TITLE OF THE TENDER: **"THESSALONIKI METRO DEVELOPMENT STUDY (TMDS)"**

RFP-361/19 Α.Σ. 81337

TECHNICAL DESCRIPTION OF THE SCOPE AND SPECIFICATIONS FOR THE PREPARATION OF THE STUDY

ABBREVIATIONS	
AM	Attiko Metro
DB	Database
ELSTAT	Hellenic Statistical Authority
GDP	Gross Domestic Product
GGRS	Greek Geodetics Reference System
HB	Home-Based
MRN	Main Road Network
NHB	Non-Home-Based
OASTH	Organization of Urban Transportation of Thessaloniki
O-D	Origin – Destination Table
ORTHE	Organization of Planning and Environmental Protection of Thessaloniki
OSE	Hellenic Railway Organization
PCUs	Passenger Car Units
RSS	Roadside Survey
SL	Screen Line
SPS	Stated Preference Survey
ThePTA	Thessaloniki Public Transport Authority
TheTA	Thessaloniki Transport Authority

PART A: INTRODUCTION

1   AIM OF THE STUDY

The Thessaloniki Metro works currently under construction (Base Project, Kalamaria Extension) were designed on the basis of the General Transport and Traffic Study for the city of Thessaloniki, assigned by the Organization for the Master Plan and Environmental Protection of Thessaloniki (ORTHE) and completed in 2000. Since then, no other study of such magnitude and extent has been undertaken for the city of Thessaloniki. In view of the needs for the Thessaloniki Metro Extension to Kalamaria, ATTIKO METRO S.A. (AM), in cooperation with Thessaloniki Public Transport Authority (ThePTA), prepared the necessary studies (Feasibility Study), having dully updated the trips demand data, 2016 being the target planning year.

In view of exploring the needs for the construction of new Metro projects after the completion of the Metro Base Line and the Metro Extension to Kalamaria, and in view of establishing a Metro Network Development Plan for Thessaloniki in the framework of an updated Transport Plan for the city of Thessaloniki, establishing the year 2040 as the 20-year planning horizon, a new General Transport Study must be prepared, the Thessaloniki Metro Development Study, which shall determine the trips demand and the need for the construction of the corresponding infrastructure projects in Thessaloniki.

2   STUDY AREA

The Study Area of the Thessaloniki Metro Development Study includes the Urban Agglomeration of Thessaloniki and the surrounding Suburban Zone, with a total population rising approximately to 991,847 residents (Hellenic Statistical Authority-ELSTAT census, 2011), a figure corresponding to approximately 89% of the population of the Prefecture of Thessaloniki (1,110,551 residents).

To the North, the Study Area extends to the Municipality of Oraiokastro and to the Municipality of Lagada, to the west to the Municipality of Delta, while to the east it includes the Municipality of Pylaia-Chortiati and to the south, the Municipalities of Thermaikos and Thermi (see Map 1). The municipalities included in this Study Area are grouped in 8 sectors, as shown in Table 1. Each municipality/ community is divided into traffic zones which will be used as a basis for the sampling to be carried out in the framework of the Household Survey and of the Stated Preference Survey, as well as for the codification of the Origin and Destination direction of the trips to be recorded in each individual trip survey.
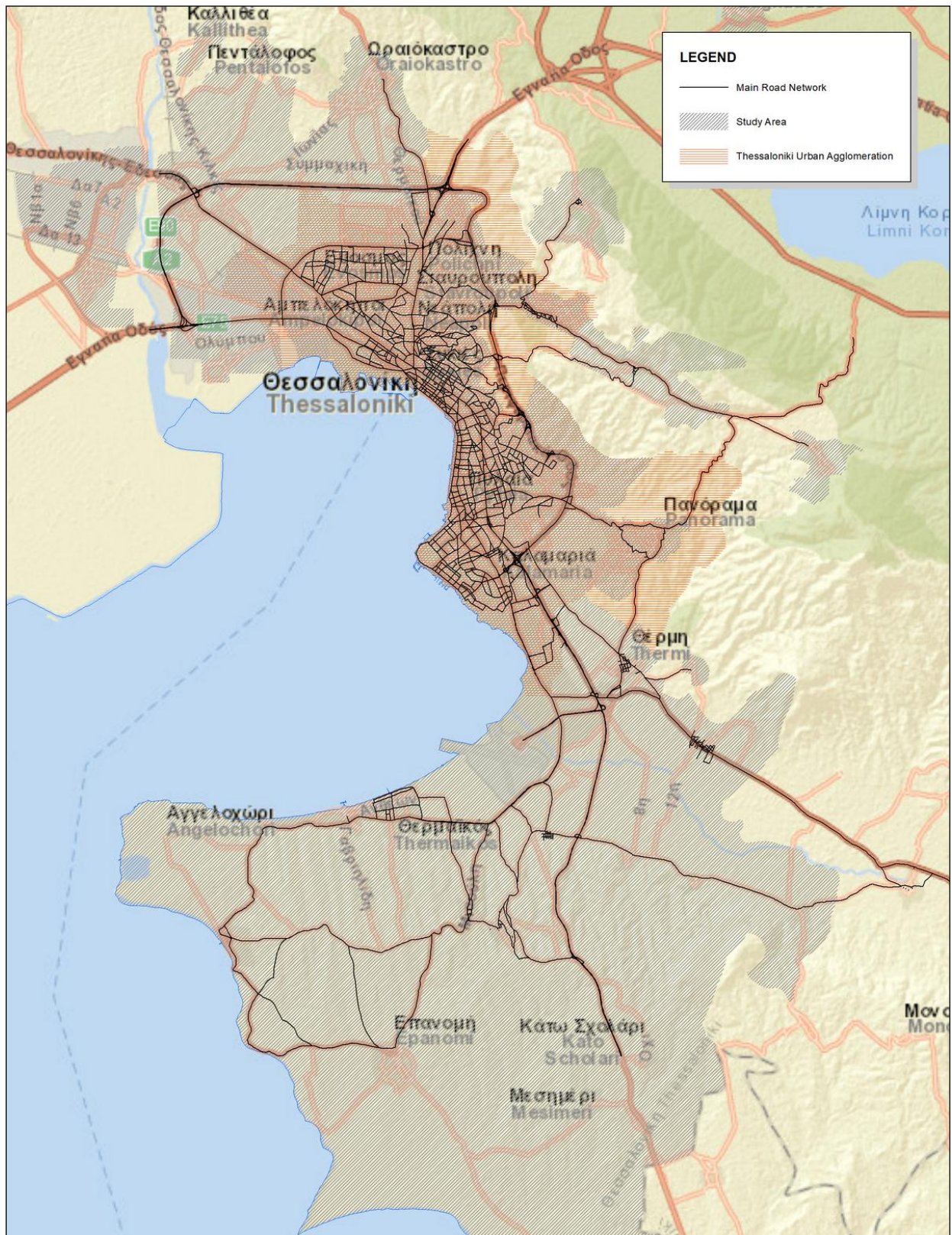
Map 1

The Zone System in the Thessaloniki Metro Development Study shall include all zones of the zone system contained in the two studies described in paragraph 1 (i.e. General Transport and Traffic Study, 2000 and Feasibility Study for Thessaloniki Metro Extension to Kalamaria, 2011); the said the zone system shall be properly adapted and complemented, based on population changes and the new transport infrastructure projects. As shown in Table 1 and based on the two studies, the zones inside the zone system rise up to 315, while they are not expected to exceed 360 zones after all adaptations and additions. There are approximately another 10 external zones, which correspond to districts outside the Study Area (i.e. to the rest of Greece and abroad).

Table 1: Zone System of the Thessaloniki Metro Development Study (Zones in the system)

Sector	Municipalities/Communities	Zones
1	Thessaloniki (Districts A', B' and C')	60
2	Thessaloniki (Districts D' and E')	65
3	Kalamaria	31
4	Thessaloniki (Municipal subdivision of Triandria), Pylea-Chortiatis	16
5	Neapoli-Sykeon, Pavlos Melas	30
6	Ambelokipi-Menemeni, Kordelio-Evosmos	54
7	Delta (Sindos, Diavata, Kalochori, Nea Magnissia), Oraiokastro (Oraiokastro, Pentalofos, Neochorouda), Pylea-Chortiati	36
8	Thermaikos, Thermi (except Vassilika, Peristera, Aghios Antonios)	23
		315

3   SCOPE OF THE STUDY

The scope of Thessaloniki Metro Development Study shall include:

a. Capturing of the current status governing the operation of transport systems in the Study Area and the attributes or parameters defining the demand and supply of these systems. In particular, the following items are included:
   - Household Survey
   - Stated Preference Survey
   - Recording and Measurements on the Main Road Network and Roadside Surveys

- Measurements and Surveys in Public Transport Means (Urban Buses, Terminal Stations)

b. Analysis of the current status and development of the relevant Databases[1].

c. Development of alternative scenarios for transport infrastructure networks in the framework of the medium/log-term Plan for the Development of the Study Area and the transport systems.

d. Development of a Transport Model for the city of Thessaloniki, namely of the mechanism for simulating the transport service in the Study Area and the elements that define the transport system's demand and supply parameters, in order to assess the alternative scenarios of the transport networks, in view of selecting the optimum Metro Network Development Plan in the framework of an integrated Transport Plan.

4   DIGITAL BASEMAPS

The following digital basemaps for the Study Area shall be provided to the Contractor in shapefiles format and in the GGRS-87 Greek Geodetics Reference System 1987 (EGSA-87), which is the system to be used in the Study.

a. Road axes basemap for the Main Road Network, as defined in the Transport Model for the city of Thessaloniki, in AM's possession (from the Study for Thessaloniki Metro Extension to Kalamaria). The Main Road Network shall be verified by the Contractor and shall be completed/amended accordingly if required (see §7.2.3).

b. Basemap intersections of the Main Road Network junctions indicating the locations of them (priority and signalized intersections). These intersections shall be confirmed and updated by the Contractor (see §7.2.4).

c. Traffic Zones Basemap.

d. Basemap of the Metro Lines Network and Metro Stations

e. Basemap of Bus Lines and Bus Stops

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[1] By using the term DB in this text we refer to Relational Databases, ie RDBMS systems with structured and associated data (in the form of tables) and managed by SQL. In this sense, and in order to avoid technological incompatibilities between AM and the contractor, DB files will be accepted in Access and SQL.

In a broadest sense, digital files appropriately structured to identify the data stored in them such as spreadsheets (eg Excel), which by derogation will be accepted as individual data tables. Although the data stored in CSV or TXT files, may identified (using an appropriate header) they will not be accepted under the term DB, except as input files to other software applications (eg, Statistical Analysis).

PART B: DATA COLLECTION (SURVEYS, INVENTORIES) AND DEVELOPMENT OF DATABASES

5   HOUSEHOLD SURVEY

5.1   SCOPE

The scope of the Household Survey is to collect, process and evaluate data related to the socioeconomic and trip attributes of the population in the Study Area during a typical period (autumn or spring). The survey includes door to door interviews on a random sample of households in the Study Area.

The survey will collect data which will be used in the analysis, quantification and correlation of traffic parameters in transport, such as:

* number of trips
* trip time and duration
* trip origin and destination
* trip mode of transport and
* trip purpose.

In the framework of the survey, the population shall be classified on the basis of socioeconomic attributes, such as:

* household size, vehicle ownership index, income group
* gender, age, employment status and availability of private vehicle.

5.2   SURVEY CONDUCTING PERIOD

The survey shall be conducted during a standard period (autumn or spring), so as to ensure the representative nature of a typical week day of the trips.

Interviews shall be taken from Tuesday to Saturday inclusive, at a ratio of approximately 1/5 of the sample per day. During the interviews, the last 24-hour period prior to the interview shall be assumed as the reference period for the trips made by the members of the household.

The survey shall be conducted in three phases:

* The survey's planning and organization phase, during which sampling lists are compiled, questionnaires and the instructions to the interviewers are designed, reviewed and finalized, the survey personnel receives the relevant training and all activities are scheduled.
* the data collection phase, during which interviews at the households are carried out, while activities are monitored on a constant basis.

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- the <u>processing phase</u> of the collected data, during which the answers is reviewed, checked for correctness and for their reasonable consistency, corrected, codified, correlated to the population they refer to and organised in Databases, the results are tabulated and a Technical Report is prepared. Data collection and processing phases are carried out in parallel.

5.3   SAMPLE AND METHODOLOGY OF THE HOUSEHOLD SURVEY

The survey shall be carried out on a random sample of households in the Study Area at a general sampling fraction of 3% of the households in the Study Area. According to the Hellenic Statistical Authority-ELSTAT population census (2011), the number of the households in the Study Area rises to approximately 380,000, thus it is estimated that a sample of approximately 12,000 households will be required.

All sampling zones of the Study Area shall be covered. The size of the household sample in each zone shall equal to the households' general sampling fraction (3%). The minimum sample in each sampling zone shall not be less than 25 households, unless the number of the households in the zone is less than 25, in which case the sample shall include all households. When designing the questionnaire, special instructions will be provided on how to divide the additional households exceeding the sampling fraction, in order to reach the number of 25 households.

The sample will be selected using the appropriate statistical methods so as to ensure representative and reliable results. Sampling will be performed in two stages. During the first stage, a predefined number of Building Blocks is selected for each sampling zone, whose odds for selection is proportional to their size in terms of household number (census 2011). During the second stage, complete catalogues of residents' names of the <u>existing</u> households in the selected Building Blocks are generated, and the households are (systematic) randomly selected on the basis of these catalogues.

ATTIKO METRO S.A. will deliver in due time to the Contractor tables and maps showing the sampling zones and the selected Building Blocks for the entire Study Area. The Contractor shall organize in situ groups to compile complete catalogues of the existing households for the selected Building Blocks of the sampling zones. Building Blocks will be identified on site beforehand by supervisors who will coordinate the crews preparing the above catalogues. At the office, based on the catalogues of residents' names of the existing households in each Building Block and on a calculated sampling ratio step per Building Block, a (systematic) random sampling of households shall be carried out. A help note will be provided to the Contractor for assistance in the calculation of the sampling ratio per Building Block.

5.4   QUESTIONNAIRES

Ensuring the impartiality and validity of questionnaires, which constitute the main tool for the household survey, is of outmost importance.

The questionnaire shall consist of three parts:

- <u>Questionnaire for Households</u>. The purpose of the questions is to collect information on the socioeconomic attributes of the household: size of household, income, number of employed members, nationality, vehicle ownership index and age of owned vehicles (passenger cars, bicycles, motorbikes, taxis, vans, lorries). Dwelling attributes are as follows: type and number of rooms (detached house, apartment in a block of flats etc.), residing status (owned, dwelling provided free of charge, under a lease). The interviewee's first name and the telephone number are recorded as well.

- <u>Questionnaire for the members of the household.</u> The purpose of the questions is to collect information on the socioeconomic attributes of each member of the household: gender, age, level of formal education, economic activity category (member/no member of the workforce) and employment status (full-time, part-time, etc.) assuming as reference period the week before the survey. Members over 18 years of age will be asked whether they hold a driving license, a monthly pass (during the same month / in the past) and whether they have access (in contrast to owing) a private vehicle (daily basis, occasionally, not at all).

  Employed persons over 15 years of age will be asked the following: main employment (profession, type of business, working hours (fixed, flexible, alternative/periodic/shifts), work address. Students: address of the educational institute.

  The serial number of the person providing the information on the household and its members, as well as the serial number of the principal income earner shall be noted.

  During the interview, the interviewer verifies that the following information coincide, namely: a) the size of the household and the number of the declared members and b) the number of the employed members in the household and the number of the declared employed persons (full-time / part-time).

  The reason (health / physical disability, activity / visits at home, absence of activity etc.) for which a person didn't (on the previous day) make any trip must be asked and recorded.

- <u>Trips questionnaire.</u> Each person of the household over 5 years old is asked questions concerning the attributes of his/her trips made on the previous day (04.00 until 04.00 on the day of the interview). The trip is defined by a destination where an activity is intended to be carried out or by a transfer to another transport mode/vehicle. Any intermediate stop combined with an activity exceeding 15 minutes constitutes a new trip. Trips on foot are recorded when they exceed 500 meters or four (4) building blocks. Questionnaires must be properly designed so as to render the logical sequence of trips.
  For <u>each</u> trip made by each member, questions shall cover the following: origin address, land use at the origin, time of departure (+/- 5 minutes), purpose (work, training/education, shopping/personal reasons, business-related trip, recreational/social reasons, other, returning at home, transfer from another transport mode), trip mode (on foot, driver of private vehicle, fellow passenger in a private vehicle, motorcycle, taxi, van, lorry, special bus, number or route of the public transport mode used, other means), walking time to the boarding stop/ parking place, destination or transfer station/stop, walking time from the alighting stop / parking place to the destination, time of arrival). If a private vehicle has been

used, the total number of passengers in the vehicle shall be asked, as well as the parking regime, time and cost. Finally, it will be asked if a new trip was made afterwards.

The questions of the two first questionnaires shall be answered by one member of the household over 18 years of age on behalf of all the members of the household. Trip-related questions shall be answered separately by each member of the household older than 5 years. If - despite the early notice given to the household - there are absent members, then a present member, well-informed on the activities of the absent member, shall answer on his/her behalf on the attributes of the trips made in the previous day. If such information is not known, the necessary trip data for the absent member shall be obtained by telephone call. At the Contractor's responsibility, such communication shall take place on the day of the interview or, exceptionally, on the next day of the interview. If - despite the effort to speak with the absent member over the phone - it is impossible to obtain the trip data of an absent member, this shall be dully noted at the supervisor's responsibility.

Each questionnaire shall be identified by a unique number that corresponds to the specific household. The following information will be marked on each questionnaire: zone number, Building Block number, number of household used on the Building Block sampling catalogue and the household address. The date, day and time of the first or of a possible second interview, as well as the reasons for which a household replaces (possibly) another household which failed to provide answers (repeated absence, refusal to cooperate) shall be also noted. Finally, the name and code number of the interviewer, the name of the supervisor and the date of inspection/check shall be also noted.

A draft of the questionnaire and its completion instructions shall be provided on time by ATTIKO METRO to the Contractor. Questionnaires shall be properly developed by the Contractor so that the survey is conducted using a tablet computer (tablet). The final design of the questionnaire and the instructions document to interviewers shall be prepared by the Contractor and shall be submitted for approval by ATTIKO METRO.

5.5   ORGANIZATION OF HOUSEHOLDS SURVEY

5.5.1   Personnel

The survey personnel shall consist of a sufficient number of interviewers to ensure that the required sample is adequately and reliably obtained within the foreseen time period of the survey. In addition, the corresponding equipment for each interviewer (tablet computer) and any additional back-up battery (powerbank) must be available.

Each group of 5 interviewers shall be coordinated by a supervisor who, on a daily basis, prepares the work of the interviewers group, organizes their schedule of daily visits, hands the tablets to the interviewers at the beginning of their daily schedule, monitors and controls their work and at the end of the daily schedule gathers the tablets and uploads the questionnaires from the tablets to the relevant central database. Upon completion of the upload, the supervisor shall carry out primary checks the completed questionnaires.

The overall survey shall be headed by a Traffic Engineer possessing at least five years of actual experience in conducting such surveys. In any case, the Task Force shall encompass the specialties of Statistician and Social Scientist, with experience in the conduct of social surveys.

The Contractor is obliged to organize thorough theoretical training of supervisors, surveyors and coding clerks, in order to inform them on the objectives of the survey, the adoption of appropriate communication methods, the understanding of the questions and the possible answers, the method and scheduling of recordings, (re)visits and replacements. Practical training shall be carried out at the stage of the pilot interviews.

Pilot interviews shall be conducted at least two weeks before the scheduled start of the main survey. If extensive modification is required in the design of the questionnaires, the instructions and the survey process, then a second pilot survey shall be conducted.

5.5.2 Publicity

Advertising to the public is a key prerequisite of the success of the survey. ATTIKO METRO shall sufficient advertising of the Household Survey.

Given that at home surveys are targeted at specific households selected using the methodology described in paragraph 5.3 and not at random households, a particularly helpful method of publicity and communication is the focused method. The Contractor must promptly notify the selected households by letter and home visits about the purpose of the survey and the time of the upcoming interview. The letter will be promptly provided to the Contractor by ATTIKO METRO. The Contractor's obligation is to print and deliver the letters. All household members shall be asked to be present on the specific day and time of the interview.

In order to ensure household's cooperation, it is appropriate to take measures to reduce the possibility of refusal to cooperate. For that reason, a material incentive in the form of a gift will be offered by the Contractor in every household participating in the survey. AM will bear the relative cost.

It is the Contractor's responsibility to make available a telephone line for responding to relevant questions throughout the interview period on a daily basis.

5.5.3 Scheduling of the Survey

The Contractor's design for the Survey shall be submitted for approval to ATTIKO METRO within 15 days from the commencement of works and shall include a work schedule. The tasks of drawing up the nominal household sampling lists per Building Block for conducting interviews in each Building Block must in sequence, but in terms of geography the interviews are allowed to be conducted in parallel.

With regard to the sampling lists to be prepared by the Contractor, the method of recording the households in each Building Block shall be clearly defined by the Contractor and will be strictly

observed by the recorders. Lists of households recorded per Building Block shall be submitted to ATTIKO METRO on a weekly basis. ATTIKO METRO (and certainly the Contractor independently) shall check the completeness and accuracy of the lists of a sample for the recorded Building Blocks.

The interviews shall take place from Tuesday to Saturday, from 17:00 to 21:00; re-visiting is necessary in case the interview is not conducted. Households selected in the sample shall be replaced in case of refusal to respond or absence of the household members. More specifically:

- In case the interviewer cannot contact the household at the second visit, then he/she shall communicate with the supervisor in order to replace the absent household with the next one in the sampling list,

- if the household ultimately refuses to respond, the interviewer, in consultation with the supervisor, replaces it with another remote household in the list, so as to rule out the possibility that the new household is affected by the refusal of the previous household.

5.5.4 Control of the Survey

The Contractor shall identify and minimize possible partialities in the sampling, as well as suggest suitable data weighing or adaptation techniques, and to implement these techniques during data processing phase.

During the interview phase, the Contractor checks, by means new phone interviews conducted on a sample of approximately 3% of the interviews conducted by each interviewer, whether the interview was actually conducted, as well as the accuracy of certain answers to the questionnaire.

The Contractor shall compile cumulative tables on a weekly basis, showing the number and distribution of interviews per week day/hour and interviewer, the socio-economic indices and mobility indices of the sample as a whole, in order to verify that the sampling was representative.

The indices shall refer to variables such as:

- household size, number of working members in the household
- gender, age
- travelers-passengers/100 persons, number of trips / traveler

The tables shall indicate both the results of the previous week, as well as cumulatively the results of the surveys conducted earlier than the last week.

Based on these data, the Contractor shall statistically verify the sample's and the interviewers' reliability on the basis of the indices of the Greek Statistical Authority and other comparable sources. If deviations arise stretching beyond the expected sampling error, remedial measures shall be taken for the remaining time of the survey.

5.6 DATA COMPUTERIZATION AND CONTROL

As already mentioned, the questionnaires shall be in electronic form and therefore a tablet computer (tablet) application shall be developed. All fields of the questionnaire shall be stored in the tablet's internal Database. The use of pre-codified lists and the general configuration of the questionnaire shall make it easy to accurately and quickly complete the questionnaire and shall make it possible to review the completeness of the collected information of each questionnaire at the stage of conducting the interviews. Moreover, all collected information shall be reviewed for correctness and reasonable consistency by the supervisors or, if possible, by means of software, on the basis of procedures developed in cooperation with ATTIKO METRO. Questionnaires with omissions or inconsistent responses to critical variables shall be rejected. The precise design of the Database for the questionnaires shall be proposed by the Contractor and approved by ATTIKO METRO after the incorporation of AM' s pertinent comments.

In order to achieve faster and more accurate data entry of some selected fields that accept verbal responses (i.e.: street name, municipality name, bus line name, profession, etc.), the application shall have these fields in the form of pre-codified lists. However, the application shall also ensure the possibility of registering the reply in full data entry, in the case that the interviewee's response is not found within the pre-codified lists.

The origin and destination addresses to be collected in the framework of the survey must be complete, in order to ensure their geocoding (identification of their geographical coordinates as x, y points in the EGSA-87 Reference System) and the matching of each origin / destination point with the Traffic Zone code wherein it is located. All origins and destinations shall be geocoded by the Contractor, either by means of software to be developed by the Contractor, or by means software available in the market, or by using web-based geocoding services. Origin/destinations not located in the above manner shall be manually located and assigned to a Traffic Zone.

5.7 DELIVERABLES

Upon completion of the survey, the Contractor shall deliver to the ATTIKO METRO its full results. i.e.:

a. all primary data (sampling lists, maps with the sampling building blocks, Databases with the really original filled in questionnaires as they were uploaded from the tablets).

b. <u>Comprehensive Database of Households</u> with survey data after any interventions / corrections made after the thorough check of the correctness, completeness and reasonable consistency of the responses. The Database shall consist of the following three interrelated Tables:

- The first, "Household Table", uses as primary key (ID) the serial number of the household and includes the interviewer's code, a variable (1/2) that indicates an interview with the 1st or 2nd visit, a variable stating the reason the household was replaced in the sample (0 if there was no replacement, 1 if the household was replaced

on account of refusing to cooperate, 2 if it replaced an absent household), the date and day of the interview, and the household questionnaire variables.

- The second, "Household Members Table", uses as keys (ID) the serial number of the household and the person's serial number. It includes variables (of type 1/0) indicating the person who gives the information, the person who earns the income, as well as the variables of the questionnaire for each member of the household separately. A variable is also foreseen indicating whether trips are included in the "Trips Table" for this person and, if not, explaining the absence of this information.

- The third, "Trips Table" uses as keys (ID) the serial number of the household, the serial number of the person and the serial number of the trip. It includes a variable (of type 1/0) indicating whether the trip-related questions are answered by the same person or by an intermediate, as well as the variables of each trip.

The precise Database design shall be proposed by the Contractor and approved by ATTIKO METRO after AM' s pertinent comments have been incorporated.

c. A Consolidated Database that will be created for the needs of the development of the traffic model of the Study Area (input data) from the Comprehensive Database, by combining the recorded trip purposes and transport modes in order to generate journeys from the individual trips. In addition, trips shall also be combined in tours in a separate working database, based on the residence. The composition rules, the typology of the trip chains as well as the ways of combining the purposes into categories and the transport modes in the main mode for journeys shall be timely be provided to the Contractor by ATTIKO METRO.

The Origin / Destination matrices for the journeys at a level of traffic zone, municipality and traffic sector shall refer to the entire population. Separate files for passengers per main transport mode and trip purpose, as well as vehicle files (Private Vehicle Units – PVU) shall be delivered for four time periods of trip commencement. These four time periods are the following: morning peak, afternoon peak, in-between period and total number in 24-hours.

d. Tabulations and diagrams in hard and soft copies with the results of the Household Dataset Processing. The survey data shall be correlated to the population as a whole and will be delivered in a broken down form per traffic zone, as well as cumulatively per municipality, traffic sector and combined. Distributions shall be delivered in a broken down form, while correlations only cumulatively. The trip attributes shall refer to a full 24-hour period (for the day before the interview). The tables shall present absolute and percentage figures and are expected to support comparisons and necessary presentations. The deliverables shall also include any data processing applications to be developed by the Contractor.

The minimum deliverables of the processing of the Household Database are the following:

- Statistical indicators: estimation of population / mean values and sampling errors per household, person and trip variables in total population

- Socio-economic attributes of households
  - Spatial distribution of households per household attribute

– Correlations between:

- Household size <u>and</u> income
- Household size <u>and</u> vehicle type ownership index
- Household size <u>and</u> number of employed persons in the household
- Vehicle type ownership index <u>and</u> income
- Private vehicle ownership index <u>and</u> age of 1st /2nd /3rd private vehicle
- Private vehicle ownership index <u>and</u> age of the news private vehicle <u>and</u> income
- Type of residence <u>and</u> residency status
- Type of residence <u>and</u> number of rooms
- Type of residence <u>and</u> income

– Statistical review per Municipality of the household size <u>and</u> number of employed persons in the survey household, on the basis of Greek Statistical Authority census (2011). Similar control concerning the Private Vehicle ownership index shall also be take place.

- <u>Socio-economic attributes of the individuals</u>
    – Spatial distribution of persons per individual attribute
    – Correlations between:
- Private vehicle availability <u>and</u> sex
- Private vehicle availability <u>and</u> age
- Private vehicle driver's license holder <u>and</u> sex
- Private vehicle driver's license holder <u>and</u> age
- Holder of a monthly free pass <u>and</u> age
- Holder of a monthly free pass <u>and</u> private vehicle availability
- age <u>and</u> sex
- age <u>and</u> level of academic education
- age <u>and</u> employment status
- main profession <u>and</u> level of academic education
- main profession <u>and</u> type of business

    – Statistical review per Municipality of the survey data such age <u>and</u> sex, percentage of intra-municipal / inter-municipal trips to/from work, based on the Greek Statistical Authority census (2011)

- <u>Trips attributes</u>:
    – Travel data:
- Traveling person/100 residents
- trips / journeys
- journeys / tour based on residence
- tour / traveler
- distribution of type of expenses, sequence of journeys, sequence of trips

    – Trip indicators:
- trips / travelers (as a whole and per mode of transport)

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- journeys / traveler (as a whole, per main mode of transport and per purpose)
- trip duration / individual (as a whole and per transport mode)
- journey duration / individual (as a whole, per main mode of transport and per purpose)
- time spent in a (moving) private vehicle / day

  - Trip attributes:
- Trips distribution per transport mode
- Journeys distribution per main mode of transport
- Correlation between main mode of transport and purpose of journey
- Correlation between land use at the point of origin and purpose of the journey
- headway / trip (as a whole and per mode of transport)
- headway / journey (as a whole and per main mode of transport and per purpose)
- correlation between journey headway per main mode of transport and per purpose
- correlation between walking time and utilized mass transport mode
- correlation between average occupancy of vehicle and purpose of the journey
- correlation between hourly distribution of trips commencement and mode of transport
- correlation between hourly distribution of journeys commencement and purpose
- correlation between parking status per type of vehicle
- correlation between parking time and status
  - Trip attributes are also broken down specifically for trips to the center of Thessaloniki (destination: center, origin: periphery) and for trips from the center of Thessaloniki (origin: center, destination: periphery).
  - Statistical review per Municipality of the distribution of trips to work per transport mode, based on the Greek Statistical Authority census in 2011.

- Correlation between journeys and socio-economic attributes:
  - Correlations between:
- selected main mode of transport and household attributes
- selected main mode of transport and individual attributes
- journeys per household and private vehicle ownership index and household size and income (as a whole and per journey purpose)
- journeys per person and private vehicle ownership index and age and employment status (as a whole and per journey purpose)
- journeys per person and private vehicle ownership index and sex and employment status (as a whole and per journey purpose)

e. Secondary statistical data from population census (2011), as well as data from studies of other entities related to the trips attributes of the population within the Study Area.
f. Technical Report on the planning and conduct of the Survey, the method for building the Database of the collected data, evaluating the results, commenting on the findings and drawing of conclusions. The Report shall include and explain the tables and diagrams mentioned in paragraph e.

6 STATED PREFERENCE SURVEY

6.1 PURPOSE AND SCOPE OF THE SURVEY

The scope of the survey is to collect information on the passenger preferences regarding the trips attributes, based on which the generalized travel cost can be assessed, e.g. travel time, travel cost, and transit penalty. The survey shall be planned in such a way that, under controlled conditions, it shall be possible to quantify the subjective value and the weight that groups of passengers attribute to variables such as travel time or waiting time at public transport stops. The aim is also to estimate the generalized cost parameters of a trip and to compare different modes of transport.

The subject of the survey is the interviews to be taken from a sample of passengers in the Study Area. The group of people among which the individuals of sample shall be selected are the physical persons over the age of 15, who travel within the Study Area. The survey shall provide data for the analysis and quantification of the following transport planning parameters:

- Time value per category, such as: walking time, waiting time for first boarding on public transport mode, waiting time for transferring to another mode and time spent within the vehicle
- Penalty, in terms of time and cost, which is related to the transfer from one vehicle to another during a trip, excluding walking and waiting times during the transfer.
- Coefficients of generalized cost of trip and comparison with alternative transport means

In order to analyze / assess the above, the market shall be segmented according to the purpose of the trip, the income / socio-economic category and the availability of a private vehicle.

6.2 SURVEY TIME

The Stated Preference Survey (SPS) shall be conducted in the same formal period of the Household Survey. Interviews shall take place on weekdays, excluding holidays and the days when extraordinary events (strikes, elections, particularly bad weather, etc.) could affect the outcome of the survey.

The conduct of the survey is distinguished into three phases:

- the survey planning and organization phase, with a duration of approximately 5-6 weeks, during which the survey personnel shall be selected and trained, the questionnaire and the interviews instructions shall be designed, reviewed and finalized and the survey time schedule shall be set up. This phase also includes a pilot survey
- the data collection phase, during which on-the-spot surveys are carried out and at the same time checks are made on the adequacy and reliability of the sample and the collected data.
- the data processing and analysis phase, during which the answers are checked, the results are analyzed and a Technical Report is prepared.

THESSALONIKI METRO DEVELOPMENT STUDY (TMDS)

TECHNICAL DESCRIPTION OF THE SCOPE

AND SPECIFICATIONS FOR THE PREPARATION OF THE STUDY

RFP-
361/19

Α.Σ. 81337

ΑΤΤΙΚΟ ΜΕΤΡΟ Α.Ε.

6.3 PLANNING OF THE SURVEY

During the survey planning phase, the questionnaire shall be formed, the survey technique shall be selected, the sampling shall be designed, the sample size shall be determined, the training and supervision of the surveyors will be organized and the survey logistics shall be planned.

The survey shall be designed to avoid tiring the interviewees, to enhance the validity of the responses, to avoid individually biased responses and to minimize responses of an emotionally charged nature. The technique to be used will be the personal interview method.

6.4 SAMPLING METHOD

The survey shall be designed so as to collect at least 100 complete interviews for each predetermined category of individuals. There shall be no more than 5 classes for each of the three categorization parameters: the purpose of the trip, the income group and the vehicle availability category. This requires a minimum of 500 complete interviews, which are estimated to result from completing about 750 questionnaires. This total of complete interviews shall be broken down into categories, in such a way as to ensure a sufficient minimum sample per category in accordance with the rules of statistical science.

Complete interview is the one with the following features:

• Has been conducted correctly and as per the instructions provided
• Is not affected by remarkable extraordinary events before or during its conduct
• Contains clearly recorded answers to all questions
• It is suitable to be used as input data during the data analysis phase

Each interviewee shall be asked to provide information about a trip-related purpose associated with the trip the interviewee has just made or is making, or a with recent trip the interviewee made on the day of the interview.

The interviews shall be conducted in households, shopping centers and recreation centers (whose locations shall be determined in cooperation with ATTIKO METRO), as well as in transfer areas, with interviewees waiting at public transport stops / stations. The sampling method shall be a combination of stratified sampling and sampling based on a selected choice. Stratified sampling shall take place in categories of individuals (e.g., households), while the sampling based on a selected choice shall focus on trips with transfers to mass transport modes

The sampling rate per sampling area type shall be determined in conjunction with the sample size required for each category of individuals, the existing percentages of each category in the Study Area, and the relationship between the sampled individuals and relevant trip parameters. The location of the survey areas shall reflect representatively the socio-economic and trip attributes.

The major portion of the sample (at least 50%) shall be taken by means interviews with households, while the rest of the sample shall be split among interviews at transfer points (to

enrich it with trips by public transport modes involving transfers) and in interviews at activity centers (to enrich it with trips made for purposes other than work).

In addition to the above mentioned categories, it shall be ensured that the sample of interviews is distributed approximately equal among gender and age (3-4 age groups, eg 16-30, 30-45, 45-66), while the sample of household interviews shall be distributed across the Study Area per zone proportionally to the population, in a similar way, albeit at a fractional sampling rate, compared to the rate for the trip Survey at Household (random systematic sampling, creating a sampling list concurrently with the Trip Survey at Households). Moreover, it shall be ensured that the trip sample by each examined mode of transport is sufficient and representative.

The minimum sample of 500 complete interviews shall necessarily meet all the above requirements (eg, equal number of interviews with males / females), to ensure the required minimum sample by category. If this is not the case, the sample shall be enriched with new interviews in addition to the minimum 500 ones. Using the appropriate procedure (eg alternatively interviewing a male and a female, stopping the interview when the conditions are not met) can minimize the need for enrichment with an additional sample.

6.4.1 Questionnaire

The questionnaire of the Survey shall come in an digital form. To this end, an application for tablet computer (tablets) shall be developed. The questionnaire shall ensure easy recording of answers. Questions shall be formulated so as to take advantage of the most recent experience of the interviewees, taking into account the restrictions acting as impairment to the interviewees, in order to facilitate responding. The scenarios included in the questions should reflect actual conditions, while the variables used for the quantitative presentation of alternatives should range within realistic values. In the evaluated scenarios the use of the new Fixed Track Transport Means (Metro, Tram) shall be taken into account.

For the purpose of this survey, the simple selection methodology shall be used rather than the grading or prioritization methodology. Groups of hypothetical alternatives shall be established, where each alternative shall be represented by a combination of trip attributes. Hypothetical alternatives shall be established so as to enable the evaluation of the contribution of each individual attribute.

Experiments design techniques shall be utilized so as to ensure that each attribute changes independently from the remaining attributes. The orthogonality of the formed alternatives shall be examined. Fractional Factorial Designs may be taken into account.

The questionnaire must provide the possibility to the interviewees to select an answer which does not fall within the predefined answers. This will prevent directing the interviewee to necessarily select an answer he might not prefer.

The planning of the questions shall define the attributes included in wording of each alternative, the unit of measurement for each attribute, the number and the order of magnitude of the attribute levels, as well as the number of alternatives.

It will be tested whether the questionnaire can record all required data by using an appropriate Database to be developed by the Project Contractor in the office, and by testing its performance by means of a broad enough pilot survey.

In addition to the above, a limited number of basic descriptive questions shall also be included in view of collecting socioeconomic and trip attributes of the interviewees. Such data shall be used in order to classify interviewees, to make controls for statistical errors and to weight data. Questions/ recordings shall necessarily touch upon:

Personal attributes

- Availability of private vehicles
- Income category
- Age
- Gender (no question)

Examined trip

- Purpose
- Hour of making the trip during the day
- Modes of transport
- Frequency of trips
- Total trip time
- Type of fare and overall cost
- Number of transfers
- Origin and destination
- Trip made alone or with other person(s)

Moreover, additional space shall be provided in the questionnaire for the surveyor to record the place of survey, the day, date, time, weather conditions, his/her name or code number and the gender of the interviewee. Each questionnaire shall be assigned its own unique number and shall include a brief description of the survey and an indicative/introductory question.

6.5 CONDUCT OF STATED PREFERENCE SURVEY

When conducting the survey, interviewers shall explain the purpose of the survey and how the question should be answered, shall provide guidance to the interviewee on answering an indicative question, shall identify the problems that the interviewee may have with respect to the questionnaire and shall provide additional assistance as objectively as possible.

At the end of the interview, a gift will be offered to the interviewees. AM will bear the relative cost.

The Contractor is obliged to timely inform ATTIKO METRO on the date, time and location training of the surveyors and the actual field surveys will take place. ATTIKO METRO is entitled to attend and make recommendations to the Contractor.

6.5.1 Personnel training

The training of the supervising personnel, of the surveyors and of the codification personnel shall be so organized that the scope of the survey, the questionnaire, the instructions, the sampling methodology and the requirements of the survey are fully understood by all parties. A complete definition of the technical terms shall be provided. Hands-on interview training shall be provided. A detailed description of the survey procedures shall be also provided in order to ensure that all interviews shall be carried out in a uniform manner.

Survey personnel and supervisors shall receive preliminary training before the pilot surveys and shall be trained anew before conducting the main survey. Training shall be provided by scientists possessing extensive experience in Stated Preference Surveys. All training sessions with the several groups of the survey personnel shall be headed by the same scientists in order to ensure cohesive training.

Persons possessing experience in Stated Preference Surveys shall be employed as the Survey Supervisors. Interviewers shall possess experience in conducting personal interviews. Supervisors shall be University Degree holders. Interviewers must be university graduates or at least students in the third year of their university studies.

6.5.2 Pilot survey

Trained interviewers shall carry out field surveys at least three weeks before the scheduled commencement of the main survey. If extensive modification to the main survey's planning is required, a second pilot survey must be conducted. The pilot survey shall be also used in order to verify the organization, testing and monitoring procedures, as well as the quality assurance procedures. A minimum of 100 interviews shall be taken during pilot surveys. The pilot survey sampling shall be properly stratified, in view of verifying the entire planning of the survey.

6.5.3 Survey monitoring and control

During the survey, a control plan shall be implemented. Based on this control plan, supervisors shall be required to pick out a certain number the interviewees, in order to verify the correctness of their responses and to highlight any problems with the survey or with the survey personnel. This is a necessary stage of the survey control procedure.

Moreover, there will be systematic recording and reporting of unusual conditions, comments by the interviewees and any additional observations they may have.

The Contractor shall have to identify impartial sampling, to minimize these impartialities and to demonstrate that any residual impartialities can be eliminated, by implementing corrective methods in the data processing and analysis stages.

6.6   DATA PROCESSING

Once the Survey questionnaires have been uploaded from the tablet computers (tablets) to the relevant Database, they shall be reviewed. Any spotted irregularities and invalid interviews shall be regarded as incomplete and shall be removed from the relevant Database. Whenever questionnaires are incomplete, the original surveyor or interviewee shall be sought in order to complete any missing information. All questionnaires with omissions or deficiencies in the section regarding the socioeconomic attributes of the interviewees or the trip data shall be regarded as incomplete.

The exact Database design where the questionnaire data shall be collected shall be proposed by the Contractor and approved by ATTIKO METRO, once AM's eventual comments have been satisfactorily responded.

ATTIKO METRO shall supervise the data processing procedures by visiting the Contractor's premises.

6.7   DATA ANALYSIS

The key descriptive data of valid samples shall be analyzed using the appropriate statistical software. The software to be used shall receive ATTIKO METRO's preliminary approval. The distribution –in terms either of absolute figures or percentages- of the answers to each key question shall be summarized in a table. Correlation tables per category of interviewees shall be developed.

A Multinomial Logit model shall be used to analyse Stated Preference choice data, based on the maximum likelihood estimation method. Weighting shall take place on the basis of aforementioned categorization of interviewees in the sample.

There shall be analysis of problems related to coefficient of incorrect sign, small statistical t figures (Student distribution), and low likelihood index ρ. The resulting estimates on the value of the time and trip penalty parameters shall be compared with the values obtained from other associated studies, as well with the average daily wage.

An analysis shall be conducted in order to identify lexicoghraphic samples and their eventual causes. The percentages of lexicographic answers associated with one or two attributes shall be identified. The impact of such lexicographic answers shall be interpreted.

Sampled population and weighing procedures shall be so defined that the results of the stratified analyses are correlated to larger populations, such as to total population in the Study Area.

6.8   DELIVERABLES

Upon completion of the survey, the Contractor shall deliver to ATTIKO METRO the complete survey results, which will include as a minimum the following:

- Input files for the specific statistical analysis software that was used
- Basic Descriptive Data Tables and Diagrams in printed form and in digital files whose format shall be subject to ATTIKO METRO approval. Tables and diagrams shall include both absolute and percentage values of the distribution of the answers to each basic descriptive question. Moreover, correlation tables and diagrams per category of persons and cumulative ones.
- Results of the Stated Preference Method, with reference to all estimated parameters values, as well as to all relevant statistical indexes of variation and reliability, such as statistical value "t" at a confidence level 95%, ρ^2, confidence intervals, etc. In addition, the values of the individual samples for each sub-total of estimates (per trip purpose, income category, vehicle availability, etc.).
- Technical Report to include detailed description of the survey planning, conducting, problems, verifications and corrections, analysis methodology and all relevant results. In addition, it shall include assessment and commenting on the Survey results, as well its conclusions. The report shall necessarily include indicators, assessments and commenting on the reliability of the Survey, the representative nature of the samples, the statistical degree of confidence on the results, the confidence intervals of the estimates concerning all key values (mobility, private vehicle ownership, distributions per trip mode and purpose, etc.). Finally, the Report shall include appendices with the questionnaire and reference to its compilation method, as well as description of the content of the data files.

7 INVENTORY OF THE MAIN ROAD NETWORK & ROADSIDE SURVEY

7.1 SCOPE OF WORKS

Inventory of the Main Road Network (MRN)

ATTIKO METRO has a coded Main Road Network in the Study Area, which, after an on-site inspection, must be confirmed in terms of its characteristics and updated where necessary in order to represent its current state of operation.

The Contractor's scope incorporates the organization and conduct of the necessary surveys, measurements and inventories related to the infrastructure and operation of the road network and the development of databases with the attributes of the road network and its intersections.

Origin – Destination Roadside Survey The Contractor's scope, as regards the Trips Survey on the road network, includes surveys and measurements at the boundaries of three (3) Screen Lines of filtration (SL) and two (2) rings, as mentioned below:

- **Origin - Destination Survey,** by means of road-side interviews with vehicle drivers at various points of the Main Road Network
- **Traffic Measurements**, by means of measuring traffic volumes and compositions.
  The traffic measurements are complementary to the Trip Surveys.

The Origin-Destination Survey for trips at the boundaries of the screen lines and the rings is intended to identify the essential attributes of the trips that pass through these boundaries. Traffic measurements at the boundaries of these lines are intended to record the number of daily trips crossing these boundaries, by recording the overall number and the category of all passing vehicles.

With the data collected from traffic measurements, it shall be possible to validate and complete the Trips Survey, as well as to convert / generalize these traffic data in order to be able to simulate demand in a digital model for trips. Therefore, it is necessary that traffic measurements be conducted on the same days and times as the interviews for the Trip Surveys.

The Contractor shall carry out the Trip Survey and Traffic Measurements at the points where the road network of the Study Area intersects the three filtration lines and the two rings (in the inbound direction to the center of Thessaloniki) as described in paragraph 7.3.

Filtration lines / rings are imaginary lines, separating the Study Area into smaller sections, so that all trips to other sections pass through a screen line / ring. The trip survey and the traffic measurements shall be conducted at survey / measurement stations located at the points of intersection between filtration lines and ring roads with the road axes through which, theoretically, all trips to other sections are served. The aim of the survey is to cover to the fullest (in terms numbers) all trips passing through the boundaries of the 3 filtration lines and the 2 rings.

Surveys and measurements shall be conducted during a typical period (autumn or spring) of the year. It is pointed out that the terms "typical period" mean the period during which no extraordinary events have occurred that may affect the trips and can therefore be considered representative in order to draw conclusions. It is stressed that the typical period is the period when schools are open.

7.2   INVENTORY OF THE MAIN ROAD NETWORK

7.2.1   Inventory of the road network

The terms "reference road network" mean the MRN in the Study Area, which incorporates the Freeways and Highways, Main and Secondary Arteries and Main and Secondary Collectors. Upon signing of the Contract, the Contractor shall be given a digital basemap of the MRN, which will include information about the length, the direction of movement (one way / two-way street) and the number of traffic lanes. The following Table 2 illustrates the key elements of the reference road network.

Table 2: Indicative data of the MRN

INTERSECTIONS

		Signalized	Priority
Number of intersections	**1.200**	290	910

ROAD SECTIONS

		One way	Two ways
Road surface length (km)	680	220	460
- Freeway	125	110	15
- Highway	35	15	20
- Main artery	80	30	50
- Secondary artery	140	10	130
- Main Collector	65	5	60
- Secondary Collector	235	50	185
Total number of kilometers in one direction	**1.140**		

7.2.2   Preliminary works

On the basis of the reference road network to be provided to the Contractor, the Main Road Network will be identified on site, in order to gain knowledge of the Study Area, to finalize the network by integrating, as required, additional essential structures, and to identify network components which will allow the organization and scheduling of the surveys and measurements to follow.

In parallel with or following the identification of the network, the necessary inventory forms will be prepared and the inventory will be organized: organization of the work and setting up of the survey groups, scheduling of the works and securing of the necessary equipment and vehicles.

Finally, the Contractor shall collect all available data from the Services, Organizations and Government Bodies concerning the infrastructure and operation of the road network, which can possible be used in the context of the Contractor's works.

7.2.3 Inventory of road sections

This inventory covers all road sections of the MRN, that is road sections between the intersections of the MRN.. Appropriate forms shall be used, which shall be configured as mentioned above by the Contractor and shall be approved by ATTIKO METRO. The information to be collected for each road section is at least as follows:

- Road surface width (one-way, two-way street with one or two roadways)
- Number of lanes per direction (for the road pavement not used for parking). The exclusive bus lanes shall be marked separately, as well as the left / right turn lanes
- Directions
- Pedestrian roads
- Longitudinal slope of the road network

Wherever there is significant variation in one or more of the above characteristics within the same road section, then the inventory shall be conducted separately for the individual smaller parts.

In addition, the inventory records the locations of point or abrupt bottlenecks, the points where double parking is practiced on the road surface, as well as other characteristics that may influence the capacity of the road.

The inventory shall be conducted by means of field inspections by trained groups of 2 or 3 people, one of whom will be a University Engineer or Technical Institute Engineer, while all road network inventory works shall be coordinated by a University Engineer.

An Infrastructure Database shall be developed with the details per road segment gathered during the road network inventory, which will be correlated to the basemap that ATTIKO METRO will hand over to the Contractor. The MNR will be confirmed / updated according to the collected data.

7.2.4 Inventory of intersections

This inventory relates to signalized and major priority intersections of the Main Road Network. In the framework of identifying the Main Road Network, the signalization plans of the signalized intersections in the Study Area shall be collected by the competent bodies. In case where signal phases are traffic actuated, the Competent Body shall request the light signaling programs

actually applied in those intersections during a typical day selected by the Contractor and specifically for three time periods of the day, i.e., morning and afternoon peak period and off-peak period.

An Intersection File shall be created containing all intersections of the Main Road Network recorded with their drawings or sketches.

- As regards signalized intersections, each drawing shall be accompanied by the signalization plan, completed with the dimensions of the basic geometric data per intersection approach and the number of traffic lanes with common green time, identified on site. It will also be noted if the intersection forms as part of an artery with coordinated signalization plan.
- In respect with the major priority intersections, the relevant drawings or sketches shall indicate the dimensions of the basic geometric data, the type and location of the traffic signs, as well as the number of lanes and the number of allowed minor-street turning movements.

The inventory shall be carried out by a group of 2 persons, one of whom will be a University Engineer or Technical Institute Engineer while inventory of intersections shall be supervised and coordinated by a University Engineer.

According to the data collected from the inventory, the Main Road Network to be given to the Contractor shall be confirmed or updated, as required. In addition, capacity at signalized intersections shall be computed according to Highway Capacity Manual methodology.

7.2.5 Measurements concerning traffic volumes and traffic composition

The Contractor, using automatic measuring machines, shall measure the hourly traffic volumes and traffic composition per direction for 24 hours, at a minimum of 100 road sections of the network for 2 typical week-days, in order to obtain a complete –to the extend feasible – picture for the loading of the Main Road Network during a typical week-day. It is clarified that the number of these measurements does not include the traffic measurements to be carried out in the context of the Roadside Surveys.

The above machines shall be placed during night hours (after 22:00) by groups of 2 people at least, depending on the difficulties in the area, while an Engineer will supervise and coordinate the work of all groups. The measurement program and locations shall be decided by the Contractor and approved by ATTIKO METRO.

A Traffic Volumes and Composition Measurement File shall be created for each road section where measurements were conducted. This file shall contain the measurement data per hour. Reference to the measurement data shall be achieved by all of the following:

- by the code numbers of the start/end nodes of the road section at the direction of traffic

- by the code number of the measuring station

- by the street name where the section belongs to

- by the names of the crossing streets between which the measurements were conducted

- by the date and time of measurement.

The precise method of data recording shall be defined by the Contractor and approved by ATTIKO METRO.

At a minimum, the following shall be implemented during the stage of processing of traffic measurements:

- a preliminary control of the traffic volumes to be carried out during the measurements period. Verification of consistency of measurements shall be conducted with a comparison of traffic measurements from adjacent road sections. Inconsistent measurements should be erased and the measurements shall be repeated.

- calculation of each vehicle type percentage and of the average hourly traffic volume for each of the three time periods of the day, that is, morning peak, off peak and afternoon peak. These periods shall be determined based on input from ATTIKO METRO during the Contractor's preliminary work stage. The above hourly traffic volumes are calculated per traffic direction for each road section in which a measurement was made.

In addition, traffic volumes and traffic composition measurements by turning movement will be carried out at a minimum of 130 intersections within the Study Area. The selection of the intersections along with the time periods for the measurements will be made in consultation with ATTIKO METRO. Measurements will take place at a minimum in two periods of the day, that is, during the morning and afternoon peak period for at least one typical day. Each period shall have a minimum duration of 3 hours and its exact starting/ending time shall be timely determined by the Contractor and approved by AM. At each intersection, composition measurements of turning movements (including straight movement) shall be carried out by observers using mechanical handheld counters (or by another method proposed by the Contractor and approved by AM).

At each intersection there will be a group with a sufficient number of observers, usually one per intersection approach, supervised by a University Engineer or Technical Institute Engineer, while a University Engineer shall coordinate and supervise the work of all groups.

A Turning Movements File will be created by means of computerizing the primary measurement data. Reference to these data shall be made with the following:

- by the code number of the intersection

- by the street names and code numbers of the intersection approaches

- by the measurements date and day.

The file shall contain registered data for traffic composition per turning movement and per period of the day (morning peak, afternoon peak). The exact form of data registration shall be determined by the Contractor and approved by ATTIKO METRO.

The following calculations shall take place at the data processing stage:

- Calculation of PCUs coefficient per turning movement and approach for each measurement period, and calculation of heavy vehicles percentage

- Conversion of the turning movements/hour to PCUs for each measurement period and calculation of the percentages per turning movement.

The above processed data related to traffic measurements and composition on road segments and intersections shall be correlated with the digital basemap of the Main Road Network.

7.2.6 Measurement of travel times

These measurements shall be carried out throughout the Main Road Network, with the exception of the National Highways operating under closed motorway conditions and of the Secondary Roads. Measurements shall be taken in three distinct periods of the day (approximate duration of each measurement 2 hours), i.e. the morning and afternoon peak periods and off-peak period. The exact limits of these periods shall be timely determined in cooperation with ATTIKO METRO.

Four (4) measurements shall be conducted during each time period in the same day, using the moving observer method. For each road section, the observers shall record the starting time at the first intersection, the ending time at the last intersection, and the overall delay at that intersection. If there are signalized intersections at the specific road section, the observers shall also record separately the delay times at them. The terms "Delay at the intersection" mean the time that elapses between the moment the observer's vehicle stops at the intersection, usually behind an already formed queue of vehicles, until the time of the vehicle passes from the center of that intersection.

Throughout the measurement period the supervisor shall maintain a detailed log of the measurements, which shall also record the weather conditions as well as any other observations. Generally, measurements during extraordinary occurrences that temporarily reduce the actual theoretical traffic capacity of the road (eg road accident, road maintenance, etc.), or during particularly adverse weather conditions should be avoided, and the measurements should be taken to the degree feasible under normal conditions.

The measurements shall be carried out by a group of two people in the vehicle, one of whom shall be a Technical Institute Engineer, while the Supervising Engineer shall supervise the work of all groups. The measurement program, the measurement periods and the measurement form will be developed by the Contractor and approved by ATTIKO METRO.

A Travelling Time File shall be created by computerizing all primary data, ie travel times per road section and traffic direction along with the delay times at intersections. Computerization will be done for each of the 3 periods of the day separately, as well as for each of the four trips within one period. The data will be recorded per road segment with start and end nodes. The exact form of data recording shall be determined by the Contractor and approved by ATTIKO METRO.

At the measurements processing stage, the contractor shall calculate the average total travel time for each road segment, as well as the average delay at the end junction of the road section. Based on the length of each road section and in relation to the total travel time, the contractor shall also calculate the average total speed per period of time. The contractor shall estimate the average speed within an 18-hour period for both directions as a whole, based on the weighted results of the three measurement periods. Based on these data, the contractor shall assess the level of service of the road sections and of the intersections approaches according to the Highway Capacity Manual methodology.

7.3   ROADSIDE SURVEY

7.3.1   Survey Stations

Based on a preliminary reconnaissance conducted by AM in order to evaluate the extent of the assigned work, the Roadside Trip Survey shall be conducted at approximately 43 stations throughout the road network, grouped as follows:

- Screen Line Stations: Three screen lines are established to control access to the center of the city (at the boundaries of Thessaloniki municipality). From west to east: Screen Line 1 (to the west of Lagada Street) is delimited by Koleti and Aghion Panton Streets, Screen Line 2 by 3 Septembriou Street and Screen Line 3 by 25 Martiou Street. Measurement positions at the screen lines: ~15.

- Peripheral Ring Stations: The Stations are located on the road axes transverse to the Inner Ring Road. Measurement positions: ~17.

- Outer Ring Stations: The Stations are located on the main road axes leading to the Study Area, outside the outer ring. The outer ring is delimited as follows: (a) to the west and north by the Outer Ring Road (section of Egnatia Odos extending from the grade-separated junction 21, at the west entrance to the city, up to the grade-separated junction with Lagada Street, and then the section extending to Efkarpias grade-separated junction), and (b) to the east by the Inner Peripheral Road. Measurement positions: ~11.

The following map shows the two rings and the three screen lines of the Roadside Survey (RSS).

The information to be collected from all three screen lines and peripheral ring stations shall supplement and validate/ correct the data collected from the Household Survey. Information to be collected at the Outer Ring stations shall refer to trips outside this ring (one end outside the Study Area) leading to the Study Area and shall supplement the Household Survey.

The location of the survey stations as derived from AM preliminary reconnaissance will be given to the Contractor who shall reconnoiter the aforementioned roads and/or other possible locations on the road network along the rings and the screen lines before commencing the Roadside Survey, in order to include in the survey all important roads; it shall be possible to recommend another location or to abolish some of the aforementioned stations.

The exact location of each station shall be defined on site by the Contractor in cooperation and with the consent of ATTIKO METRO S.A. The specific location of a station on the road shall be selected on the basis of specific criteria, since the locations of the stations must not serve only as traffic measurements points, but also as interview points for the Roadside Surveys. The following criteria shall apply:

- Sufficient space for temporary parking of at least 3 private vehicles in a row,
- enabling smooth deceleration and stopping of vehicles (e.g. close to a traffic light), visibility from the station and possibility of placing signage for the station's safe operation,
- minimum possible obstruction to traffic.
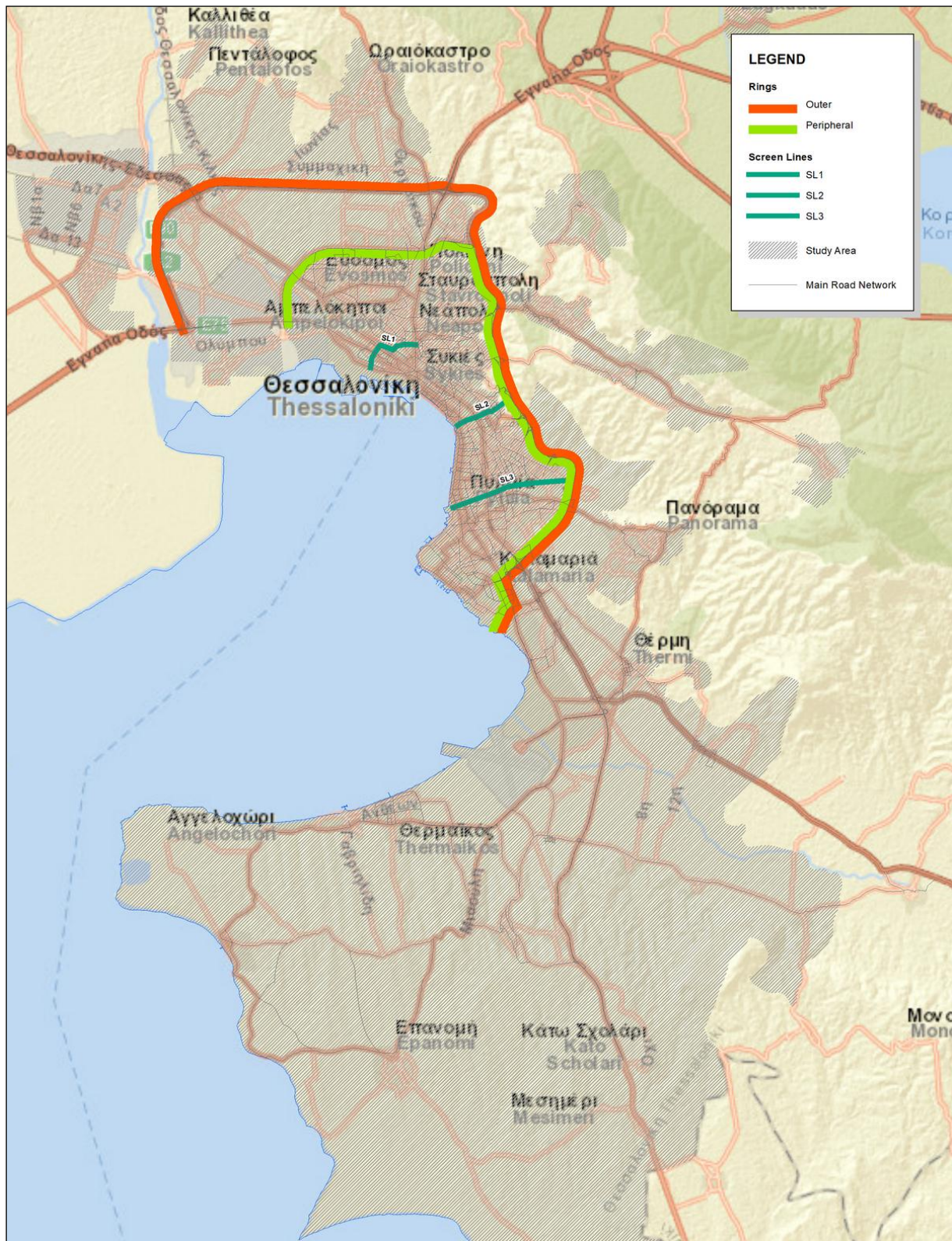
Map 2

7.3.2 Methodology

In all survey stations sampling interviews shall be carried out. For each survey, the sampling period shall be 12 consecutive hours (07:00-19:00), in shifts, and interviews shall be taken from drivers and eventual passengers of the following types of vehicles:

- motorbike drivers,
- passenger car/van drivers,
- taxi passengers.

It is pointed out that the survey is not addressed to taxi drivers and to drivers/passengers of urban or suburban buses and lorries. In addition, in the case of taxis, one interview per vehicle shall be conducted.

The required sample of interviews per station is determined on the basis of the traffic volume in the road direction where the station is located, the performance of the surveyors and the survey's reliability degree aimed at. The size of the minimum required daily sample (number of interviews) in every station is set to 1200, irrespective of the traffic volume of the road. The days of survey in each station differ depending on the traffic volume in the direction leading to the station as follows:

Volume per direction (vehicles/day)	Days of survey
< 10.000	1
10.000 – 25.000	2
25.000 – 40.000	3
> 40.000	4

It is worth mentioning that the survey shall only concern the inbound direction.

In view of conducting the daily sample of 1,200 interviews, at least three (3) interviewers are required. The aforementioned number of interviews must be evenly distributed in the 12-hour period (07:00-19:00) of the survey.

The daily sample to be taken from each station shall not be 10% less compared to the required sample, i.e., less than 1080 interviews; otherwise, the Contractor shall have to conduct a supplementary survey at the specific station at no additional compensation.

Interviews shall be carried out only from Monday to Friday. No interviews shall be conducted during holidays, strikes or other extraordinary events affecting the normal and standard behavior of the traffic. The Contractor shall consult with ATTIKO METRO S.A. for any of the above cases which could alter the schedule of the surveys.

Vehicles for interview shall be selected by a policeman in view of ensuring random sampling. As soon as the policeman sees that a surveyor is free, he/she shall direct the first coming vehicle in the interview area, as instructed, leaving the other vehicles to pass until another surveyor is free. Special attention should be given, in order to ensure <u>even distribution of the</u>

sample depending on the hourly load of each vehicle category, while vehicles travelling in all traffic lanes should have the same chances of participating in the sample.

Concurrently with the interviews, the Contractor shall carry out 24-hour traffic flow measurements at the inbound traffic direction. These 24-hour traffic flow measurements shall be conducted using automatic roadside counters. Measurements shall be taken for one, two, three or four days, depending on the traffic volume of the road axes where measurement stations are located, concurrently with the Road-side Survey.

In addition to the interviews and traffic flow measurements, the Contractor shall carry out at each survey station hourly traffic composition measurements (conducted by observers), in only one traffic direction (the inbound direction, depending on the screen line). The following 8 vehicle categories shall be recorded:

1. Motorbikes,
2. Passenger cars,
3. Taxis,
4. Vans,
5. Buses (urban or suburban executing timetable trips),
6. Special buses (tourist coaches, company buses, school buses),
7. 2-axle lorries and
8. Multi-axle (>2 axes) lorries.

The purpose is to ensure satisfactory assessment of the composition attributes, in order to be able to make corrections per mode of transport to the Origin / Destination tables - resulting from the roadside survey - for the entire traffic, and also to convert the measured volumes (obtained from the counters) to Passenger Car Units. In the measurement sheet the composition shall be entered (grouped) every 15 minutes and shall be added in multiples of 15 minutes.

ATTIKO METRO S.A. personnel shall be present on-site and shall monitor the survey and the measurements.

7.3.3 Preparation and organization

Before conducting the interviews, the Contractor should pay attention to the following points in order to organize the survey:

a. Precise identification of the location of the stations, on the basis of the criteria defined in §7.3.1.
b. Consultation with the local Police Authorities on the one hand to temporarily prohibit parking in the area of the stations, and on the other hand, to ensure the presence Police Personnel during the conduct of the surveys. ATTIKO METRO will assist in this issue.
c. Organizing the arrival / departure of the survey personnel to/from the stations.
d. Organizing the safe operation of the stations by means of warning signs, station labeling signs, speed-reducing signs (reflective), warning lights, plastic cones and reflective vests for the survey personnel. For the proper and timely organization of the safe operation of the stations and the installation of the necessary warning signs it is necessary for the

Contractor's survey team to be at the station at least half an hour before commencing the interviews.

e. Installation of the automatic traffic counter prior to 24:00 of the previous day, preferably during the night hours between 22:00 and 24:00, by groups of 2 persons at least depending on the difficulties in the area, while the works of all groups shall supervised and coordinated by a University Engineer.

f. Examination of the data obtained from earlier measurements and / or new ones, in order to make a preliminary assessment about the required number of survey days at the station.

g. Conduct of testing traffic measurements during peak hours, in order the precisely define the required staffing at each station.

h. Training of the interviewers and practical training of the persons conducting the survey, in order to assess their performance (required time per interview) and to respond to any additional questions they might have.

i. Purchase or otherwise securing of the various instruments, signs and technical equipment. In order to conduct the survey, equipment is required such as: tallies for recording the composition and equipment for the safe operation of the stations referred to in (d)

The Contractor shall be given in due course more detailed instructions, such as the typical general layout of the survey station, during the preparation, planning and organization of the survey.

In order to properly prepare and organize the survey and to ensure the reliability of the results, the surveyors shall be coordinated by an experienced Engineer (Coordinator), while on a daily basis the surveys shall be supervised by two Engineers (Supervisors) possessing the relevant experience, who shall supervise, in shifts, (one Engineer per shift), all survey stations.

It is estimated that each survey station shall be staffed with at least the following permanent personnel (group):

- Supervisor
- Three (3) interviewers
- One traffic composition observer
- One police personnel

It is pointed out that the Supervisor does not have to be a University Engineer (or a Technical Institute Engineer); he/she can be a well-trained person in order to ensure the proper operation of the stations and proper sampling and also able to take initiatives in case of unforeseen conditions.

The presence of Police personnel during the conduct of the survey is imperative. The Contractor shall initially submit the program and the locations of the survey stations to the local Police authorities and subsequently ensure that the necessary number of police officers is provided. The Contractor shall ensure that the police officer is present at the location of the survey at least 15 minutes before the start of the interviews, in order to be updated by the Supervisor about the survey his/her duties.

Due to the extended duration of the survey, it must be conducted by different groups (in shifts) in the morning and afternoon. The same applies to police officers and supervisors.

7.3.4 Questionnaires

Printed questionnaires will be used in the survey. Before the start of the interview, the surveyor's code shall be written on each questionnaire, as well as the date and time of the interview.

For each vehicle falling within the scope of the survey, the following information shall be recorded:

- The vehicle type (according to the vehicle types mentioned in the traffic composition in §7.3.2)
- The number of passengers in the car
- The vehicle's origin and destination addresses,
- The purpose of the trip
- Place of residence (origin, destination or other)

For each station, the above information shall be grouped per time of the survey.

A draft questionnaire and the relevant completion instructions will be timely given to the Contractor by ATTIKO METRO at the stage of preparation, planning and organizing of the survey. The final planning of the questionnaire and the instructions to the interviewers shall be prepared by the Contractor and approved by ATTIKO METRO.

7.3.5 Computerization and processing of the data

The computerization of the data obtained from the individual surveys shall be performed in parallel with the conduct of the field surveys. When processing is completed, a Technical Report shall be prepared presenting the results and the conclusions. The data computerization and processing shall be supervised by an experienced Engineer.

During field surveys, all information shall be directly codified, with the exception of the trip origin and destination addresses.

Initially, all data including the addresses shall be computerized on a PC. The data will be typed twice (with the exception of the addresses which are entered once). The two copies shall be compared in order to correct any errors during data entry. Geocoding of all origin / destination addresses shall follow, as well as their correlation to Traffic Zones as described in chapter 5.6.

Subsequently, the Contractor shall propose and ATTIKO METRO shall approve multiple logic controls of the computerized data by electronic means, to ensure (a) the absence of incomplete data, (b) the logical consistency of the data and (c) the spotting of insufficient sample.

Data computerization shall also include traffic composition and automated traffic measurements data from the station. The Contractor shall receive in due course instructions on how to save the data in files.

One week after each day of survey, the questionnaires must have been computerized, codified and checked by the Contractor. The computerized data will be delivered on a weekly basis to ATTIKO METRO for review in order to promptly take corrective measures or make suggestions that the Contractor is obliged to comply.

The processing involves creating Trips Files that will contain the data from the stations for each ring and screen line. Reference to these data will be made with the following:

a. with the code number of the survey station designated by ATTIKO METRO instructions, based on the location of the station on a particular screen line / ring
b. with the name of the street where that station is located
c. with the date and day the survey was conducted.

The files shall contain data per station, day of survey at the station and time of survey.

In brief, the data processing stages are the following:

a. Creation of a Database for each of the Trips Files with all the parameters of the questionnaire, ie vehicle type, occupancy, origin, destination, place of residence (origin, destination, or other) and purpose of trip.
b. Grouping of the data from each station per hour, cumulatively for the survey days at the station.
c. Correlating the sample per vehicle category (type) for each hour of the survey with the total vehicles of the category (average of the survey days)
d. Grouping of the data resulting from the above per period of the day (morning peak, off peak, afternoon peak) and calculation of the data on an average hourly basis for each time period.
e. Correction of daily traffic volume (automatic measurement) on the basis of the results from the 12-hour traffic composition measurement and converting to daily data (pertinent instructions will be provided early enough)
f. Creation of cumulative tables presenting results on a daily basis (separately for the data of each File). These tables will show the following:
    - Trips per trip purpose and vehicle type
    - Average vehicle occupancy per vehicle type and trip purpose
    - Hourly distribution of trips per purpose
    - Hourly distribution of trips per vehicle type
    - Trips per trip category (the categories shall be defined by ATTIKO METRO in due time) and vehicle type
    - Average vehicle occupancy per trip category and vehicle type
    - Hourly distribution of trips per trip category
g. Drafting of the following origin/destination (O-D) tables for (vehicle) trips per zone, per municipality (or Community), and per District (to be defined in the course of the Works).

- Trip Tables per trip category, for each station at the ring and the screen lines. These tables are created only per District and per time period of the day and will be delivered in computerized form.
- Trips tables as above, separately for all the stations of each ring and screen line. These tables are created per Municipality and District for each time period and cumulatively for the entire day. They will be delivered in computerized form, while the tables per District on a daily basis will be also presented in the Technical Report.

Initially, the Contractor shall point out when carrying out the surveys, those cases that may lead to biased results (eg failure to obtain a satisfactory sample from all lanes of a road artery). These cases will be examined by the ATTIKO METRO and if they are unavoidable, the repetition of the survey will not be required, but at the data processing stage the Contractor will determine the size and extent of the biased errors of the survey based on the following:

- Examination of the O-D tables on a daily basis (before they are converted), per type of vehicle and per trip purpose at each survey station for large geographic units, and review of data in each table for unusual traffic patterns or for unjustified and unequal distribution of trips in the geographical units under consideration.
- Examination of the O-D tables on a daily basis (before they are converted) at each station at the level of the traffic zones, per vehicle type and per trip purpose, looking for a comparatively large number of zero data and / or unjustified concentration of trips in specific pairs of zones.

Thereafter, the station data shall be adapted to eliminate the errors that may be discovered when examining the above-mentioned O-D tables. These adaptations shall be made on the basis of other more reliable data gathered at an adjacent survey station, or on the basis of more reliable data gathered at the examined station for another category of vehicle category or trip purpose. Unreasonable, non-zero results in the O-D tables shall be deleted and the same shall apply to the data obtained from the automatic traffic measurements before conversion, on a daily basis.

7.4   Deliverables

In view of recording the Main Road Network and in the framework of the Roadside Survey, the Contractor shall deliver to ATTIKO METRO the following items:

a. All primary data, ie all inventory, measurement and survey forms completed, codified and classified appropriately.
b. Databases with the collected primary data about inventories, measurements and surveys.
c. The results from the processing of the data in the above Files, as described in §7.2.5, §7.2.6and §7.3.5, in a digital form.
d. The updated digital basemap of the Main Road Network (in shapefile format).
e. A Node-Link map that will illustrate the breakdown of the Main Road Network into its main structural elements. This map shall also present the hierarchy of the main road network, the directions of the roads, the road junctions (signalized, priority and pseudo node), as well as the grade-separated junctions.

f. Digital basemap with the positions of the Roadside Survey stations and the locations of all measurements (locations of automatic measurements, intersections where measurements took place).

g. The complete results of the surveys in a Technical Report (accompanied by the appropriate Annexes as deemed advisable by the Contractor), which shall include a detailed description of the planning and organization of the inventory, the measurements and the surveys, their conduct and the problems that emerged. It will also describe the collected data and their structure. The report shall also contain a judgmental analysis of the data processing results, as well as the findings of the survey, making a clear reference to the applied methodology.

The primary data of the survey (the deliverables referred to in point (a)), as well as the data processing software to be developed by the Contractor shall be delivered to ATTIKO METRO upon completion of the work.

8 TRIPS SURVEY IN THE PUBLIC TRANSPORT MEANS

8.1 PURPOSE AND SCOPE OF THE WORKS

The scope of the works is to record the current operating conditions of the Urban Buses, as well as the basic attributes of outside trips accessing the Study Area by Public Transport Means (train, intercity bus and airplane).

The framework of the scope his works, the Contractor shall organize and conduct the following two surveys:

- Trips Survey at the Urban Buses, the conduct of boarding/ alighting measurements and passenger volumes point measurements at bus stops.
- Trips Survey at Terminal Stations, which means interviews with a sample of passengers entering the Study Area from the four terminal stations (MACEDONIA Thessaloniki International Airport, new Railway Station, MACEDONIA intercity bus terminal and Intercity Bus terminal for Chalkidiki).

The above surveys concern the following Public Transport Modes:

Trips Survey at Urban Buses
- The urban buses of Thessaloniki. Their supervising authority is the Thessaloniki Transport Authority (TheTA). Their executing authority is Organization of Urban Transportation of Thessaloniki (OASTH).

Transportation Survey at Terminal Stations
- Airplanes connecting the city of Thessaloniki with the rest of the country and with other countries via MACEDONIA Thessaloniki International Airport. The Civil Aviation Authority is the supervising authority.
- The intercity and suburban railway connecting the city of Thessaloniki with the rest of the country and with other countries. The transport services provider is TRAINOSE S.A. and the railway infrastructure administrator is the Hellenic Railway Organization (OSE).
- KTEL intercity buses connecting the city of Thessaloniki with the rest of the country, as well as buses traveling to international destinations, connecting Thessaloniki with other countries, housed in MACEDONIA Intercity Buses Terminal Station.
- The CHALKIDIKI KTEL intercity buses; their terminal station is located at the National Road of Thessaloniki – Moudania.

THESSALONIKI METRO DEVELOPMENT STUDY (TMDS)

TECHNICAL DESCRIPTION OF THE SCOPE

AND SPECIFICATIONS FOR THE PREPARATION OF THE STUDY

RFP-361/19

Α.Σ. 81337

ΑΤΤΙΚΟ ΜΕΤΡΟ Α.Ε.

8.2 TRIPS SURVEY AT URBAN BUSES

8.2.1 Purpose and scope of the Survey

The purpose of this survey is to define for each bus line the following:

- Number of boardings and alightings
- Number of traveling passengers and bus occupancy between passenger boarding/ alighting stops
- Travel time and speed of buses, as well as delays in stops (if no reliable data are provided by OASTH Telematics).

In order to ensure a better understanding of the volume of the Contractor's works, the following indicative figures are provided, which correspond to the current transport work (year 2018) and may have changed slightly until the execution of the field surveys:

Number of scheduled daily trips	Number of bus lines
≤ 10	9
11 - 50	31
51 - 100	17
> 100	21
Total	**78**

8.2.2 Collection of data

The Contractor shall collect the required data concerning the structure and the operation of urban buses. This work constitutes the first step towards defining the components/points of the urban buses network where individual surveys/ measurements shall be carried out and towards scheduling field surveys.

The data to be collected concerning the urban buses structure and the operation are listed below:

- **Depots:** location, lines served, existing statistical data of executed and missed trips
- **Fleet of vehicles:** number, vehicle type and characteristics (number of seats, total capacity, number of doors, etc.)
- **Lines and Stops:** Lists of lines and for each line: served areas, route, stops, terminal station (bus route start/end), trip length and time per direction, number of scheduled daily trips and trips during rush hours, standard number of trips executed daily (or percentages of missed trips)
- **Terminal Stations** (Bus route start/end)**:** Location, number of served buses, number of served bus lines, itineraries. etc.
- **Itineraries:** Tables of scheduled trips per line direction, as well as data for scheduled trips per day of a standard (winter) period, distinguishing weekdays from week-ends.

- **Ridership:** Any available statistical ridership data for a standard period, ticket validations, hourly and daily ridership fluctuation, points of maximum load and rush hours.

The aforementioned data are indicative and non-exhaustive as regards the data that have to be collected, if provided by TheTA and OASTH.

8.2.3 Sample size and sampling procedure

The survey shall be conducted at all bus lines with a scheduled number of daily trips above 10. Measurements can be also carried out at lines with a smaller number of scheduled trips, further to ATTIKO METRO S.A. consent, if these lines, at their major part, operate in parallel with other lines, so that the overall sum of daily trips at the stops along their common section exceeds 20.

The survey shall be conducted only during weekdays (Monday to Friday) on a standard period of the year by groups of researchers on the buses. Each bus line shall be surveyed during one day, based on a (minimum) trip sample (as defined below), to be taken during each of the time periods forming the operating hours of the line (approximately between 06:00–24:00), in order to ensure stable transportation attributes at each time period. The service hours of the lines shall generally be divided into 6 to 8 periods representative of the operation of the urban buses of Thessaloniki, where morning rush hours, evening rush hours and off peak hours shall be clearly identified. The final selection of the time periods shall be made by ATTIKO METRO S.A. further to the Contractor's recommendation.

The minimum sample of trips for each period shall depend on the daily number of scheduled trips and shall be structured as follows:

Daily scheduled trips	Minimum Period Sample
≤ 10	0
11 – 50	1
51 - 100	2
> 100	3

The aforementioned sample should be necessarily distributed as evenly as possible in each period, but also in the transitions from one period to the next. In other words, the time period between the trips of the sample shall be (almost) fixed, with no accumulated sample trips at a specific time. At those bus lines where a minimum sample of 2 or 3 trips per (two-hour) period is required, it shall be sought to take a sample of at least one (1) trip for each. In any case, sampling shall be constant (no gaps).

The above stated sizes of samples are the minimum permissible. In practice, the sample to be taken shall usually be a little higher than the minimum one. In these cases, the entire sample shall be utilized.

The purpose of the measurements is to collect data for the trips sample in a way rendering possible to correlate them – fairly accurately – with the total number of trips on the line made during the measurement day, in order to assess the overall figures for each line. Therefore, it is absolutely necessary that the trips sample is representative of the period which it was taken from. In case of doubt about the representative nature of a trip, the Contractor shall be responsible to remove the trip from the sample and replace it with another, either during the sampling period or afterwards (by conducting a supplementary measurement). The conditions prevailing on the specific day and line, the number of the recorded ticket validations and the ridership figures of the closest, in terms of time, sample trips of the line or another line with similar attributes, provide safe indications about the representative nature of a trip included in the sample. The detailed sampling schedule (for each line: working hours of the surveyors, number of trips in the sample and departure hours of such trips) shall necessarily be approved by AM.

8.2.4   Methodology and organization of the survey personnel

The Contractor may optimize the use of its personnel by means of a detailed and documented scheduling and by combining lines in groups, especially for lines with a common (or neighboring) terminal station (route start / end). It is self-evident that in order to ensure such an optimisation, understanding the topology and operation of the line network is a prerequisite. In any case, each group of surveyors shall work throughout its entire shift with no interruptions (except those due to vehicle dwelling at terminal stations) and shall never stop his/her work in the middle of a trip.

The number of the persons comprising each group of surveyors shall depend on the number of bus doors. In case of normal buses (12m) there will be three (3) surveyors, while in the case of articulated buses (18m) and midi/mini (10m) buses, there will be four (4) and two (2) surveyors, respectively. Groups shall be supervised by the Contractor's properly trained and experienced supervisors, who shall coordinate works on a daily basis and shall be responsible for the efficient conduct of the survey.

At standard buses, each surveyor shall be assigned with one entry/exit point. At each stop, surveyors shall record on a special form the number of passengers boarding and alighting from the door they are assigned with. One surveyor, preferably the front door surveyor (with more free time at his/her disposal due to the small number of passengers entering/ leaving the bus from this door and because he/she has a better visual coverage of the entire bus), shall also record the arrival time (door opening) and the departure time (door closing) at/from the stop using a dedicated chronometer. At the beginning /end of the trip, each surveyor shall also write down on his form the figures displayed on the nearest ticket validator.

To avoid delays, the stops (stop name and code number) along each trip and direction shall be written by default on the surveyor's form. The same applies to the number of the line and the traveling direction (leaving or arriving at the terminal station). At the beginning of each route/ trip, the surveyors shall write down the type of bus, the seated/standing capacity of the specific vehicle, the code number of the door where they take measurements, as well as the time period

when the trip survey is conducted. Recording sheets shall be designed by the Contractor and approved by ATTIKO METRO.

In view of facilitating the survey, OASTH must be informed in advance in order to ensure cooperation with its personnel. The Contractor shall be responsible to obtain all readings from all ticket validators on the buses who have operated the daily trips of the examined bus line, regarding the day of survey on the specific line, in view of forming a complete picture on the number of validations in each line on the day of the survey. In addition, the Contractor is also responsible to seek out all data concerning the trips executed on all lines during the survey days on the corresponding lines.

The duties of the supervisors / Contractor in general include among other: providing the adequate material to the surveyors (forms, chronometers), ensuring strict adherence to the shifts schedule, selecting the surveyors, replacing the surveyors in case of incompetence or inability to show up for the survey, and finally ensuring that completed measurements forms are collected at the end of each shift. Finally, the Contractor shall timely organize training procedures for the entire personnel to be involved in the surveys. Training shall be mainly take place in buses by means of pilot surveys. ATTIKO METRO shall supervise the training process.

The Contactor is responsible to organize the personnel involved in measurements, i.e., scheduling of groups/ shifts/ supervision etc. However, the entire procedure shall absolutely ensure the reliability of the measurements. To this end, ATTIKO METRO shall approve the procedure and shall review it at the preliminary stage, at the planning stage and during the survey. A standard procedure for organizing the survey personnel which can ensure a satisfactory degree of reliability shall be as follows:

- Due to the extended duration of the survey (bus lines service hours approximately 6:00-24:00), it is estimated that three six-hour shifts shall be required in order to cover the trips of the entire day. The shifts 6:00-12:00, 12:00-18:00, 18:00-24:00 are given as an example. However, these can be changed depending on the service hours of the bus line and the travel time.
- At the beginning of each shift, each group of surveyors shall be at the terminal station of the line (start/end). The trip on which each group of surveyors shall conduct measurements shall be selected on the basis of the travel time. The intended purpose is that trips measured by all groups are evenly distributed in the measurement period. More precisely, for1 trip per period, one of the groups shall start from the terminal station. For 2 trips per period, one of groups shall start from the terminal station of departure and another group from the terminal station of termination, while 3 trips per period, two groups shall start from the station of departure and one from the station of termination, choosing the trips in a manner that ensures even distribution of the measured trips within the entire number of the trips in each period. Measurements in all lines are necessarily constant without gaps. Unless ATTIKO METRO's approval has been granted, surveyors are not allowed to suspend measurements or change lines during their shift.
- On a daily basis, it is preferable to conduct surveys at lines with the same or neighboring terminal stations, in order to facilitate monitoring by the Contractor's supervisor. A second supervisor shall monitor measurements from the end terminal station. Monitoring the

start/end terminal stations shall also be in shifts and shall include collecting executed daily trips (with their departure times) in all surveyed lines, in cooperation with the station masters and the responsible services of OASTH. All works shall be headed by a Contractor engineer who shall schedule the works and coordinate the personnel.

8.2.5 Point measurements for passenger volumes

The scope of point measurements is to review and correct the passenger volumes, as they result from the sampling survey for embarkations/disembarkations from buses, as described earlier herein.

For point measurements of passenger volumes, specific stops will be selected in a way that the measurements cover the entire number of bus lines to be surveyed during the trips survey. Specifically, the two main criteria for selecting the stops of the sample are the following:

1. Selection of central stops (not start / finish terminal stops) serving several lines, preferably at the points of maximum load - even if not all of them stop (although it is clearly preferable that they actually stop), if the measurement is made on the road and not in the vehicle.
2. Selection of stops with suitable conditions for measuring activities (good visibility, low speeds, weather protection (e.g. canopy), etc.

The measurements shall be conducted on both directions of each line during typical weekdays of the typical period by observers placed at the selected measurement points. Point measurements at a bus line shall take place simultaneously (within the same day) with the boarding / alighting measurements on the same bus line.

The surveyors shall be well trained, in theory and in practice, so as to be familiar with the capacity of each type of vehicle (standing / seated passengers). At each measurement point (stop), depending on the number of stops, the number of the passing lines and the timetable frequency, one or two surveyors shall work at the same time, while at certain few points three surveyors might be required. The pilot measurement to be carried out by the Contractor shall assist in selecting the number of surveyors.

Each surveyor shall be located at the selected stops and will write down in a specially designed form (designed by the Contractor and approved by ATTIKO METRO) the number of passengers on each bus (occupancy) by estimating the number of standees and taking into account the number of seats in the particular vehicle type. Measurements shall be made macroscopically from the stop, rather than from within the vehicle.

The form shall have entries to note the measurement point (stop code number), the day, the time of the measurement and the direction of the movement. The number of passengers (occupancy) will be recorded per passing vehicle (so sufficient space will have to be provided in the form) and this number shall be summed up per line for a period of half an hour – standard time period existing in the form.

It is clear from the foregoing that careful design of the measurement forms, as well as including in them as many details as possible during the preparation phase, are very important factors in

order to reduce the time required for recording the measurements and to improve the accuracy of the recording. For this reason, the Contractor must pay particular attention to this matter.

The measurements shall cover the entire period of each line's operation, typically from 06:00 to 24:00. Due to the lengthy period of measurements, at least 2 shifts of observers must be foreseen. All measurements should be supervised by a properly trained supervisor and coordinated by an Engineer of the Contractor.

8.2.6 Data processing and evaluation

All collected data shall be processed and evaluated progressively, according to the evolution of the field works.

8.2.6.1 Passenger volume point measurements

A Passenger Volume Point Measurement File shall be created by computerizing the primary measurement data, i.e., the number of passengers per vehicle and per direction for each bus line. The data are recorded at half-hour intervals during bus line operation.

Subsequently, the number of passengers per line and per direction shall be calculated for each of the individual time periods and cumulatively for the entire day.

Any reference to this file's data shall be made by:

a. The (code) number of the Line
b. The direction of the bus route (to start/end terminal stop)
c. The code number of the stop where measurements were made
d. The measurements day and date.

8.2.6.2 Passenger trips Survey

A Standard Period Operation Data File shall be created by computerizing the primary data of the survey, i.e., the number of passengers boarding/alighting per vehicle door at each stop in the direction of movement on a Line, for each examined trip, as well as the time of arrival / departure from the stop, respectively.

Any reference to this file's data shall be made by:

a. the (code) number of the bus Line
b. the time period in the day
c. the serial number of the timetable trip within this time period
d. the direction of the bus route
e. the details of the examined vehicle (seated/standees and number of doors)
f. the code number of the door
g. the date and day of the survey

The File shall also contain the data related to the number of executed timetable trips on the day of the survey, for each of the individual time periods of bus line's operation, as well as to the distances between the stops.

The data processing stages are briefly the following:

a. calculation of the total number of passengers boarding/alighting at each stop (all doors) for each trip per direction.

b. calculation of the number of the transported passengers in general, as well as between stops for each timetable trip per direction of travel.

c. calculation of the number of passengers transported in general, as well as between stops per line and per direction of travel, during each individual time period. The calculation will be based on the number of passengers resulting from the sample of timetable trips in each period, and the number of actual bus trips executed in each period.

d. calculation of the conversion, based on the resulting number of the transported passengers per time period at the stop, when conducting point measurements for passenger volume (Point Measurements File) and the number of passengers at the same stop obtained at the preceding stage.

e. "correction" of the number of boarding/alighting passengers that was calculated in stage (a) on the basis of the conversion coefficients obtained during the preceding stage for the individual time periods.

f. Repetition of stages (b) and (c) with the "corrected" resulting data in the preceding stage.

g. Calculation per Line and per direction of the total and average number of passengers transported per hour, on the Line in general and between stops, as well as of the average number of passengers transported per timetable trip, for the time periods that the day shall be divided into, whose precise limits shall be determined in consultation with ATTIKO METRO. The following periods are mentioned as an example:
   - Morning peak
   - Afternoon peak
   - Period between peaks
   - Off-peak periods (beginning/end of day)
   - Total over the day (06:00 – 24:00)

h. On the basis of the initial processing of the primary data in stages (a) and (b), the following items shall be identified or calculated per line and per direction of travel:
   - The position (between stops) on the network and the time period where the maximum vehicle occupancy is observed and the respective number of passengers
   - The total number of standees (entire day), their percentage to the number of the transported passengers, and the number of cases where the overall vehicle capacity (seated and standees) is exceeded.

i. Calculation of the average headway (min) per Line, based on the number of actually execute timetable journeys, for the morning and afternoon peak periods, the remaining off-peak time period and totally in the day.

j. Calculation of the average and total capacity (passengers / hour) of seated passengers for each Line, based on the type(s) of vehicle put into service and the number of executed timetable trips. In the case vehicles types of different capacity are put into service on a Line,

the calculation will be made separately for the morning peak, the afternoon peak and for the remaining off-peak periods.

All individual processing steps shall be available in a digital form to be reviewed by ATTIKO METRO, while the results of stages (g) to (i) will be delivered in digital form.

In addition to utilizing the above processed data for the creation of databases, they shall also be presented in the form of tables and / or diagrams in the Contractor's Report (or as an appendix), and in particular the data obtained from steps (g) to (i) inclusive.

8.3 TRIPS SURVEY AT PASSENGER TERMINAL STATIONS

8.3.1 Purpose and scope of the Survey

The scope of the survey is to record the basic attributes of the external trips entering the Study Area from the Passenger Terminal Stations.

The survey concerns the conduct of interviews at a sample of passengers entering the Study Area from the four passenger terminals of the city, i.e. Thessaloniki International Airport "MACEDONIA", the new railway station and the intercity bus stations (KTEL "MACEDONIA", KTEL of Halkidiki), during the typical period of the year. The information to be collected covers the external trips entering the Study Area and complement the Household Survey, just like the information from the Roadside Surveys conducted at the Study Area entry / exit checkpoints.

8.3.2 Sampling

At each terminal station, sample interviews are conducted to passengers arriving during a typical weekday, between 06:00 and 22:00. There might be small variations in this period per Terminal Station, depending on the specificity of the station and in view of covering the passenger traffic to the maximum possible extent. The exact time period of the survey at each station shall be proposed by the Contractor based on the ridership data of the station and shall have to be approved by ATTIKO METRO.

The required sample of the survey, i.e., the number of interviews to be held, shall represent at least 30% of the total daily passenger arrivals, and shall escalate per hour of survey proportionally to the passenger arrival rate.

Interviews will take place only on weekdays, that is Monday through Friday. They shall not be conducted on holidays, strikes or other extraordinary events affecting the smooth and usual structure of the trips on the day of the survey. The Contractor shall consult with ATTIKO METRO for the above cases which may lead to changes in the survey program.

Before its conduct, each survey period shall organized on the basis of the information requested by the competent Services / Companies (Civil Aviation, Thessaloniki International Airport "MACEDONIA", KTEL, OSE, TRAINOSE) , and mainly on the basis of the most recent

data (eg last week) concerning the daily passenger traffic and timetable trips. These data shall enable the Contractor to make a preliminary assessment of the required sample at each Terminal Station, and hence the required number of researchers. In the case of the Interurban Bus Terminals and the New Railway Station, the survey shall be planned on the basis of the timetable trips and, hence, of the rate of bus and train arrivals.

It is pointed out that the Contractor shall also obtain data from the competent Services / Companies related to the ridership figures of each Terminal Station for the specific day of the survey at this Station, in view of checking the sampling process and correlating the sample with the general population. In case the above data aren't available, the Contractor shall ensure that the number of passengers is recorder during the surveys in order to calculate the total daily number of passengers.

8.3.3 Questionnaires

In this survey, printed questionnaire forms will be used. The questionnaire will be configured in such a way that it is generally applicable to every type of Terminal Station for passenger interviews. Especially for the Intercity Bus Stations and the New Railway Station, it shall be possible to record the number of passengers of each bus or train respectively.

The following details shall be recorded for each passenger:

a. place of origin
b. place of residence
c. final destination address (Address, Municipality)
d. trip purpose
e. type of transport mode used in the trip outside the Terminal Station

Before interviewing the passengers of a transport mode (airplane, train, etc.), the following must be recorded in the forms:

a. the name (and/or the code number) of the Terminal Station
b. the survey day and date
c. the (initial) origin and the "identity" (train number, flight number, etc.) of the transport mode whose passengers' responses are to be recorded in the form.
d. the hour of the day when the survey is conducted (in time periods of half or full hour).

The Contractor shall plan the final form of the questionnaire and the instructions to supervisors and interviewers, which shall be approved by ATTIKO METRO.

8.3.4 Personnel

The number of interviewers at each Passenger Station shall depend on the size of the required interview sample at this Station. The number of interviewers shall be sufficient to ensure the required sample whenever a transport mode arrives at the Station, even in the case when more than one arrives simultaneously.

Throughout the duration of a survey at a Passenger Station, there shall be at least one supervisor who will monitor the work and shall give the appropriate instructions to the interviewers in order to obtain the required sample.

Due to the long duration of the survey, at least two different shifts of interviewers and supervisors shall be required.

In order to properly organize the survey and to ensure reliability of the results, the survey must be headed by an experienced engineer who will direct the survey overall.

Finally, it is necessary to train staff accordingly before the commencement of the work. The training shall be directed to both interviewers and supervisors, and shall be carried out in a way approved by ATTIKO METRO, which shall participate in the training process as a supervising entity. Train shall be both theoretical and practical by means of actual interviews.

8.3.5 Survey scheduling

The survey shall be conducted as follows per type of Terminal Station:

<u>KTEL Intercity Buses Terminal Stations</u>

Interviewers shall be properly scattered throughout the bus arrival halls. Upon arrival of a bus, the interviewer nearer shall:

a. record the bus arrival time and origin,
b. record the number of passengers inside the bus either by asking the driver or, if necessary, by estimating him/herself the occupancy of the vehicle, and
c. randomly interview alighting passengers.

The supervisor in the terminal station shall define the number of interviewers necessary for each bus. The number of the interviews taken at each bus shall correspond to 30% of the bus passengers, with a minimum sample of 5 interviews per bus.

<u>New Railway Station</u>

Interviewers shall be scattered inside the trains moving on "Plati – Thessaloniki" and "Gallikos – Thessaloniki". Interviewers shall board the train at Platy and Gallikos stations, shall be assigned to the cars of each train by the supervisor, shall record the number of the train and the car and shall interview passengers whose final destination is Thessaloniki. The minimum number of interviews taken by each interviewer shall be defined by the supervisor depending on the number of passengers in each train. Upon arrival of the train at Thessaloniki Station, all completed questionnaires shall be handed to the supervisor and interviewers/supervisor shall return either by car or by train to the boarding stations to continue the survey.

Alternatively, interviewers can be properly dispersed by the supervisor on the station platform. Upon the arrival of a train, each surveyor shall:

a. record the train arrival time and origin,

b. randomly interview passengers alighting the closest car. The minimum number of interviews to be conducted by each interviewer shall be defined by the supervisor, on the basis of the preliminary estimate of the required sample per train (work done at the Contractor's premises).

MACEDONIA International Airport of Thessaloniki

As regards MACEDONIA International Airport of Thessaloniki, the Contractor shall select the appropriate locations in the passenger arrival halls (usually in the baggage claim) in order to carry out interviews. Interviews shall be conducted on randomly selected passengers, while the minimum number of interviews by each interviewer shall be defined by the supervisor on the basis of the preliminary estimate of the required sample per airplane arrival (work done at the Contractor's premises).

Should the survey at one of the aforementioned terminal stations (Intercity Buses Terminal Stations, new Railway Station and MACEDONIA International Airport of Thessaloniki) lasts more than one (1) day, the required sample of each itinerary shall be collected within a day.

8.3.6 Codification

Questionnaires shall be codified and digitised as per the specifications for the relevant transportation surveys where printed questionnaires are used (e.g. Roadside Survey).

One week after each survey day, questionnaires must have been digitized, codified and reviewed by the Contractor. Digital data shall be delivered on a weekly basis for review by ATTIKO METRO, so that corrective measures can be introduced or recommendations can be made, to which the Contractor shall comply. Together with the weekly data, the relevant passenger arrival data from the relevant Services/ Operators (Civil Aviation Authority, KTEL, OSE, and TRAINOSE) shall be delivered.

8.3.7 Results analysis

A Trips File shall be established, that will include the digitalized primary data from the Passenger Terminal Stations. Reference to such data shall be made on the basis of:

a. the terminal station code number and name
b. the survey date and day.

Data shall be entered in the Trips File per station, per mode of transport (according to flight number, train number etc.) and per survey conducting hour. The exact form in which data shall be entered shall be defined in cooperation with ATTIKO METRO S.A.

The data processing stages are briefly presented below:

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a. Creation of a Database with all questionnaire parameters.

b. Correlating the sample for each transport mode (train, airplane, etc.) to the total number of alighting passengers based on the arrivals data obtained from the Services/ Operators, for the specific date on which the survey was conducted in each station. If it is not possible to obtain the data related to arrivals at the Intercity Buses Terminal Stations and the New Railway Station, this correlation can be made on the basis of the number of passengers on each bus and train, as recorded by the interviewers.

c. Grouping of the data resulting from the above, per hour and time period of the day (morning peak hours, evening peak hours, period between peak hours, start/end of day) and extrapolation to the entire day. The above definition of periods and extrapolation shall take place in a method to be reviewed by ATTIKO METRO.

d. Data concerning trips within the study area shall be separated from the resulting data.

e. Creation of cumulative tables showing the results per Terminal Station and as a whole (separately for trips within and outside the study zone). Tables shall concern person trips over the entire day, which are made after leaving the station:
   - Hourly distribution of trips per type of vehicle
   - Hourly distribution of trips per purpose
   - Hourly distribution of trips per trip category (categories shall be defined in due time by ATTIKO METRO)
   - Trips per trip purpose and vehicle type
   - Trips per trip category and vehicle type

   These tables shall be given in a printed form and in digital files.

f. Creation of tables with origin / destination trips for each Terminal Station and for all stations (separately for trips within and outside the study area) per zone, per Municipality and per geographical region (refers to destination). These tables shall be developed for each time period (morning peak hours, evening peak hours, period between peak hours, start/end of day) including the average number of trips per hour and the total number of trips throughout the day:
   - Origin – destination tables per mode of transport and purpose
   - Origin – destination tables per mode of transport and trip category.

8.4 Deliverables

After processing the Data concerning the Trips Survey at the Public Transport Modes, the Contractor shall deliver to ATTIKO METRO the complete data of the survey. Such data include at minimum:

a. All primary data (records of boarding-alighting passengers in Urban Buses, records of passenger volume point measurements, questionnaires completed at terminal stations, ridership records for intercity buses and/or trains)

b. Databases with all the primary data from the surveys

c. Digital basemaps with bus lines, bus stops and point measurements sites

d. The Databases processing outcome, as described in §8.2.6 and §8.3.7

e. Map of the Public Transport system, showing the existing routes, the bus lines code numbers, the terminal stations and individual stops of the urban buses, as well as the locations of the Passenger Terminal Stations. The map shall also show the locations of the point measurements, as well as their code numbers.

f. Technical Report on the planning and conduct of the survey, the description of the collected data, the presentation of the processed data in the form of tables and/or diagrams accompanied with comments on the results and assessment of trips through the Study Area. The Report shall necessarily include indicators, estimates and comments on the reliability of the Survey, the representative nature of the sample, the statistical certainty of the results, the confidence intervals for the estimates of all basic figures (distributions per mode and purpose, on the entire Study Area per municipality and zone).

PART C: MEDIUM / LONG-TERM PLANNING THESSALONIKI METRO DEVELOPMENT PLAN

9   GENERAL

9.1   Collection of Information Material

The primary data to be collected in the framework of Phase A and utilized in the execution of the works of Phase B shall be adequately complemented with Information Material elaborated by other authorities. The following data shall be collected: (a) Information Material concerning land uses, environment, land value, growth framework, the socioeconomic attributes of the Study Area, etc. and (b) Information Material concerning scheduled public works and major private investments.

The Information Material on land uses, environment, land values, growth framework to be collected shall concern indicatively but not exhaustively the following:

• Data and guidelines of Thessaloniki Regulatory Plan prepared by the Ministry of Environment and Energy (technical reports, FEK and maps).

• The Town Plans approved by Ministry of Environment and Energy (FEK and maps).

• Data and guidelines of the General Urban Plans and the environmentally and residential development protected zones approved by the Ministry of Environment and Energy (technical reports, FEK and maps).

• The fair land values (values of immovable property and land plots) obtained from the relevant Tax Authorities. The land values shall be at Building Block level.

• Data on the Gross Domestic Product (GDP) of the country and its prefectures (Ministry of Finance).

• Data and analyses contained in pertinent studies for the Prefecture of Thessaloniki.

• The Town Planning Studies approved by the Ministry of Environment and Energy (technical reports, FEK, maps).

• The building terms applicable in the Study Area (maps, tables, FEK).

• Industries location plan in the zones not scheduled for development, as prepared by the Ministry of Environment and Energy (FEK and maps).

• Data concerning the Transport networks: current road network, alignment and characteristics of new road axes, alignment and characteristics of fixed route networks, headways of Public Transport Modes (Ministry of Infrastructure and Transports).

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- Data on the evolution of the number of vehicles circulating in the Study Area (ELSTAT).

- Measurements data and forecast concerning the quality of the environment and the evolution of pollution in the Study Area. In particular, air pollution data (CO, NOχ, HC, PC10), noise levels (Led) and concentration of pollutants.

- Socioeconomic attributes of the entire country and of the wider Study Area area – surface, population and demographic characteristics, active population, unemployment, employment per sector, groups of freelance occupations, farmland and production per product, units and employment per job position and sector, tourism infrastructure and tourist flows, gross regional product per sector, investments foreseen in the development laws, infrastructure and growth indicators (ELSTAT, Ministry of Finance, Ministry of Rural Development, Ministry of Health, Ministry of Education etc.).

The Information Material to be collected in relation to scheduled public projects and major private investments in the Study Area shall concern indicatively but not exhaustively the following:

- the approved programmes on tourism development

- the approved programmes on the exploitation of public land

- envelopes containing applications for approval of residential suitability or urban planning drawings of building associations and private city planners by the Ministry of Environment and Energy

- programmes or plans for exploiting vast areas prepared by the Ministry of Environment and Energy, Local Authorities, chambers, other bodies etc.

- Information drawn from town planning local offices or from the responsible public authorities on the construction of major privately-owned industrial facilities (employing more than 100 persons or land larger than 3,000 m^2.).

9.2   Scope of Works

A basic precondition for meeting the purpose of the design is the development of a reliable method for predicting future trips demand and the creation of a reliable mechanism for assessing alternative scenarios on transport infrastructure networks and transportation systems in the Study Area, which enable the selection of the optimum Transport Plan for the Study Area.

Developing a Strategic Planning Transport Model allows investigating and evaluating alternative solutions on transport infrastructure. The role of the Transport Model is to simulate the transport services of an area at a given time horizon, in order to establish the link between supply (transport networks) and demand (trips), in view of obtaining a clear picture of the loading on the networks.

A prerequisite for the Model's implementation is to adapt it to the current conditions, namely to ensure a satisfactory simulation of the traffic services in an area at a given time horizon. Whether a simulation has been successful or not shall be checked based on the extent to which the loading on the networks presented in the model is satisfactory, compared to the respective loading that derives from the surveys and the measurements. The base-year for adapting the Model shall be 2020, which is the year when all measurements and surveys related to the current conditions shall be conducted.

Based on the current condition data to be collected during Phase A of the Study, the Contractor shall develop a Strategic Planning Transport Model, as described in chapter 10.

The development of a Transport Plan necessitates an estimate of the future demand for transportation services in the Study Area with 2040 as the time-horizon. The basic variables which trips produced in the Study Area depend on are correlated with the socioeconomic attributes of households (number and size of households, ownership of private vehicles, income, number of employed persons living in the household). Attracted trips depend on variables, such as land uses and work positions. The aforementioned variables constitute the basic design parameters in the framework of the Study.

The Contractor is requested to develop and process realistic growth scenarios for the Study Area until year 2040 with year 2030 as intermediate horizon. Such scenarios shall concern both the anticipated evolution of the area and the future evolution of the socioeconomic attributes of the population and job positions, as described in chapter 11.

Completing the study planning factors forecast process and calculating the number of futures trips in the Study Area on the basis of these forecasts constitute the basic framework for developing the figures on demand for transport services in the Study Area.

The Transportation Planning process requires developing and evaluating the networks of each transportation system, in order to finally select a solution which will satisfy in the most efficient way the future transportation demand.

The Contractor is required to develop, process and assess at least three transport infrastructure basic scenarios, which will differ as to the development level of the Metro network, combined with the development of other alternative Means of Public Transport, such as the tram, the suburban railway, etc., as described in chapter 12.

During the assessment of the alternative scenarios, the impact of each infrastructure scenario on the mobility of residents, public transport services, passenger service levels and environmental conditions shall be investigated. In the framework of this investigation, overall performance indexes shall be developed to control and evaluate the infrastructure scenarios.

Performance indexes shall be utilized in comparatively correlating the long-term planning scenarios to the base-year scenario, but also to the do-nothing scenario (hypothetical scenario according to which no projects are constructed).

In the framework of the scenarios, infrastructure projects and policy measures shall be examined.

10 TRANSPORT MODEL DEVELOPMENT

10.1 Introduction

AM has a Transport Model for the city of Thessaloniki, developed in the framework of the "Feasibility Study for the Thessaloniki Metro Extension to Kalamaria (2011)". This is a traditional Four-Stage Strategic Planning Model, developed using VISUM software.

Based on the results of the census, measurements and surveys, as described in the Technical description of the scope (in PART B), the Contractor is requested by utilizing the Databases he will have created and in combination with any supplementary data obtained from various authorities, to develop (or properly update) a Transport Model of Strategic Planning for the Study Area in VISUM software. The purpose of this procedure is to generate a "tool" that will enable continuous transportation planning for the wider area of Thessaloniki, a tool that will enable AM to plan new lines/extensions of the Thessaloniki Metro by developing a Thessaloniki Metro Development Plan and to monitor and control the trip demand and ridership on the Metro lines in operation.

Bear in mind that in order to prepare the subject study in accordance with the stipulations in the Tender Documents, the Contractor shall have at its disposal a sufficient number of VISUM software licenses.

The purpose of the Thessaloniki Metro Development Study is the medium/long-term planning of the Metro System in Thessaloniki. Approaching the Metro system in the framework of a wider single Public Transport system encompassing all public transport modes, as well as the constant interaction between the Public Transports system and the infrastructure /operation of private transport network, dictate the need for strategic planning of the transports in the Study Area.

Developing an adequate Strategic Planning Transport Model provides the opportunity to investigate alternative scenarios for organizing the Metro system in future time horizons, in order to cover the needs of the anticipated demand of transport services, based on the current transport services supply / demand relationship. The supply variable is defined by the attributes of the private and public transport networks, while the demand variable is shaped by the socioeconomic attributes and the distribution of land uses within the Study Area, features that delimit the overall number of daily trips.

10.2 Transport Model

The Transport Model establishes the relationship between supply and demand, by means mathematical formulas defined when the Transport Model is adapted to the current conditions,

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and used when Transport Model <u>is applied</u> to every future planning horizon and examined transport network.

Input data used in adapting the Transport Model describe the transport services supply and demand on the base-year of Thessaloniki Metro Development Study (2020) and derive from the data to be collected during the works described in Part B:

- Inventory of Main Road Network and Roadside Trips Survey
- Trips Survey at the Public Transport Modes
- Household Survey and Stated Preference Survey

The Contractor shall develop a four-stage Strategic Planning Transport Model, as described below. The order of the Trip Distribution and Modal Split stages shall be confirmed in correlation with the sensitivity parameters values of the corresponding samples.

- <u>Trip Generation Model:</u>

    This model calculates the trips that each zone in the Study Area generates and attracts. At the trips generation stage, trips shall be broken down into trips of individuals and trips of trucks and shall be distinguished into trips inside and outside the study area.

    Trips of individuals shall be distinguished into home-based trips (HB) and non-home-based trips (NHB), depending on whether one of the two ends of the trip (origin or destination) coincides or not with the residence of the traveling individual. The ends of the home-based trips shall be distinguished into the home-end and the non-home-end.

    Trips generated by a zone are defined as the sum of the HB trips for which the zone is the home-end and the NHB trips originating from the subject zone. Trips attracted by a zone are defined as the sum of the HB trips where the zone is the non-home-end and the NHB trips with destination the subject zone.

    With regard to trips inside the study area, HB trips are broken down based on the <u>trip purpose</u>, contrary to the NHB trips which are addressed as one single category, as follows:

    - home-based work-related trips (HBW)
    - home-based education-related trips (HBE)
    - home-based trips for recreation (HBS)
    - other home-based trips and trips for the purpose of shopping, personal affaires, business trip or other (HBO).
    - non-home-based (NHB) trips for all purposes.

    The trip generation model shall be based on the socioeconomic attributes, such as household size, private vehicle ownership, household income, number of employed household members, age, etc. The trip attraction model shall be based on variables such as land use, job positions etc.

Trips outside the study area refer to trips of individuals having their origin or destination outside the Study Area. The attributes of these trips shall be broken down on the basis of the data collected in the framework of (a) the Roadside Survey on vehicles at the Outer Ring of the Study Area and b) the Trips Survey at passenger Terminal Stations.

Generation and attraction of trips outside the study area shall be broken down according to the following trip categories:

- home-based work-related trips (HBW)
- home-based trip for other purpose (HBO)
- non-home based trips for all purposes (NHB)

- <u>Modal Split Model</u>: the number of trips in every zone by one of the main transport modes (private vehicle, taxi, public transport, on foot) is calculated as a function of the generalized travel cost of each mode respectively, and of the socioeconomic attributes of the passengers/persons.

  Breakdown is based on the trip purpose as above. Disaggregate models, such as multinomial logit, nested logit etc, shall be utilized.

- <u>Trip Distribution Model</u>: trip exchanges by each transport mode among the zones of the Study Area are calculated as a function of the trip generation and attraction by each zone, as well as of the generalized travel cost among the zones. A gravity model is expected to be used. The breakdown is made per trip purpose.

- <u>Assignment of Trips in the Networks:</u> it is about the loads on the public and private transport networks, as a result of the user's selection of a route. As regards the public transport networks, there will also be an assignment to alternative modes of public transport (e.g. bus, Metro, tram, suburban railway).

  The model related to the assignment to private modes network shall take into account the limited capacity of the network, in view of best simulating the network's operation under saturated conditions. Assignment to the network takes place under balanced supply and demand conditions, so that the user's route selection minimizes the general cost of the trip. The applied assignment shall be characterized as equilibrium capacity constrained assignment.

  The algorithm for assignment to the public transport network, permits the users to select their route having examined multiple alternative routes (multipath assignment), having the option to decide at all transfer stops/stations whether to continue on the same route or transfer to another line, being aware the service frequency of each line.

10.3 Model Calibration and Validation

During the Model Calibration stage, all parameters and coefficients involved in individual mathematical equations are evaluated, aiming at developing a Transport Model that will simulate the current situation with deviations within acceptable limits. During the Model

Validation stage, the Transport Model is applied for the base year and the successful simulation of the trips demand is confirmed, as this demand was recorded in the current situation.

The Model shall be calibrated and validated during each of its stages/steps.

The Model shall undergo "realism testing", by proper testing of demand elasticities, as regards the changes in the values of individual components of trip cost and time.

The Model Calibration and Validation methodology and the type of each sub-model shall be presented by the Contractor and approved by the AM.

11 PLANNING VARIABLES FORECAST

11.1 Scope

It is well known that the demand for trips depends directly on the spatial distribution of the population and job positions, as well as on other socio-economic characteristics such as the income of the households and the private vehicles ownership indicators, which are also the key planning factors in a transportation study.

The Contractor is required to develop reliable forecasts on planning factors for the years 2030 and 2040, assuming 2020 as the base year. In order to develop these planning factors in the framework of the present study, the following tasks are required:

- Analysis of the current situation (year 2020) based on the data collected during Phase A of this study and the Information Material of paragraph 9.1. Comparative assessment of the current situation with the forecasts made in the General Transport and Traffic Study for the city of Thessaloniki (ORTHE, 2000).

- Processing of alternative population, employment and job positions forecast scenarios, with 2040 as the target year and intermediate time horizon the year 2030, for the entire Study Area and its subdivisions (sub-regions and geographic districts with similar socio-economic characteristics).

- Evaluation of alternative forecasts and selection of the most probable. The above evaluation and selection shall be implemented with the involvement of official from the relevant bodies, such as the Ministry of Environment and Energy and the Metropolitan Planning Department of Thessaloniki, as well as the Ministry of Infrastructure and Transport. To this end, an Evaluation Committee shall be established, with the participation of representatives of aforementioned Bodies, and possible other as well, whose participation will be timely decided by AM.

- Elaboration of the selected scenarios by developing forecasts for all planning factors at a traffic zone level.

11.2 Description of the Works

The works to be executed by the Contractor include:

a. *Development of Alternative Scenarios for Population, Employment and Job Positions forecasts*

This task includes at least the following works:

• Development of population forecasts for the entire Study Area and for years 2030 and 2040.

• Segregation of the Study Area into spatial units of traffic zones. It should be noted that in no case shall these units included more than 30-40 traffic zones each.

• Development of six (6) alternative population, employment and job positions forecasts for each of the above units for the years 2030 and 2040, taking into account factors such as: (a) demographic trends, (b) migration from and to the Study Area and residence relocation tendencies within the Study Area (c) trends in the development of employment, (d) existing distribution of job positions, (e) existing and established land uses, and (f) the Thessaloniki Regulatory Plan

In order to execute the above tasks, the information material collected in the framework of Phase A shall be utilized.

The work of the Evaluation Committee will be initiated with the organized presentation by the Contractor of the alternative forecasts scenarios, in order the Committee to select two scenarios. The Committee shall evaluate Contractor's presentation/information, and may require the Contractor to present additional data; the Committee shall complete its work with the selection of two populations, employment and job positions forecast scenarios which can also result by combining individual components of the alternative scenarios. Throughout period of evaluating the alternative scenarios by the Committee, the Contractor must be available to provide any clarifications, if required.

b. *Elaboration of the Selected Forecasts*

The scope of this work is to specialize the two (2) selected scenarios, in the sense that forecasts shall be made for all the planning factors in each selected scenario. The forecasts for each unit of traffic zones for the years 2030 and 2040 shall concern the following:

• permanent population, age distribution of the permanent population (at least 3 categories),

• magnitude and composition of employment (at least 3 categories)

• distinguishing the job positions into retail, non-retail, key and non-key

• average household size and distribution of households into three categories of monthly income, and

- private vehicles ownership indicator.

The forecasts for each traffic zone are related to the following:

- population capacity (maximum number of persons who can be housed in the particular traffic zone, if the established plot-to-building ratio for the land use is exhausted) and

- key job positions for the years 2030 and 2040.

c. Creation of a Database

A Digital Database shall be created with the detailed data of the forecasts at the level of traffic zone and spatial unit of the traffic zones. As works progress, AM shall give instruction to the Contractor as regards the design of the Database

11.3 Methodology

The Contractor of this study is required to develop mid/long-term forecasts of the planning factors, i.e. the basic program figures for Thessaloniki Prefecture (population, employment and job positions). The forecasts will relate to years 2030 and 2040, assuming 2020 as the base year.

The processes for the elaboration of these forecasts shall generally follow the steps listed below:

- Formation of two alternative scenarios concerning future evolution of the country's figures (population, employment, jobs positions, GDP) and then, based on them, an estimation of the respective figures for the Study Area.

- Segregation of the Study Area into individual geographical areas, the spatial Traffic Zone Units, which will derive from a grouping of Traffic Zones on the basis of the most homogeneous urban and socio-economic attributes. Formation, for these Traffic Zone Units, of three alternative scenarios concerning population, employment and job positions, for each scenario on the figures of the Study Area.

- An assessment of the above six alternative forecasts scenarios, at the level of Traffic Zone Units, and selecting two of them for which detailed forecasts of all planning factors will be made either at the level of Traffic Zone Unit or at Traffic Zone level.

- Assessment of future demand for trips, based on the figures of the planning factors, for the two selected scenarios and definition of the necessary transport infrastructure in the Study Area by 2040.

This study, which is based on the data collected during Phase A of the present study and on the additional Information Material (see paragraph 9.1), is not an urban or spatial planning study for the future development in Thessaloniki Prefecture. Instead, the projection of the planning factors will be based on:

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- the current status, as recorded in the framework of the aforementioned collection of data and information

- the dynamic that has been created in terms of current figures and their spatial distribution; and

- more general social, economic and urban attributes of the Study Area and its various sectors- attributes that create specific advantages or disadvantages that attract or restrict growth.

In addition, the forecasts shall be in line with and shall comply with the existing institutional and regulatory framework for space management, as defined by the Thessaloniki Regulatory Plan, the General Urban Plans, the Plot-to-Building Ratios, the Residential Control Zones, etc. The study shall not propose interventions, but will assess the likely impact of the current or planned interventions on future growth.

The forecasts for the planning factors shall be developed in two stages:

1.   During the first stage, projections shall be made on the overall figures concerning population, employment and job positions in the Study Area as a whole, as well as at the level of the Traffic Zone Unit. Forecasts shall be in the form of "Alternative Assessments" (Scenarios). Therefore, there shall be six alternative assessments, differentiated on the basis of:

- the overall figures in the Study Area (two scenarios, related to the expected developments across the entire country, as well as in the Study Area)

- the distribution of these overall figures in the Traffic Zone Units (three alternative distributions based, on the one hand, on past trends and natural population growth, and, on the other hand, on the comparative advantages of Traffic Zone Units for the future development of population and activities).

Projections at Traffic Zone Unit level shall essentially reflect alternatives related to the development and growth of the individual districts in the Study Area and shall be formulated on the basis of three alternative perspectives:

(a)   that the trends and dynamics that have been developed so far will continue to apply in the future

(b)   that the effect of the comparative advantages or restriction on the current situation and dynamics of the individual Traffic Zone Units shall diversify past trends and shall lead, depending on the case, to higher or lower rates of future growth,

(c)   that an intermediate perspective of development shall be followed.

These six alternative assessments shall be submitted to an Evaluation Committee which will be specifically set up to evaluate them and select two of them for a more detailed analysis. The Evaluation Committee will be informed (a) by means of a relevant information document, which will be drafted by the Contractor and will be approved by AM, and (b) by means of a

presentation to be given by the Contractor's employees followed by a discussion with AM employees on all relevant issues.

2.   In the second stage, planning factors forecasts shall be made in greater detail, for the two selected alternative scenarios, as listed below

•   At the level of the Traffic Zone Units:

  • Total permanent population
  • Permanent population per age groups
  • Employment (per place of residence) per field of employment (primary, secondary, tertiary sector)
  • Job positions (per place of employment):
    •   Retail (retail trade, restaurants, hotels) and non-retail (other sectors)
    •   Basic and non-basic
  • Number of households per group of (monthly average) income
  • Private vehicle ownership

•   At the level of the Traffic Zones:

  • Number of basic job positions
  • Capacity in terms of population

12 DEVELOPMENT OF ALTERNATIVE TRANSPORT NETWORK SCENARIOS

The planning of infrastructure Projects of the entities responsible for the transport infrastructure in the study area must be initially recorded, along with all road and transportation projects, which have either been foreseen by the institutional framework (e.g. regulatory plan, General Town Planning Schemes), or designed, or simply proposed in the past through other studies, in view of investigating the feasibility of these projects, as well as the time horizon for their implementation.

After an initial assessment of the Projects (technical feasibility, urban planning criteria, social criteria, environmental criteria etc.) two initial basic scenarios will be developed (one optimistic as regards funding -which will include a broader picture of the projects related to Public Transport Modes - and one conservative as regards funding -which will include the Public Transport Modes related Projects of top priority); these scenarios will differ as regards the extent of development of the Metro network, in combination with the development of other Public Transport Modes (tram, Suburban Railway). These scenarios are verified with the assistance of the Transport Model, are evaluated and are further improved (several versions).

The subject scenarios shall be evaluated by investigating the impact of each version of an infrastructure scenario on the figures related to the residents' mobility, the provided services of public transport, the level of services provided to the users and the environmental conditions, in order to assess the effectiveness in terms of meeting the overall targets of the planning. In the framework of this assessment, overall performance indices shall be established, which will be

used in verifying the targets of the overall planning, as well as departure from these targets or improvements, compared to the respective indices for base-year 2020.

These indices include, among others, the following:

a.   Mobility
   * Distribution of trips per transport mode-total share Public Transportation Modes
   * Passenger hours per mode.
   * Passenger kilometers per mode.
   * Vehicle-kilometers per district (e.g. central district, etc.).
   * Vehicle-hours per district.
   * Average trip length per mode.
   * Total amount and number of transfers among the different modes.

b.   Public Transport Services and Level of Services provided to the Passengers
   * Kilometers of Public Transport Mode networks.
   * Population and job positions having access to stations of Fixed Track Transport Modes.
   * Average trip time and speed per mode of transport.
   * Average walking time and average waiting time at public transport modes stops/stations.
   * Frequency of transfer to public transport modes.
   * Average Volume/Capacity index at the road network per district.
   * Road network intersections at saturation level.
   * Overall vehicle delays and total delay per vehicle at the road network junctions.

c.   Environmental conditions

Emissions of CO and TSP pollutants at the road network per district.

At each step of the improvement process and based on the results of one version of an infrastructure scenario, the following basic attributes of the Plan shall be examined (among others):

- The demand (loading) for each individual project that constitutes a key element of the examined scenarios, in combination with the overall loading of each transport system;
- Whether the initially selected system technology for individual transportation projects was correct or not (e.g. Tramway instead of Metro and vice versa);
- The level of services provided to the users by the individual new projects for each transportation system and in general (delays, speed, travel time, headways, transfers etc.);
- The extent to which the public transport modes complement each other and the combined operation of all systems (transfer stations, feeder bus lines, park-and-ride, bus lanes etc.);
- The satisfactory coverage of all individual areas of the Prefecture, in terms of private means / public transport networks and accessibility, in combination with the socio-economic attributes of these areas (population, concentration of job positions, level of income /private vehicle ownership).

As a result of the assessment of the two initial basic scenarios of infrastructure, a third scenario shall be developed, which shall verified, assessed and improved by means of the procedures described above. Eventually, this scenario shall serve as the Selected Transport Plan for Thessaloniki and shall incorporate the Thessaloniki Metro Network Development Plan.

PART D: DELIVERABLES AND TIME SCHEDULE FOR THE PREPARATION OF THE STUDY

13 DELIVERABLES

All Deliverables shall be submitted in printed and in digital form.

At the Preliminary Submittal of each phase, the deliverables shall be submitted in four (4) printed copies and in a (2) digital form as described below.

At the Final Submittal of each phase, the deliverables shall be submitted in ten (10) printed copies and in three (3) copies in digital form as described below.

13.1 DELIVERABLES – PHASE A

For each of the four (4) surveys ((a) Household Survey, (b) Stated Preference Survey, (c) Inventory of Main Road Network and Roadside Trips Survey, (d) Survey of Trips by Public Transport Modes) the Contractor shall deliver to ATTIKO METRO at least the following information:

1. All primary data from all surveys, as more extensively specified in paragraphs 5.7, 6.8, 7.4 and 8.4;
2. All Databases with survey data, as described in paragraphs 5.7, 6.8, 7.2.3, 7.2.4, 7.2.5, 7.2.6, 7.3.5, 8.2.6 and 8.3.7 in a digital format;
3. The outcome Databases processing, i.e. the Tables mentioned in 5.7, 6.8, 7.2.5, 7.2.6, 7.3.5, 8.2.6, 8.3.7 as well as the correlations to the Main Road Network, as mentioned in paragraphs 7.2.3 and 7.2.4;
4. The Maps specified in paragraphs 7.4 and 8.4;
5. All results of the surveys in four (4) Technical Reports (one Technical Report for each survey), as specified in paragraphs 5.7, 6.8, 7.4 and 8.4, accompanied by the appropriate Appendices.

Each Technical Report shall include at least the following information:

- Survey planning, organization and conduct, as well as all problems that emerged;
- Brief description of the collected data and their structure (in relation to point (2) above);
- Critical analysis of the data processing results (in relation to point (3) above), as well as the results of the survey, with clear reference to the applied Methodology;

- Conclusions.

The content of each Technical Report must be approved by ATTIKO METRO. An Executive Summary shall also be included in the deliverables.

All deliverables in digital format shall be submitted to ATTIKO METRO in a CD or DVD or USB flash drive.

1. Databases (see footnote at page 8) shall be in Microsoft Access. Furthermore, they must also submitted in SQL format (dump tables, views, procedures & functions). All Database tables, as well as any tabulated files shall be accompanied by Data Dictionaries.
   Moreover, the Contractor shall deliver an Entity Relationship Diagrams (with the tables, their correlations -- 1:1, 1:v, v:1, v:v -, - as well as the keys for these correlations).
2. Texts shall be in Microsoft Word format.
3. Spreadsheets shall be in Microsoft Excel format.
4. The digital basemaps to be used or produced shall be in Shape files or ESRI Geodatabase format. The reference system shall be GGRS87.
5. The Technical Reports shall be submitted in PDF format (without restrictions), complete, incorporating any charts and drawings up to A3 size.
6. The produced maps / drawings and diagrams shall be submitted in PDF format (without restrictions).
7. Any applications to be developed by the Contractor for data processing / analysis shall be submitted in source code format, accompanied by the relevant instructions for use.
8. Any data to be used as input to various applications (e.g. statistical analysis software, transport model or elsewhere) shall be submitted in a format compatible with this application software.

13.2 DELIVERABLES – PHASE B

Upon completion of Phase B, the Contractor shall submit a Technical Report, Drawings and the Databases.

13.2.1 Transport Model

The Contractor shall deliver Databases along with all information (input data and results) of the Transport Model (DB of the Main Road Network, the Public Transport Modes Networks, the socio-economic figures and the zone system). This information shall refer to base year 2020.

The Technical Report shall include a detailed description of the Model, its individual stages, and the respective mathematical models and algorithms. A detailed description shall be made of the Model calibrations and validation per stage, while the respective results shall be presented in a tabulated form. At least the following information shall be presented on maps at the appropriate scale:

- Travel demand per main mode (private vehicle, Public Transport Mode)

- Traffic flow on the road network
- Traffic volume on the Public Transport lines.

13.2.2 Planning Variables Forecasts

Technical Report

The Technical Report shall present the basic results obtained from the Surveys' data processing - Phase A, the processing of data from the supplementary Information Material, as well as of statistical data from the Hellenic Statistical Authority (ELSTAT); this Report shall contain at least the information described in paragraph 11.2.

The Technical Report shall present, analyze and comment on:

- the existing conditions (base year 2020) in relation to forecasts made in the framework of the General Transport and Traffic Study for Thessaloniki (ORTHE, 2000) for the time horizon 2014+;

- the alternative forecast scenarios on population/employment/job positions for years 2030 and 2040;

- the assessment of the alternative scenarios;

- the selection of the most probable scenarios;

- the further specification of the selected scenarios, and

- the forecasts for all planning factors at the level of spatial units and/or traffic zones.

Drawings

The Technical Report, apart from the A3 and/or A4 size drawings, shall also incorporate the following Drawings, as a minimum, in the form of an atlas:

- Drawing under scale 1:100.000 (one (1) drawing of size 100 cm x 70 cm per scenario and subject), which shall cover the entire Study Area and shall present in the most appropriate manner for each spatial unit (traffic zones) the variations in population, job positions and private vehicles ownership index for the time period 2020-2040.

- Drawing under scale 1:100.000 (one (1) drawing of size 100 cm x 70 cm per scenario and subject) which shall cover the entire Study Area and shall present in the most appropriate manner for each traffic zone the basic job positions (for two time horizons, i.e. 2030 and 2040), as well as the population capacity.

Databases

Databases shall include the results of the works described in paragraph 11.2, in accordance with the stipulations of paragraph 11.2c.

In addition, as regards the Transport Model, there shall be a separate Entity Relationship Diagram with the correlations between the tables and files required for this model to be run, between the produced (intermediate and final) tables and files of results, as well as a flow chart of the works required for this model and for the relevant results to be obtained.

13.2.3 Development of Transport Network Scenarios

Technical Report

The following issues shall be presented, analyzed and commented in the Technical Report:

- An estimate of the future transportation demand for each planning horizon, i.e. for years 2030 and 2040, on the basis of the Transport Model (TM) and comparative correlation to trip demands in base-year 2020.
- The Methodology for the configuration of the basic transportation infrastructure related scenarios (two initial scenarios and the final third scenario), selection of infrastructure projects and policy measures per scenario, review of scenarios on the basis of the Transport Model.
- The Procedure to improve the scenarios, the evaluation criteria and the performance indices per scenario.
- The selection of the optimum Transportation Plan and comparative correlation to the existing conditions scenario and the do-nothing scenario. Sensitivity Analysis of the Transportation Plan, on the one hand in the basis of the baseline planning parameters and, on the other hand, on the basis of the alternative policy measures.

The tables and A3 size drawings shall present all data and attributes of the examined infrastructure scenarios, as well as those of the Transportation Plan.

Drawings

The Technical Report, apart from size A3 and/or size A4 drawings, shall be also accompanied by the following Drawings, as a minimum, in the form of atlas, <u>per transport infrastructure scenario</u>, under the appropriate scale:

For the Road Network:

- Node - Link map, depicting the breakdown of the Main Road Network to its main structural elements. This map shall also determine the hierarchy of the Main Road Network, the street directions, the junctions (signalized/priority/pseudo-junctions), indicating also the grade-separated junctions.
- Road network volume map, depicting the volume in terms of Private Car Units (using lines whose thickness shall be proportional to the volume), as well as its value for each road section and for each traffic direction (on both sides of the street axis for two-way streets, and at the right side of the street axis for one-way streets).

As regards the Public Transport Modes (Metro, Tram, Suburban Railway, Buses):

- Map of Metro/Tramway/Suburban Railway lines that shall include the line routes, the Metro/Tramway/Suburban Railway stations, as well as the locations of the Transfer Stations.
- Map of the passenger volume per Fixed Track Transport Mode (Metro or Tram or Suburban Railway) depicting the passenger volume (using lines whose thickness shall be proportional to the passenger volume) as well as its value per section and per direction.
- Map of Bus Lines showing the routes, the code numbers of the bus lines, the terminals and stops of the city bus lines, as well as the location of passenger terminal stations.
- Map of the Bus Lines passenger volume, showing the passenger volume (using lines whose thickness shall be proportional to the passenger volume) as well as its value per road section and per direction.

Databases

The Contractor shall deliver Databases along with all information (input data and results) of the Transport Model (DB of the Main Road Network, the Public Transport Modes Networks, the socio-economic figures and the zone system) for each infrastructure scenario to be examined on the basis of the Transport Model.

Especially as regards the Transportation Plan, the Transport Model details shall be provided for all scenarios/variations of the selected Scenario to be examined in the framework of its improvement process, as well as for all sensitivity analysis scenarios to be examined.

14 TIME SCHEDULE OF THE PROJECT – SUMMARY OF DELIVERABLES

The attached diagram presents an indicative General Time Schedule of the Works. The General Time Schedule is binding for the Contractor as regards the overall duration of Phases A and B as well, and as regards the submittals (preliminary and final). Within fifteen (15) days after Contract signing, the Contractor shall prepare, based on the General Time Schedule, the Detailed Schedule of Works. This Detailed Schedule must be approved by AM within fifteen (15) days.

Based on the Detailed Time Schedule, the Contractor binds itself as regards: (a) the net time for the preparation of the individual designs for each design phase and (b) the precise time of commencement of the design activities for each design phase and sub-phase, in order to respect the overall deadline.

The net time (without counting the time for approvals until the Final Acceptance of Works and the time for corrections or additions) required for the completion of the entire purely design-related scope of the Contract is twenty two (22) months. It is pointed out that the two Phases A and B of the Project overlap each other by two (2) months.

At the end of each month, the Contractor shall submit a Monthly Progress Report presenting the progress of the works based on the Detailed Time Schedule. In case omissions, delays or other problems are found, the Contractor shall update the Detailed Time Schedule by implementing the proper measures (changes in mobilization etc.), in order to adhere to the deadlines for the submission of the deliverables, as specified in the Contract. Any updates shall be approved by AM.

14.1 PHASE A

According to the General Time Schedule, Phase A commences upon signing of the Contract and its total duration (net time) is ten (10) months.

Phase A of the project is divided in two sub-phases, A1 and A2, as follows:

Sub-phase A1 includes:

• preparation of Surveys (duration: two (2) months);

• conduct of Surveys (duration: three (3) months).

Upon completion of sub-phase A1, the Contractor shall submit for certification and approval all the primary data of the four surveys, in printed and digital form (Databases and Digital Basemaps). It is noted that the conduct of phase A surveys during a non-typical period is a reason to terminate the Contract.

Sub-phase A2 includes:

• preparation of the Technical Reports and the other Deliverables for Phase A, (duration: five (5) months).

The Preliminary Submittal of sub-phase A2 shall take place at the end of the tenth (10th) month.

AM shall provide its comments within twenty (20) days.

The Contractor shall complete the necessary additions or corrections within twenty (20) days and shall proceed to the Final Submittal of Phase A.

14.2 PHASE B

Phase B commences the ninth (9th) month from the Commencement of Works and its total duration (net time) is fourteen (14) months.

Phase B of the project is divided in four sub-phases, B1, B2, B3 and B4, as follows:

Sub-phase B1: Transport Model Development (duration: six (6) months).

Sub-phase B2: Planning variables forecasts (duration: six (6) months).

Sub-phases B1 and B2 commence the eleventh month from the Commencement of Works and take place in parallel. At the end of the sixteenth (16th) month, the relevant work is completed and the Preliminary Submittal takes place.

AM shall provide its comments within twenty (20) days.

The Contractor shall complete the necessary additions or corrections within twenty (20) days and shall proceed to the Final Submittal of sub-phases B1 and B2.

Sub-phase B3: Development of Alternative Transport Network Scenarios and Databases (duration: ten (10) months, commencing the 9th month after Contract signing)

Sub-case B4: Evaluation of the Transport Network Scenarios and Selection of the Optimum Transport Plan (duration: six (6) months, commencing the 17th month after Contract signing).

At the end of the 22nd month, sub-phases B3 and B4 work is completed and the Preliminary Submittal takes place.

AM shall provide its comments within twenty (20) days.

The Contractor shall complete the necessary additions or corrections within twenty (20) days and shall proceed to the Final Submittal of sub-phases B3 and B4.

The Final Acceptance of Works shall take place after the review and approval of the Final Submittal within a period of thirty (30) days.

GENERAL TIME SCHEDULE (in months)																								
No	WORK DESCRIPTION / DURATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	**Phase A: Data Collection (10m)**																						
1.1	*Sub-Phase A1 : Surveys*					↓ A1																	
1.2	*Sub-Phase A2 : Technical Reports & Other Deliverables*									↓ A2													
2	**Phase B: Thessaloniki Metro Development Plan (14m)**																						
2.1	*Sub-Phase B1 : Transport Model Development (6m)*																↓ B1+B2						
2.2	*Sub-Phase B2 : Planning Variables Forecast (6m)*																↓						
2.3	*Sub-Phase B3 : Development of Alternative Transport Network Scenarios & Databases (10m)*																				B3+B4		
2.4	*Sub-Phase B4 : Alternative Scenarios Evaluation and Optimum Transport Plan Selection (6m)*																					↓

Study Duration (net time): 22 months

Phases Duration
Sub-Phases Duration

A1 = Sub-Phase A1 Submittal
A2 = Sub-Phase A2 Submittal
B1+B2 = Sub-Phases B1 and B2 Submittal
B3+B4 = Sub-Phases B3 and B4 Submittal