

# **TRAVEL DEMAND ANALYSIS FOR TRANSPORTATION ACTION PLAN IN TIRANA METROPOLITAN AREA, ALBANIA**

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## **ABSTRACT**

While the overall objective of the Study is to develop thematic urban plans for Tirana metropolitan area, this paper presents the Study methods and analyses for developing urban transportation action plans for Tirana metropolitan area. Since qualitative, conceptual discussions would not be sufficient to provide the countermeasures to mid/long-term problems in urban transportation, the Study has established a transportation demand forecasting model. To develop a four-step demand forecast model, the Household Survey conducted in 2008 has been utilized as the only source of person-trip data that are available. Furthermore, for development of the base year case, the OD matrices from the Household Survey in 2008 have been updated to 2011 based on a wide variety of supplementary transportation survey data from Intersection Traffic Count, Cordon Line, Bus Passenger OD, Parking, and Transport Opinion Surveys, all of which were conducted in 2011-2012.

Based on the latest transportation demand forecasting model, total present and future trips have been forecast. Overall, the total number of trips in Tirana in the morning peak hours will significantly increase in future. The growth from 2008 to 2027 (i.e., target year of the action plan) is estimated to be about 2.5 times. Particularly, significant increase in both auto and transit trips is estimated in future, and the growth is estimated to be nearly 3 times. The demand forecast also showed that a parking pricing system is extremely important to promote the use of public transport.

Tirana metropolitan area is still in the transition period, and the transportation environment has been changing including motorization. Thus, a full-scale person trip survey by which a more comprehensive daily travel demand can be modelled is essential for actual transportation planning of Tirana, and it should be regularly conducted at intervals of five to ten years, especially in an urban area that is developing and expanding in scale.

*Keywords: Tirana, Four-step demand forecast model, Transportation survey, Model calibration, Parking pricing*

## **1. BACKGROUND**

### **1.1 Objective**

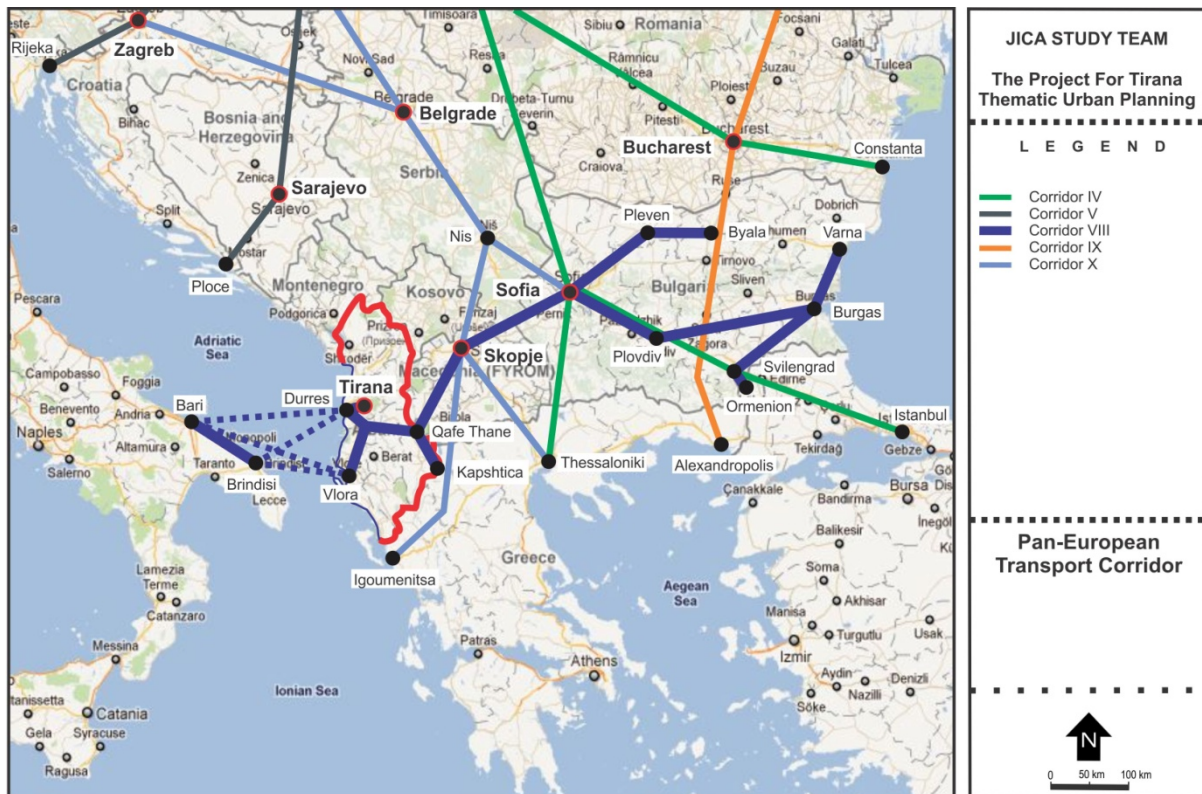
Along with democratization which started in 1991, urbanization has progressed in the capital city, Tirana, which has accommodated a rapid increase in migrants from rural areas. In 2008, the population of Tirana reached 580,000 (INSTAT) from 250,000 in 1989 (Municipality of Tirana, 1989) or an increase of about 230% in less than two decades. Such an acute urbanization resulted in serious urban problems such as shortages in infrastructure. Urbanization is still in progress, and it is predicted that the city's population will exceed 800,000 by 2027 (JICA and Municipality of Tirana, 2012). It is thus urgent for urban developments in the transportation, water/sewerage, and solid waste management sectors, in particular, to keep up with the burgeoning urban population.

Currently, the urban area has been extending from Tirana city to the surrounding communes, and it is particularly called Tirana metropolitan area. While the overall objective of the Study (JICA and Municipality of Tirana, 2012) is to develop thematic urban plans for the Tirana metropolitan area, this paper presents the Study methods and analyses for developing urban transportation action plans for Tirana metropolitan area.

### **1.2 Transportation Network**

Tirana is the capital of Albania, and it is geographically located in the centre of the country. Tirana is also located in the centre of the Albanian transport network, which should be integrated into the Balkan region and the Pan-European network (Figure 1), reflecting economic development and traffic forecasts. Above all, Corridor VIII is of utmost importance for Albania as it links the following main cities: Durres - Tirana - Skopje - Sofia - Plovdiv - Burgas - Varna- Constanta over a total length of 1,500 km, increasingly extending industrial and commercial cooperation in South Eastern Europe.

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Source: (Pan-European Corridor VIII Secretariat)  
 Figure 1 – Pan-European transport corridor in Balkan region

Based on the latest data from the municipality, there are about 170 km urban roads in Tirana, while the main roads outside Tirana connecting with other municipalities/communes are classified as interurban roads. The road network in Figure 2 shows that Tirana has three ring roads: namely, the Inner Ring Road, the Middle Ring Road, and the Outer Ring Road of which the west section is currently in service. The main radial roads of Tirana’s road network are extending from Tirana (the Inner Ring Road) west to Durres and the airport via Durres Highway, southwest to Kavaja/Durres, south to Elbasan, northeast to Dajti over the mountains, and northeast to Tufina. In addition to those five primary roads, there are several more radial roads most of which connect up to the construction limit of the municipality (called ‘Yellow Line’). In the northwest of Tirana, there is also a primary road diverting from Durres Highway and extending to Kamza/Fushe-Kruja. There is no national road inside Tirana, and all the roads are under the jurisdiction of the municipality of Tirana.

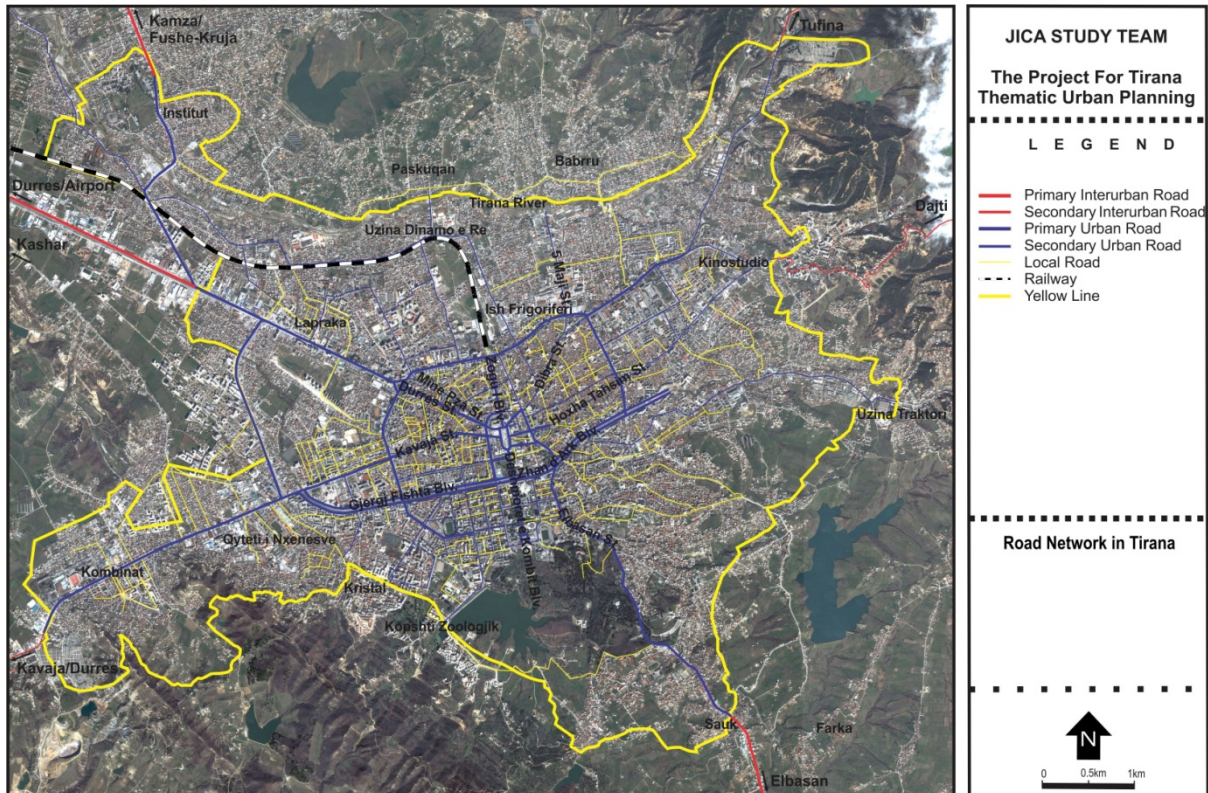


Figure 2 – Road and railway network in Tirana

## 2. DATA AND METHODOLOGY

Since qualitative, conceptual discussions would not be sufficient to provide the countermeasures to mid/long-term problems in urban transportation, the Study has established a transportation demand forecasting model. Therefore, assessing several alternative networks with simulation models will be a fundamentally important approach in addition to the traditional urban transportation analytical approach.

Basically, forecasting future traffic demand is done by applying the conventional four-step methodology, namely, trip generation and attraction model, trip distribution model, modal split model, and trip assignment model. To develop a four-step demand forecast model, the Household Survey conducted in 2008, which includes trip and socioeconomic information of 7,000 persons taken from 75 transportation analysis zones (TAZs) as shown in Figure 3, has been utilized as the only source of person-trip data that are available. Though it has been a while since this survey was conducted, it is believed that the travel demand forecast models should remain unchanged with fixed parameters over a period of time, so long as the context of the society will not change (Yagi et al., 2012).

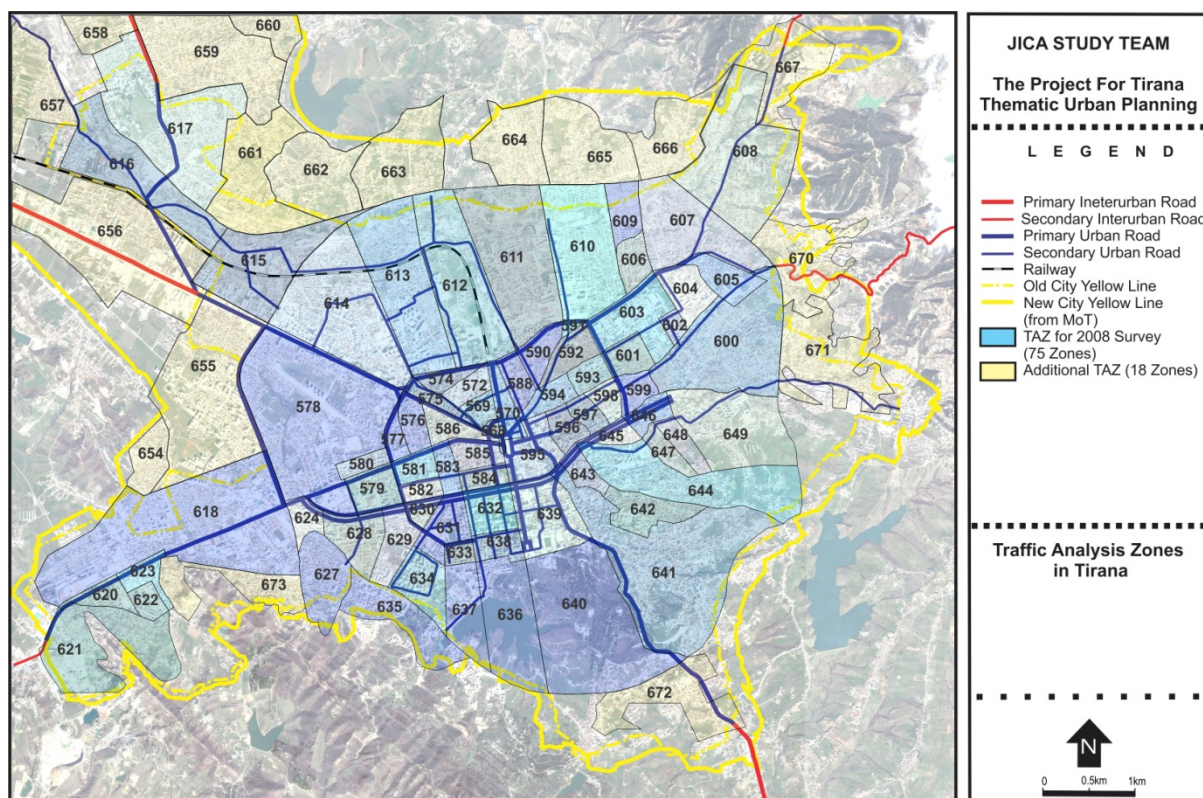


Figure 3 – Transportation Analysis Zones (TAZs) in Tirana.

## 2.1 Tirana Household Survey (2008)

A Household Survey was conducted from the end of September to October 2008, targeting 7,000 interviewees who travel daily for different purposes. It was conducted as part of a study called “Tirana Municipal Sustainable Transport Strategy (Municipality of Tirana, 2009),” which was funded by EBRD. As for transportation demand analysis, in order to implement a transportation assignment model, numerous activities were developed with cooperation of the Municipality of Tirana such as:

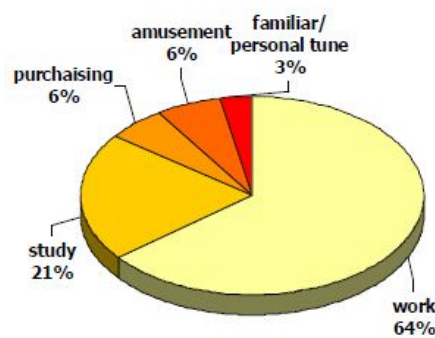
1. network creation (nodes and links);
2. network description (capacity, speed, link direction and turning relations);
3. time penalties at regulated (by traffic lights) crossroads;
4. origin/destination (O/D) zone connections with the network; and
5. O/D matrix building.

As for the highway network, the model comprised 558 nodes and 1,296 road links of which 280 were one-way links and the remaining 1,016 were two-way. The total network length was about 160 km.

Both private and public transport sectors were analyzed in this study. For private transport, an auto O/D matrix updated to 2007 was already available, while for public sector, no elaboration was ever made then. Thus, there were two outputs:

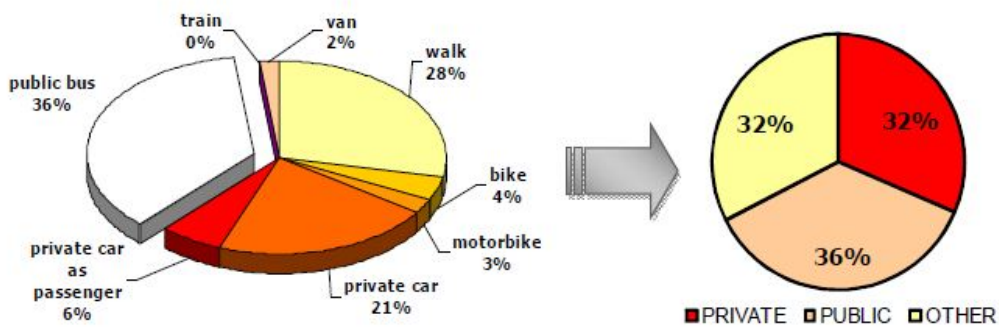
1. an updated 2008 auto matrix, and
2. a new 2008 transit matrix.

The results of the Household Survey showed that about 75% of the interviewees travel regularly between 6:00 and 9:00 a.m., whereas the remaining 25% travel during the other time of the day. Trip purpose and mode shares are presented in Figure 4 and Figure 5, respectively. As a unique characteristic of Tirana, walk is taking about 30% of all the trips. In addition, public transport is taking the largest share in spite of the ongoing rapid motorization. In Tirana, bus transportation is currently the only mode of urban transport.



Source: (Municipality of Tirana, 2009)

Figure 4 – Trip purpose shares.



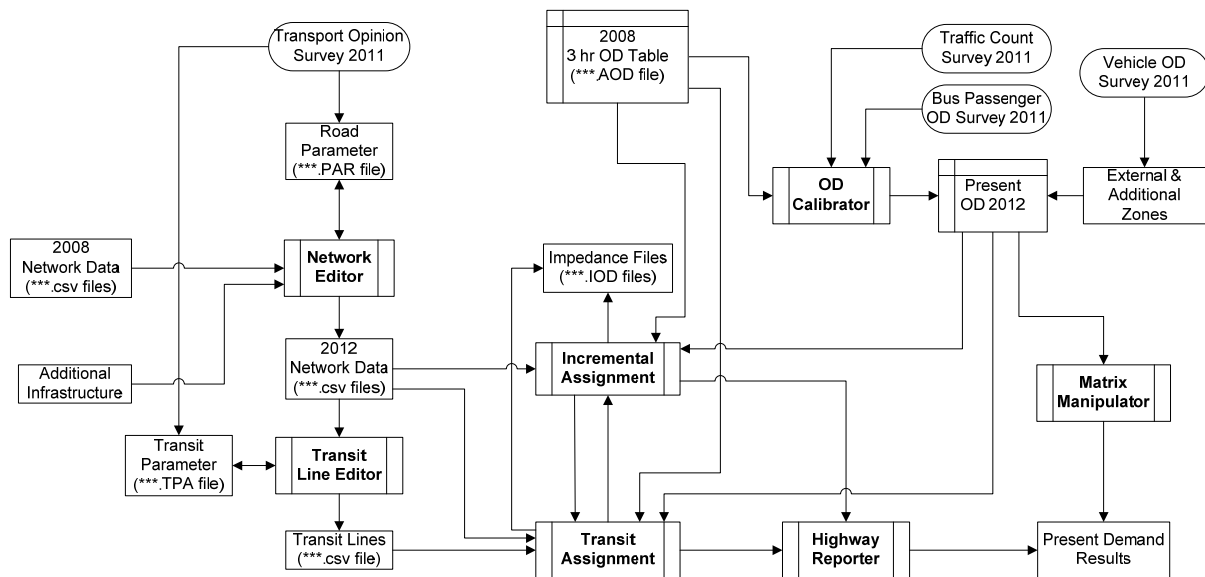
Source: (Municipality of Tirana, 2009)

Figure 5 – Trip mode shares.

## 2.2 Surveys for Updating Base-Year Travel Demand

Furthermore, for development of the base year (2012) case, the OD matrices from the Household Survey in 2008 have been updated to 2012 based on a wide variety of supplementary transportation observation survey data from Intersection Traffic Count, Cordon Line, and Bus Passenger OD Surveys, all of which were conducted in 2011-2012, as illustrated in Figure 6. Furthermore, additional TAZs around the city of Tirana have been added in the network, which now consists of 93 TAZs in total (Figure 3). Travel cost information from Transport Opinion Survey has also become an input to the highway and

transit network parameters in JICA STRADA, a transportation demand modelling software. These surveys have been utilized not only for model calibration but also for analysis of transportation control measures (TCMs), including Parking Survey.



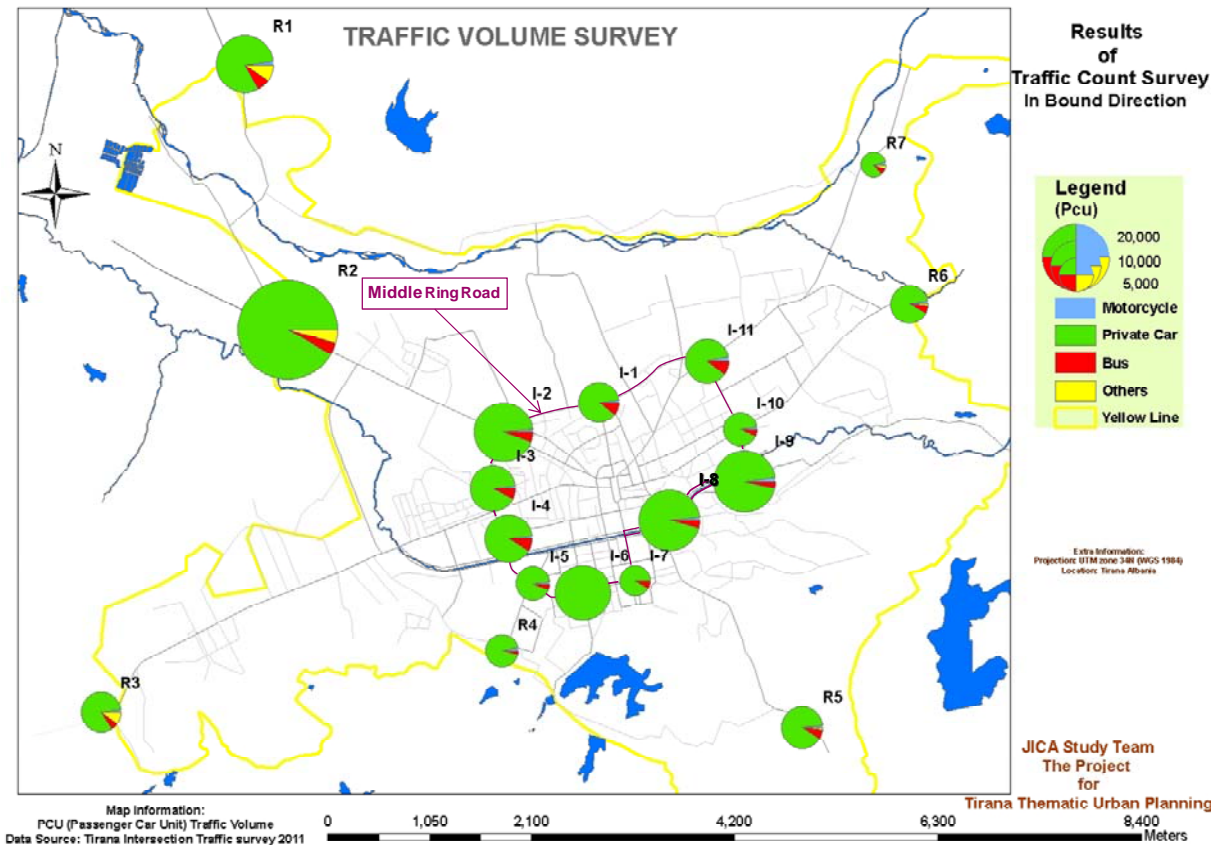
Note: **Bold letters** indicate program modules of JICA STRADA.

Figure 6 – Workflow for development of the base-year (2012) travel demand case.

### *Intersection Traffic Count Survey*

The objective of this survey is to understand the present traffic flows at those intersections by obtaining traffic volume data for each direction. The obtained data were used for grade separation projects, TCMs, etc. The data were also be utilized as a basic input for intersection analysis.

There are a total of 11 intersections for this survey, in view of the existing plans for improvement. Most of them are located on the Middle Ring Road to make it a kind of screen line for updating the base O/D matrices. Along with the traffic count stations in the following Cordon Line Survey, volumes and vehicle compositions of the inbound traffic for 16 hours (from 6:00 to 22:00) are presented in Figure 7 as an example. While trucks (excluding vehicles with a 3.5-ton or lower loading capacity) are banned from entering the central business district (CBD) inside the Middle Ring Road except in the nighttime, high traffic generation mixed with many slow, heavy vehicles is observed at the stations near the city boundaries.



Note: Unit: PCU per 16 hours (6:00 a.m. - 10:00 p.m.)

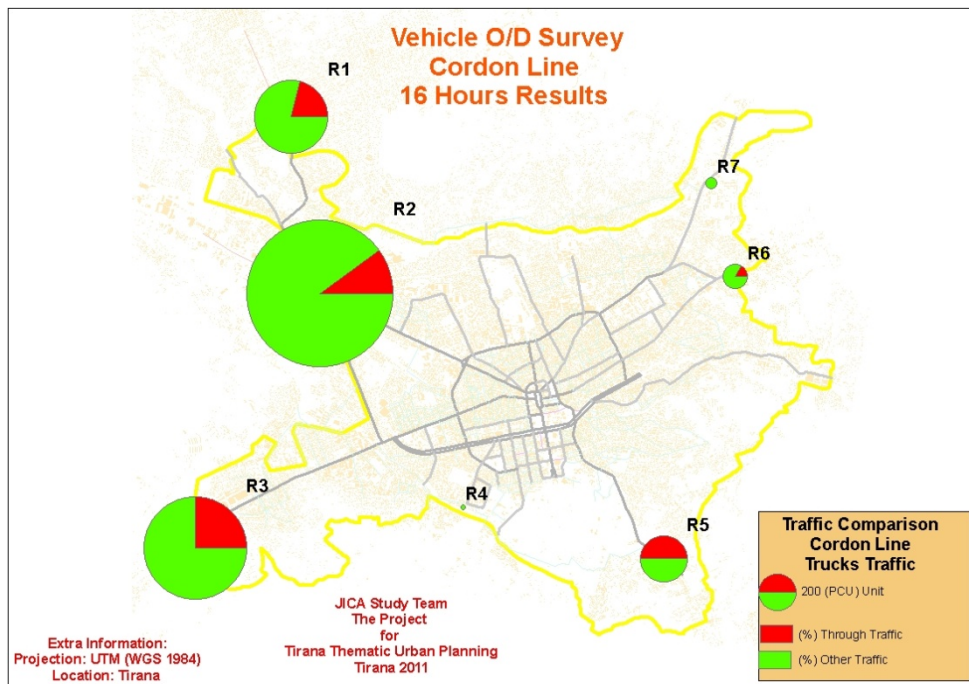
Figure 7 – Inbound traffic volumes and compositions at Intersection Traffic Count Survey stations in Tirana.

### Cordon Line Survey

The objective of the survey is to obtain the base-year data of passenger travel pattern, freight movement pattern, and vehicular trip pattern crossing the boundary of the city of Tirana. The obtained information was utilized to identify the O/D patterns in terms of person and freight movements between inside and outside the Tirana metropolitan area and to develop external O/D matrices.

As one of the findings, Figure 8 shows volumes of trucks to/from Tirana and shares of trucks passing through Tirana. Consideration of the traffic that bypasses Tirana is important to reduce the burden of other traffic going into the middle of the city. Thus, it is essential to give commercial traffic, especially trucks, alternatives to going through the centre of the city.





Note: Unit: PCU per 16 hours (6:00 a.m. - 10:00 p.m.)

Figure 8 – Volume of trucks to/from Tirana and trucks passing through Tirana.

### Bus Passenger OD Survey

The main objective of the survey that consists of bus count and occupancy, bus passenger count, and bus passenger O/D interview at major bus stops is to establish the pattern of flow and travel behaviour of bus passengers to obtain data which will contribute to the planning of public transport, including forecast of the number of passengers when a mass transit system is introduced, as well as the number of users of bus terminals when improved. The data were used for updating the base-year transit O/D matrices as well as for planning BRT (Bus Rapid Transit) facilities such as dedicated bus lanes. The data were also used for studying the necessity of a rail-based transport.

The map of Tirana city bus lines is presented in Figure 9. Tirana has total 10 city bus lines. Those existing city bus lines have been organized mainly based on a radial system, by means of which the lines go from the suburbs of the city to the city centre. In addition, there are some “through centre” lines, such as Kinostudio – Kombinat line and Uzina Dinamo e Re (or Sharra) line. Furthermore, there are two circular lines that do not follow the radial scheme: namely, Unaza line (Ring Road), which goes along the middle ring road around the city centre, and Tirana e Re line, which has a circular route passing the city centre and the western part of Tirana via the completed part of the outer ring road.

For Bus Passenger OD Survey, the three largest city bus corridors in terms of the number of passengers were particularly focused on and surveyed, namely: the north-south bus corridor (including Uzina Dinamo e Re line), the east-west corridor (including Kinostudio – Kombinat line), and the ring corridor (including Unaza line).

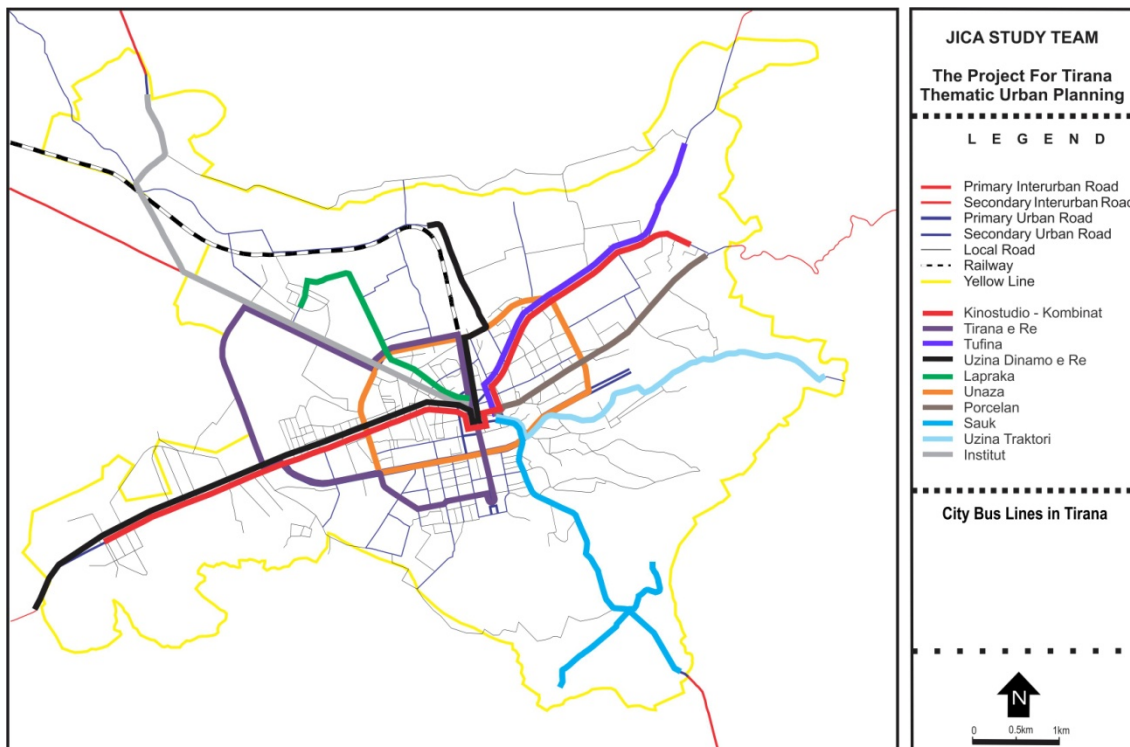


Figure 9 – City bus lines in Tirana.

### *Transport Opinion Survey*

This survey aims at developing basic data for establishment of a model to select the preferred mode of transportation and for formulation of a viable urban transport plan by identifying any willingness to use new modes of transportation. This survey was necessary because the past fact-finding surveys and analyses could not produce useful data for the selection of transportation modes when a plan for a new, especially rail-based, mass transit system as well as measures to facilitate the use of public transportation has been realized. The obtained information was also utilized to forecast the ridership of the new mass transit system and the acceptable fare level for proper operation planning.

As one of the survey results, modes of trips between central Tirana and the suburbs (outside the Middle Ring Road) made by residents that were randomly sampled in the new and old residential buildings among the possible mass transit corridors are presented in Figure 10. For the residents, the latest survey data shows that bus is by far the most used mode of transport in Tirana, followed by private car. Walk is also taking a certain share, ranking the third, in spite of the travel distance between central Tirana and the suburbs (i.e., around 1.5 km or longer). Such a tendency is characterizing the transport situation of Tirana.

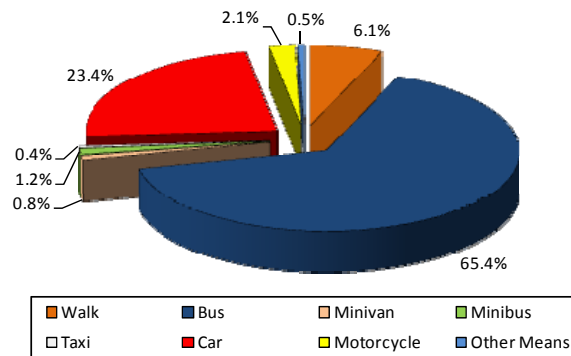


Figure 10 – Mode of trips between central Tirana and the suburbs taken by residents.

### *Parking Survey*

Under the situation of increasing automobiles and continuing reliance on private vehicles in Tirana, it is essential to increase the parking capacity in Tirana, especially in the CBD, where problems of overflowing parking vehicles are observed everywhere. With on-street public parking rules such as authorized parking time, parking fees are determined and managed by the Municipality of Tirana, but parking is not efficiently enforced. Illegal on-street parking outside the designated parking area is reducing the number of available driving lanes. This causes traffic disorder, consequently reducing the road capacity and increasing the travel time and eventually the traffic pollution.

Thus, the objective of this Parking Survey is to obtain the parking facility conditions, parking duration by purpose and other necessary data in the CBD of Tirana. The survey areas are the areas around large-scale facilities, namely: government office buildings, private office buildings, commercial buildings, and (legal) on-street parking. The obtained data provided necessary information to consider parking plans and improvement schemes.

In the proposed primary and secondary road network that is presented in the subsequent sections, on-street parking should be removed or tightly controlled to be replaced by the space for ROW (Right-of-Way) of public transport and bicycles. A rough analysis of the total parking demand and supply in the CBD of Tirana based on the findings from the Parking Survey is presented in Table 1 and Table 2. The current ratio of the demand to the supply is below 1.0, based on the assumption of 8-hour operation (e.g., 8:00-16:00). However, the parking demand often concentrates causing oversaturation for a certain period of the day. According to the Parking Survey result, such an oversaturation period is generally observed from 9:00 to 14:00 in office buildings, from 11:00 to 14:00 in commercial buildings, and from 8:00 to 16:00 in on-street parking. If parking is to be controlled as explained later, it should be applied in those hours.

Table 1 – Estimation of Parking Demand in CBD

Building Type	Total Floor Area (m <sup>2</sup> )	Daily Parking Vehicle Trip Rate (veh/m <sup>2</sup> )	Average Duration (hours)	Total Daily Parking Demand (veh-hour)
Government office buildings	87,400	0.017	4.0	5,900
Private office buildings	111,300	0.021	3.9	9,100
Commercial buildings	34,600	0.017	3.9	2,300
Other buildings* (on-street parking)	2,752,400	0.009	5.0	126,800
Total	2,985,700	-	-	144,200

Note: \*Assuming total buildings that are located within 30 meters from the road with on-street parking.

Table 2 – Estimation of Parking Supply in CBD

Parking Type	Total Capacity (veh)	Total Supply* (veh-hour)
Off-street parking	11,500	91,800
On-street parking (primary & secondary roads)	3,200 [0]	25,600 [0]
On-street parking (local & other roads)	5,400	43,200
Total	20,100 [16,900]	160,600 [135,000]
Demand/Supply Ratio	-	0.90 [1.07]

Note: \*Assuming 8-hour operation from 8:00 to 16:00.

'[ ]' indicates the case excluding on-street parking on the primary and secondary roads.

### 3. TRANSPORTATION ACTION PLAN

#### 3.1 Road Development

The principal policy measures for road network development and public transport prioritization are described below:

1. Formulation of road network through proper classes of roads so that the whole network will function efficiently and effectively. This includes developing new roads that will especially complete the current missing links, reconstructing existing roads that will often involve road widening, improving the current bottleneck intersections that may involve grade separation, developing full or partial access control that will physically separate through-traffic from local traffic, etc.;
2. Increasing road capacities to fulfil the traffic demands and to minimize the demand and capacity gap especially in the CBD, while reserving the ROW for public transport and bicycles through efficient TCMs;
3. Road development should aim not only to cope with the traffic congestion issues but also to lead to a desirable multi-core urban structure;

4. Following the general city planning, primary and secondary roads should be placed at intervals of 400 to 700 m in the CBD, while, for other residential areas, they should be placed at intervals of 700 to 900 m, which will also enable easy access to the public transport lines; and
5. The proposed road development should follow the road alignments in the previous Tirana Regulatory Plan of 1989 as much as possible for better and more realistic implementation of the plans.

The final road development projects proposed in the Study are shown in Figure 11.

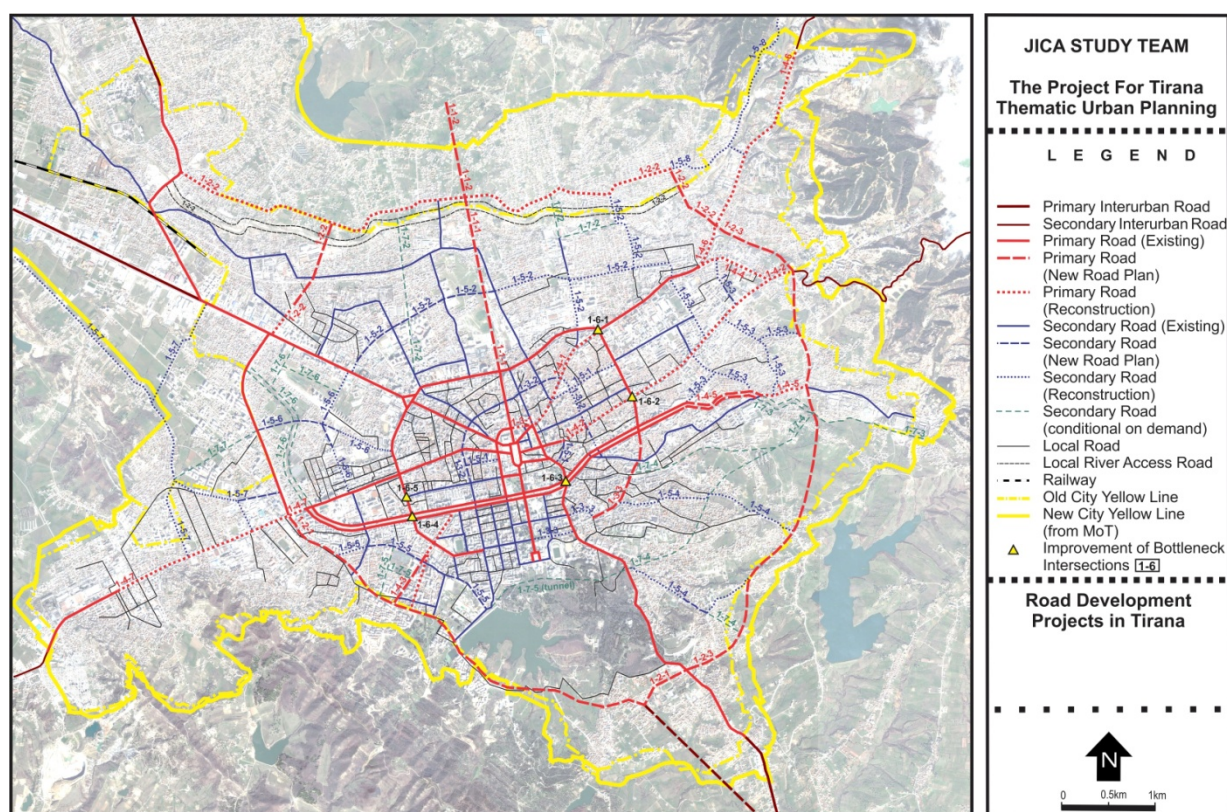


Figure 11 – Road development projects in Tirana.

### 3.2 Public Transport Development

The growth of urbanization tends to change urban lifestyles and people's values for goods and services. In this context, public transport services should satisfy various types of demands in the city. For planning the public transport development in this Study, there are two major strategic projects that have been given by the Municipality of Tirana:

1. Development of an intermodal transportation terminal along with relocation of Tirana railway station, and
2. Development of two tramlines: east-west (Kinostudio – Kombinat) and north-south (Intermodal Transportation Terminal – Student City).

The public transport development is proposed to support the above core projects and to further expand the public transport network from aspects of tramlines development, dedicated bus lanes development (including restructuring the city and commune bus lines), intermodal development, and commuter rail development. It is presented in Figure 12.

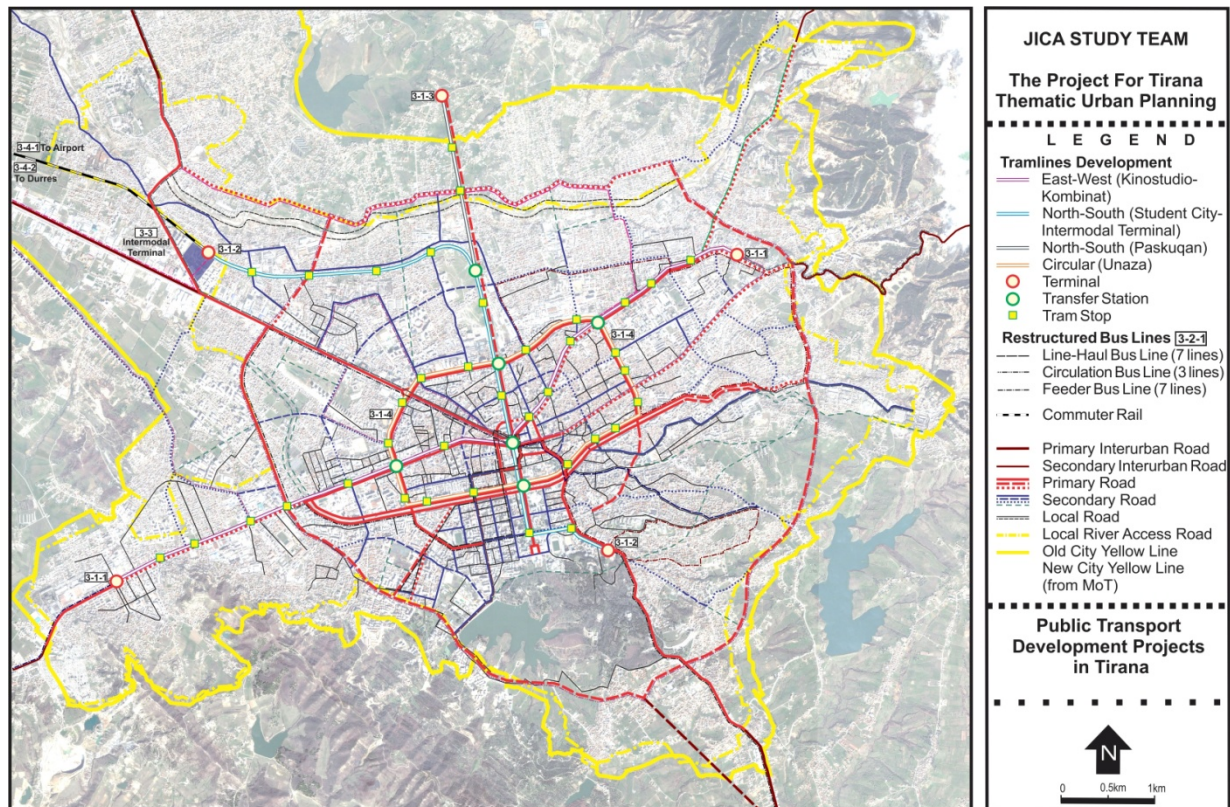


Figure 12 – Public transport development projects in Tirana.

### 3.3 Transportation Control Measures (TCMs)

In order to make the most of the existing capacity of the transport infrastructure as well as to achieve a better transportation environment in Tirana, the following TCMs have been proposed:

1. Development of “traffic cell” system and pedestrian facilities,
2. Development of bus/bicycle priority system,
3. Parking system development including development of parking facilities/parking information system and parking pricing system in the CBD, and
4. Development of urban traffic control (UTC) Center.

All the above TCMs should be prioritized as short-term projects as they are designed to optimize utilization of the existing transport infrastructure at a relatively lower cost. Among the TCMs, parking pricing, which is listed in the third item, can be considered as one of the

transportation demand management (TDM) policies in that it will decrease excessive vehicular traffic concentration and will shift private vehicle users to public transport.

Parking vehicles, whether they may be located on or off street, should be charged a fee, which is also expected to bring about considerable revenue for infrastructure investment. Furthermore, as the parking fee (commonly implemented parking fee of 100 Lek or approximately 1 US dollar per hour) becomes higher, it will eventually deter private vehicles from entering the CBD and shift to public transportation, and this situation can be relatively easily controlled. This concept is called parking pricing and is often utilized as an effective TDM policy. However, consideration must be given to the fact that business and commercial activities along the roads, especially in the CBD, may also benefit or suffer from any action or decision. Providing sufficient nearby off-street parking facilities should be the basis for this system.

## **4. TRANSPORTATION DEMAND FORECAST**

As the first step of demand forecasting, total present and future trips have been forecast. Since the Household Survey asked the interviewees about their trips made only for three hours between 6:00 and 9:00 a.m., the demand forecast models have also been developed for the morning peak hours only. Furthermore, because it is modelled only for the morning peak hours, it has been assumed that all purposes of the generated trips are from home to work, school, and other places only. Hence, non-home based trips such as business trips which normally take a considerable share were not included in the demand forecast models. When travel demand, which is called an OD matrix, is estimated and a network is developed, the traffic demand on the network can be forecast. This section shows the results of an estimation of the following cases:

1. Base Year Case: Assigns the current travel demand on the base year (i.e., 2012) highway network. This will be the basis for evaluating alternatives;
2. Do-nothing Case: Assigns the future travel demand of 2027 on the base year highway network. This is an imaginary case and it can reveal the necessity of road construction and improvement to meet the future demand;
3. Action Plan (without parking pricing) Case: Assigns the future travel demand of 2027 on the Action Plan highway network. This will show improvement of the traffic situation by implementing the action plan. However, parking pricing is not applied; and
4. Action Plan (with parking pricing) Case: Assigns the future travel demand of 2027 on the Action Plan highway network. This will show improvement of the traffic situation by implementing the action plan including parking pricing.

Total present and future trips by purpose and by mode in the morning peak are presented in Figure 13. Since the estimated base-year (i.e., 2012) OD matrices do not include intra-zonal trips, total trips including the intra-zonal trips can be compared only with year 2008 OD matrices as present. Overall, the total number of trips in Tirana in the morning peak hours

(6:00-9:00 a.m.) will significantly increase in future. Compared with the Do-Nothing case, the growth from 2008 to 2027 is estimated to be about 2.4 times. In terms of mode shares, both auto and transit modes will gain shares; whereas the walk mode will be losing its share from 30% to 15% while the total number itself will be increasing. In fact, the most preferred mode of transport by Tirana citizens is by walk. Such a drop in walk mode share in future may be because the average travel distance is expected to be longer as the Tirana metropolitan area will expand along with additional surrounding development zones in future. Additional trips will be made either by auto or by transit. Thus, significant increase in both auto and transit trips is expected in future, and the growth is estimated to be nearly three times.

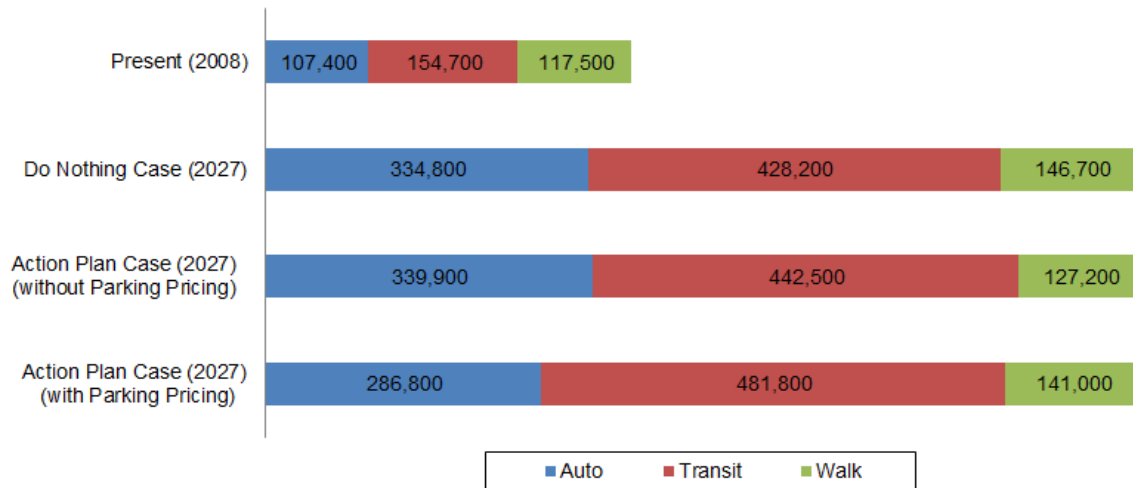


Figure 13 – Total present and future trips in morning peak by mode.

Furthermore, if the Action Plan has been implemented without parking pricing, total trips by transit and auto modes will slightly gain the shares compared to the Do-Nothing case; whereas the walk mode will be slightly losing the share accordingly. This may be because the master plan case includes not only the road developments but also the above-mentioned public transport developments. It implies that urban transportation developments may have more potential to attract more trips, bringing about a modal shift toward public transport, even though traffic congestion will be significantly alleviated by the road developments

Under the parking pricing system, a parking fee per trip was calculated based on the commonly implemented parking fee per hour multiplied by the average parking duration of 5 hours which are derived from the Parking Facility Survey, and it was assumed for this estimation and applied to all auto trips to/from the CBD. For all purposes, total trips by transit will be gaining a significant share; whereas the auto mode will be losing share accordingly. Thus, parking pricing is expected to have a direct effect in shifting auto users to public transport.

## 5. CONCLUSION

This paper presented the Study methods and analyses for developing urban transportation action plans as part of the thematic urban plans for Tirana metropolitan area. Since qualitative, conceptual discussions would not be sufficient to provide the countermeasures to mid/long-term problems in urban transportation, the Study has established a transportation



demand forecasting model. To develop a four-step demand forecast model, the Household Survey conducted in 2008 has been utilized as the only source of person-trip data that are available. Then the model output has been updated to 2012 based on a wide variety of supplementary transportation observation survey data from Intersection Traffic Count, Cordon Line, and Bus Passenger OD Surveys, all of which were conducted in 2011-2012, along with additional TAZs around the city of Tirana as the expansion of the metropolitan area. Then the transportation demand on the network was forecast for the cases with and without transportation development. The demand forecast showed that the parking pricing is extremely important to promote the use of public transport.

Though it has been a while since this person trip survey was conducted, it is believed that the travel demand forecast models should remain unchanged with fixed parameters over a period of time, so long as the context of the society will not change. However, the Tirana metropolitan area is still in the transition period, and the transportation environment has been changing including motorization. Thus, a full-scale person trip survey by which a more comprehensive daily travel demand can be modelled is essential for actual transportation planning of Tirana, and it should be regularly conducted at intervals of five to ten years, especially in an urban area that is developing and expanding in scale.

## **ACKNOWLEDGMENT**

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