIMUM	MAXIMUM
Grp 1	.4000	54.0000
Grp 2	2.2000	21.4000
Grp 3	.3000	3.0000
Grp 4	2.4000	28.0000
TOTAL	.3000	54.0000

------- ----------O N E W A Y----------------

Variable ENERJI By Variable MODE1

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	15156282905	5052094302	132.4052	.0000
Within Groups	429	16369062915	38156323.81		
Total	432	31525345821			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	293	13813.9863	7477.9367	436.8657	12954.1815	TO	14673.7912
Grp 2	54	1087.7333	411.5527	56.0052	975.4011	TO	1200.0656
Grp 3	44	47.4864	35.5269	5.3559	36.6852	TO	58.2875
Grp 4	42	2640.1048	876.8978	135.3083	2366.8442	TO	2913.3654
Total	433	9744.1326	8542.5604	410.5293	8937.2494	TO	10551.0157

GROUP	MINIMUM	MAXIMUM
Grp 1	392.0000	52920.0000
Grp 2	158.4000	1540.8000
Grp 3	18.6000	186.0000
Grp 4	379.2000	4424.0000
TOTAL	18.6000	52920.0000

APPENDIX D. ADDITIONAL TABLES FOR CHAPTER SIX

Table D.1. Two Scenarios for Total Energy Consumption of Trips For Various Purposes - Calories

	TRAVEL PURPOSES					
	SCHOOL	WORK	SHOPPING	SOCIAL	OTHER	TOTAL
TOTAL ENERGY USE (Calories per passenger km)						
IN-L	24501.20	96184.80	2144.00	31807.20	23783.20	178420.40
IN-M	40398.80	300672.40	140633.60	89500.60	58773.20	629978.60
IN-H	137220.40	552832.40	67294.00	221782.60	124370.40	1103499.80
OUT-L	28751.60	352924.00	905.20	12374.00	20771.60	415726.40
OUT-M	116629.60	991848.40	10570.80	553947.60	213216.00	1886212.40
OUT-H	353098.80	2217427.40	493664.40	997057.20	157961.60	4219209.40
TOTAL TRAVEL DISTANCE (km)						
IN-L	231.60	301.40	16	63.8	72.80	685.6
IN-M	215.40	422.40	148	140.7	97.50	1024
IN-H	491.00	679.80	104.9	266.1	141.40	1683.2
OUT-L	365.20	2608.60	14.6	134.2	283.80	3406.4
OUT-M	655.80	2154.40	107.6	857.8	626.20	4401.8
OUT-H	964.80	2663.80	584.6	1167.8	300.40	5681.4
TOTAL NUMBER OF TRIPS PER DAY						
IN-L	94	108	14	43	12	271
IN-M	60	106	22	61	21	270
IN-H	80	133	31	87	17	348
OUT-L	139	160	33	50	15	397
OUT-M	77	169	27	74	54	401
OUT-H	77	169	57	104	26	433
AVERAGE TRIP DISTANCE (km)						
IN-L	2.46	2.79	1.14	1.48	6.07	2.53
IN-M	3.59	3.98	6.73	2.31	4.64	3.79
IN-H	6.14	5.11	3.38	3.06	8.32	4.84
SCENARIO-I						
TOTAL TRAVEL DISTANCE (km)						
OUT-L	342.47	446.52	37.71	74.19	91.00	991.89
OUT-M	276.43	673.45	181.64	170.69	250.71	1552.91
OUT-H	472.59	863.81	192.88	318.10	216.26	2063.63
TOTAL ENERGY USE **(Calories per passenger km)**						
OUT-L	20311.59	140674.28	682.00	25241.16	5949.73	192858.76
OUT-M	35122.09	371282.79	38018.13	139768.07	56912.50	641103.58
OUT-H	178439.76	751506.16	166066.47	271790.27	194076.84	1561879.51
SCENARIO-II						
TOTAL TRAVEL DISTANCE (km)						
OUT-L	342.47	446.52	37.71	74.19	91.00	991.89
OUT-M	276.43	673.45	181.64	170.69	250.71	1552.91
OUT-H	472.59	863.81	192.88	318.10	216.26	2063.63
TOTAL ENERGY USE **(Calories per passenger km)**						
OUT-L	36230.50	142496.00	5053.71	36985.12	29729.00	250494.33
OUT-M	51845.13	479373.92	172595.78	108574.50	151131.09	963520.41
OUT-H	132074.64	702471.25	123734.13	265119.43	190213.55	1413612.99

Table D.2. Changes in Total Energy Consumption of Trips For Various Purposes Due to Scenario-I and II - Calories

		TRAVEL PURPOSE					
		SCHOOL	WORK	SHOPPING	SOCIAL	OTHER	TOTAL
SCENARIO-I							
DISTANCE	OUT-L	-0.062233	-0.828828	1.583170	-0.447197	-0.679351	-0.708815
	OUT-M	-0.578484	-0.687407	0.688070	-0.801019	-0.599625	-0.647209
	OUT-H	-0.510170	-0.675724	-0.670063	-0.727610	-0.280097	-0.636774
ENERGY	OUT-L	-0.293549	-0.601403	-0.246575	1.039854	-0.713564	-0.536092
	OUT-M	-0.698857	-0.625665	2.596523	-0.747687	-0.733075	-0.660110
	OUT-H	-0.494646	-0.661090	-0.663604	-0.727407	0.228633	-0.629817
SCENARIO-II							
DISTANCE	OUT-L	-0.062233	-0.828828	1.583170	-0.447197	-0.679351	-0.708815
	OUT-M	-0.578484	-0.687407	0.688070	-0.801019	-0.599625	-0.647209
	OUT-H	-0.510170	-0.675724	-0.670063	-0.727610	-0.280097	-0.636774
ENERGY	OUT-L	0.260121	-0.596241	4.582980	1.988937	0.431233	-0.397453
	OUT-M	-0.555471	-0.516686	15.32759	-0.803998	-0.291183	-0.489177
	OUT-H	-0.625955	-0.683204	-0.749355	-0.734098	0.204175	-0.664957

Table D.3. Two Scenarios for Total Energy Consumption of Trips by Various Modes - Calories

	TRAVEL MODES				
	PRIVATE	PUBLIC	SEMI PUBLIC	WALKING	TOTAL
TOTAL ENERGY USE (Calories per passenger km)					
IN-L	119364.00	15379.20	36150.40	7526.80	178420.40
IN-M	577514.00	7300.80	40321.60	4842.20	629978.60
IN-H	1019886.00	9835.20	69804.40	3974.20	1103499.80
OUT-L	76048.00	148377.60	185460.40	5840.40	415726.40
OUT-M	1608376.00	126518.40	146655.60	4662.40	1886212.40
OUT-H	4047498.00	58737.60	110884.40	2089.40	4219209.40
TOTAL TRAVEL DISTANCE (km)					
IN-L	121.8	213.6	228.8	121.4	685.6
IN-M	589.3	101.4	255.2	78.1	1024
IN-H	1040.7	136.6	441.8	64.1	1683.2
OUT-L	77.6	2060.8	1173.8	94.2	3406.4
OUT-M	1641.2	1757.2	928.2	75.2	4401.8
OUT-H	4130.1	815.8	701.8	33.7	5681.4
TOTAL NUMBER OF TRIPS PER DAY					
IN-L	29	36	41	165	271
IN-M	104	29	48	89	270
IN-H	204	33	50	61	348
OUT-L	15	114	72	196	397
OUT-M	111	134	63	93	401
OUT-H	293	54	42	44	433
AVERAGE TRIP DISTANCE (km)					
IN-L	4.20	5.93	5.58	0.74	2.53
IN-M	5.67	3.50	5.32	0.88	3.79
IN-H	5.10	4.14	8.84	1.05	4.84
PERCENTAGE DISTRIBUTION OF TRIPS					
IN-L	10.70	13.28	15.13	60.89	100.00
IN-M	38.52	10.74	17.78	32.96	100.00
IN-H	58.62	9.48	14.37	17.53	100.00
SCENARIO-I					
TOTAL TRAVEL DISTANCE (km)					
OUT-L	59.10	758.58	457.21	130.32	991.89
OUT-M	566.32	431.40	317.04	80.03	1552.91
OUT-H	1510.56	213.40	399.36	49.42	2063.63
TOTAL ENERGY USE **(Calories per passenger km)**					
OUT-L	57922.67	54617.60	72238.41	8080.08	192858.76
OUT-M	554989.60	31060.60	50091.67	4961.71	641103.58
OUT-H	1480352.42	15364.53	63098.39	3064.17	1561879.51
SCENARIO-II					
ASSUMED MODAL SPLIT (TOTAL NUMBER OF TRIPS PER DAY)					
OUT-L	42	53	60	242	397
OUT-M	154	43	71	132	401
OUT-H	254	41	62	76	433
TOTAL TRAVEL DISTANCE (km)					
OUT-L	166.84	307.11	341.34	176.61	991.89
OUT-M	902.73	159.30	384.77	106.11	1552.91
OUT-H	1350.69	174.84	458.23	79.87	2063.63
TOTAL ENERGY USE **(Calories per passenger km)**					
OUT-L	163501.73	22111.91	53931.05	10949.64	250494.33
OUT-M	884677.87	11469.25	60794.26	6579.04	963520.41
OUT-H	1323671.63	12588.45	72400.91	4952.00	1413612.99

Table D.4. Changes in Total Energy Consumption of Trips by Various Modes Due to Scenario-I and II - Calories

		TRAVEL MODE				
		PRIVATE	PUBLIC	SEMI PUBLIC	WALKING	TOTAL
SCENARIO-I						
DISTANCE	OUT-L	-0.238340	-0.631901	-0.610491	0.383481	-0.708815
	OUT-M	-0.654937	-0.754497	-0.658440	0.064196	-0.647209
	OUT-H	-0.634254	-0.738420	-0.430953	0.466531	-0.636774
ENERGY	OUT-L	-0.238340	-0.631901	-0.610491	0.383481	-0.536092
	OUT-M	-0.654937	-0.754497	-0.658440	0.064196	-0.660110
	OUT-H	-0.634254	-0.738420	-0.430953	0.466531	-0.629817
SCENARIO-II						
DISTANCE	OUT-L	1.149980	-0.850975	-0.709204	0.874810	-0.708815
	OUT-M	-0.449955	-0.909347	-0.585462	0.411084	-0.647209
	OUT-H	-0.672965	-0.785683	-0.347059	1.370060	-0.636774
ENERGY	OUT-L	1.149980	-0.850975	-0.709204	0.874810	-0.397453
	OUT-M	-0.449955	-0.909347	-0.585462	0.411084	-0.489177
	OUT-H	-0.672965	-0.785683	-0.347059	1.370060	-0.664957