university of groningen

The Implementation of Congestion Charging in the city of Sofia, Bulgaria

Lessons learned from London, Stockholm and Singapore

Master Thesis

Final Version

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Chapter I: Introduction

The main goal of this research, consisting of five chapters is to contribute to the better informed policy based on the concept of the sustainable urban mobility and traffic management in the city of Sofia, Bulgaria. For this purposes it explores the basics of necessary conditions and the public acceptance in particular under which the eventual implementation of congestion charging is possible. The following work elaborates on: the literature overview; analysis of the accumulated experience and particularly on three case studies of cities considered as ones of the best examples for successful congestion charging implementation approach; analysis of the current urban traffic management system and prevailing policy in Sofia and the contribution and feedback provided by a selected panel of experts and responses, observations and recommendations received.

Based on the developed research methodology (analytical framework and process flow, improved conceptual model providing assessment framework and criteria for selection of experts' panel) a reflection of the data acquired is done in the conclusions and recommendations in order to achieve the main research objective and answer to defined research questions.

It might be easily used as a tool for compliance assessment of the conceptual model requirements at eventual future design stage if it is found appropriate the eventual implementation of this policy tool. Further it makes possible either to track (check) the developments in a time frame for the purposes of a better informed urban traffic policy and management system or to be adapted to the cases of other cities with similar level of development and urban, socio economic and infrastructural profile.

This chapter presents the problem statement, research background and design, including, research objective, research questions, research structure and methodology. Problem statement describes the core issue of the thesis outlining the importance and necessity of research undertakings of this kind focusing on the specifics of the national context and local conditions In particular. The background illustrates the problem and its historic relatedness. Research objective describes the expected result(s) aimed to be achieved under this study in line with the research questions, establishing the starting point of the research. Lastly, the methodology presents the framework guidelines, tools, pathway, logics process flow and defined structure for performing the research.

1.1. Background

Along with many attempts to define the concept, nowadays is generally accepted that sustainable development implies balancing of environmental, social and economic qualities now and in the future *(WCED, 1987,OECD, 1996).*

There is a constantly growing interest among the general public, experts, NGOs, politicians, and policy makers, municipal authorities etc, regarding environmental effects of motorized urban transportation *(Garling and Steg, 2007).* Usually the main focus is put on the greenhouse gases (GHG) consisting mostly of carbon dioxide emissions, contributing to the global warming. Along with the energy sector, transportation is the main source of carbon dioxide emissions which continue to rise in the vast majority of developing countries. But the emissions of GHG, air pollution, noise and other

negative environmental impacts are not the only policy concern which forms the ground of this research. Increase of the car use and traffic intensity leads to many negative consequences such as deterioration of public health, scarce space, traffic accidents, lost of travel time, productivity and development opportunities for individuals and entire society.

Congestions are among the main problems in the big urban metropolitans all around the world and the city of Sofia is not an exception. Sofia is a capital city of Bulgaria which attracts business, industry and people from all over the country. Car ownership has doubled in comparison with 20 years ago, *(Sofia Master plan, 2009*) which increase congestions as well. On the other hand, public transportation and related infrastructure are still in poor conditions, development and maintenance. The big share of vehicles in use are old or incompatible with the new standards, modal share is also still limited, walking is distinctively low compared to other cities in Europe - 11% in 2009. The cycling is still not popular as it takes 1% of the trips (*Masterplan, 2009*). There is no wide spread culture and infrastructure developed for bicycle use as a fast and congestion resistant way of short distance transportation.

It is necessary to use a variety of alternative policy approaches and tools for reducing the intensity of the car use in order to overcome or minimize the consequences of these problems and the traffic congestions as one of their main cause.

A major question arises on how and under which preconditions to deal, minimize/eliminate the urban traffic congestions? The reduction of traffic congestions through the expansion of road construction and infrastructure improvements facilitates the car use. However, this approach frequently fail to keep pace with transportation demand and is likely to generate additional vehicle traffic, thus worsen air quality and creating further demand for road construction *(Pike, 2010).* There is also a wide range of factors limiting the implementation of this approach e.g., culture heritage to be preserved, limited municipal budgets, exhausted opportunities for alternative public urban transport (subway, tram lines etc.), car ownership and income distribution etc. Under similar circumstances and conditions these problems were addressed effectively to big extent by the urban mobility management authorities in many cities, including London, Stockholm and Singapore. Nowadays, the experience of these cities in adoption of road charging[1] is widely accepted as a successful model for limiting and overcoming the traffic congestions.

Congestion charging is an effort to make drivers pay for the delays, costs and congestion they impose upon each other, (Szendro, 2010). The charge aims to change the people's behavior and to raise the question among citizens "Should I drive my car or to use public transportation, walking or another cheaper way to reach my destination?". The scheme addresses pollution and congestion by charging drivers for operating vehicles at highly congested times and locations to reduce travel times, improve air quality and decrease greenhouse gas emissions*, (Szendro, 2010).* Many policy-makers and planners around the world found congestion charging to be an important strategy to increase livability and reduce pollutant emissions in their cities.

This research evaluates congestion charging schemes of London, Stockholm and Singapore where the tool has been successfully implemented at most. Based on this evaluation the basic ("model") conditions for implementation were established, and criteria for testing were identified for conduction of interviews with preselected panel of experts. The panel was chosen basically on their background related to the importance of the public acceptance, identified as a key precondition and test criteria for adoption of congestion charging. This approach gives some advantages taking into consideration the limitation and bounders in terms of unavoidable low number of respondents and necessary representativeness of the conclusions and overall outcomes of this research. Finally the study makes attempt to contribute answering the question: "Is it possible to implement congestion charge in Sofia and under which conditions?". The attempt to achieve a proper answer to this question and its interpretation is strictly limited to the defined scope, methodology and tools used to achieve the associated research objectives.

[1] The term "congestion charging" is used to encompass the broad range of terms used in the literature such as "road pricing," "road tolls," "road-use pricing," "road-user charging," "congestion pricing" and "congestion metering", "cordon zone pricing" etc.

The outcomes of the research are intended to contribute to follow-up more focused indebt discussion of the issue among the relevant audience and public as part of the ongoing debate and decision to be taken. The potential of the theoretical value of the work is limited by the research scope and objectives. It is also associated with the improved assessment of the implementation preconditions and especially the attempt to define framework for identification the role of the congestion charging as one of instruments of sustainable urban mobility policy mix, critical level of traffic intensity and overall congestions load, key role of the level of public acceptability and other elements of the improved conceptual model for adoption of the congestion charging in urban vicinities having similar profile in comparison to Sofia.

1.2. Problem statement

Bulgaria's capital city Sofia, as many big cities elsewhere experiences severe traffic and urban transport management conflicts. Among the main problems of urban management are the traffic congestions that negatively affect the quality of the environment, development prospects and the well-being of all citizens.

Despite the fact of recent significant improvements such as intensive subway lines extension, start up of construction of better interconnects, crossroads and bypasses, more and better means of public transport, current temporary slowdown in the growth of citizens, this problem continue to rise having significant negative impact on the environment, health status and economic and overall development prospects of the city of Sofia. *Most probably depending on the speed of the economic revival, income and job growth after current economic crisis, this problem will take significant rise.*

This forms the ground for further exploration of alternative policy instruments such as congestion charge system, the existing experience of the cities pioneering successfully this practice and its applicability to the urban traffic management in Sofia.

Despite significant differences (analyzed in depth in this research for selected cases), the capital cities forwarding globally the congestion charging have some basic similar characteristics as the capital city of Bulgaria – Sofia. Main problems are associated with air pollution, human health, growing population, congestions, etc. Obviously there are a lot of differences such as magnitude of the problems, causes (e.g. air pollution in Sofia which is among the most affected cities in EU is partly due to the heating alternatives – coal, wood and poor streets' maintenance), living standard, car and income distribution etc.

The main problem the thesis deals with is the complex nature and specifics of preconditions of implementing a rather new approach in a society after the collapse of the previous centrally planned system, involving many radical changes, different actors, interests, policy requirements, legislation, financial limitations etc.

1.3. Research objective

The research objective of the thesis is to identify the necessary conditions under which the congestion charge could be successfully implemented and examining the extent to which Sofia fulfills these conditions.

Congestion charging is proven as effective approach for sustainable mobility in three cities where it has been successfully implemented - Singapore, London, and Stockholm.

The study evaluates congestion charging programs in these cities in order to achieve the specified research objective and more specifically to identify the basic preconditions as criteria for: a) acceptability and, b) further (eventual) follow-up) adoption.

It is essential to understand how standards, policies, regulations and especially and more importantly – the public acceptance would cope with and react to the possible implementation of congestion charge model in Bulgaria. Therefore, this research, the conclusions and recommendations derived could be used for initiating an in-depth discussion (which is still is not a fact) among policy and decision makers and planners and other major interested parties in Sofia. The broad audience of experts and interested parties of other cities having similar urban and economic profile also might found useful the study outcomes while looking for specific congestion charge solutions and comparing the existing and future differences.

The aim of the research is to identify the major preconditions for congestion charging implementation as alternative or complementary policy tool to the existing specific mix of policy approaches. It is also important to frame out the opportunities for its acceptance as a precondition for a follow-up eventual introduction in the city of Sofia while taking into account the specifics of the mentioned challenges and limitations.

The thesis aims also to be used for facilitation of the dialog among decision and policy-makers, expert and general public audience in Sofia, focusing especially on the other interested parties having critical influence on the public opinion and acceptance (experts, consultants, NGOs, sector associations etc.). The major outcome of such publicly held discussion is *the setting up a right context and a well-informed audience in answering the questions such as whether, why, when, how and under which conditions the congestion charging and accumulated experience could be utilized to contribute in solving some of the major urban transport conflicts in the city.* For this purpose the research presents a snapshot of the Sofia current urban transport management policy, analyzes the existing general socio-institutional factors and feedback received from expert panel, and synthesizes specific recommendations for successful development and adoption of a congestion charging practice as one of the potential key elements of this policy.

1.4. Research questions

To achieve the objectives, outlined in the previous section, this research tries to answer the following questions:

1. What is the congestion charge by itself (content and workable practical definition)?
2. What is the experience of the globally recognized forerunners (London, Stockholm and Singapore) in implementing congestion charge scheme?
3. Which are the conditions for acceptance and successful implementation of the congestion charge?
4. Which conditions exist in Sofia, which not and how to build the capacities for possible implementation of congestion charging system?

1.5. Structure

The eventual implementation of congestion charge scheme has to decrease the conflicts in the urban transport and partly the car use in the city of Sofia requires broader view of the historical background and the current situation of the traffic management in the city. This relates directly to the main focus of this work - the implementation of such kind of alternative transport management tool with regard to the Sofia's urban, social and economic profile. Analysis of the implementation practice of London, Stockholm and Singapore gives foundation for recommendations derived aimed at optimization of traffic management and car use in the city of Sofia using congestion charge scheme. Under specified research methodology and its adoption the preconditions for congestion charge implementation are elaborated and tested via feedback from interviewed panel of experts, selected based on the critical importance of the relevant public

acceptance. Thus the structure of the work reflects the formulation of the entire research process, logics, consequences and distribution of the content of the chapters and their relation to the achievement of the research objective.

The research consists of five chapters. The first chapter covers the introduction, background, problem statement, research objective, research questions, research structure and methodology. It further provides an overall summary and general information about the thesis including the adopted approach, scope and limitations of the research and boundaries among which the conclusions and recommendations could be interpreted and used.

The second chapter provides the overall theoretical framework narrowed by the research objective, questions and scope. At fist it discusses the concept of urban transport and sustainability. The central issue of this research – traffic congestions and congestion charge scheme is elaborated by taking a closer look at the representative and recognized congestion charging literature and authors. For this purpose a deeper attention is given to the literature reflecting the practical experience of the transport planning methods for reducing the urban traffic needs and problems and their application to policy decisions, accepted as essential to this research. Further the chapter examines the existing definitions of congestion charging and tries to contribute to the improvement of a conceptual model for congestion charge implementation used also by other studies. Moreover it attempts to define a framework for identification of the role of the congestion charging as one of instruments of sustainable urban mobility policy mix and defines the s.c. critical level (thresholds or benchmarks) of traffic intensity and overall congestions load. These two concepts are important to be taken properly into account in the establishment of a specific sustainable urban transportation policy mix especially where and when the congestion charging have not been considered yet as a feasible policy options as in the case of city of Sofia.

Third chapter analyses conditions for the congestion charging and pricing policies implementation on the basis of practical examples of London, Stockholm and Singapore. Each case study is structured in a following manner - background, types of congestion charge implemented, and necessary (pre)conditions for Implementation. The background section also provides information on the urban mobility situation after the implementation of congestion charge scheme. Next section takes close look at the whole implementation process – stages, conditions met and policy implications. The major sources used are scientific articles and reports on urban sustainable mobility and congestion charging implementation in London, Stockholm and Singapore. These sources of information provide background information on the urban transport policy development and practice for a follow-up benchmarking and performance assessment of the analyzed transport policies and conditions for public acceptance and implementation in Sofia urban traffic management. Thus the analysis of three case studies provides a basis for deriving lessons to be learned, conclusions and recommendations for rising level of the public acceptance and development of conditions for successful implementation of congestion charging.

The fourth chapter focuses on the specific situation of Sofia urban transportation where the congestion charging still is not considered as a viable policy option. The assessment of the conditions for implementation and specifically assuring the public acceptance are based on the boundaries associated with the data availability and effectiveness of applicable analytical tools. It provides description of the research design and entire process including: - tools and method for data collection (face to face and e-mails questionnaires and interviews); - selection criteria for the group of respondents (defined panel of experts relevant to key importance of the public acceptance); - processing of the results based on the criteria for assessment and comparison of the public acceptability; - deriving at related conclusions and recommendations (lessons learned) taking Into consideration the limitations and bounders of the applicable research tools and data availability in terms of representativeness and reliability.

The limitation and boundaries coming from data availability, number of interviews taken etc, forms the basis for selection and implementation of the methodological approach. It relies on the selection of a panel of number of experts active in the field of the research. This assures representativeness and brings analytical benefits partly proven though the feedback received at the Urban Sustainable mobility organized by EcoSociety on 19th September 2013 in Sofia. Thus

it helps to achieve a closer and wider look at the socio-economic situation, its implications on the mobility management in Sofia and to draw up the follow-up conclusions and recommendations.

The fifth chapter concludes on the extent the research questions were answered and the achievement of the main research objective. It provides an overall reflection of the results and outcomes from the previous chapters and outlines the main conclusions, recommendations, conditions and possible scenario for implementation of congestion charging in Sofia focusing on the extent and identified barriers. Finally special attention is given to the boundaries of the interpretation and applicability (especially to traffic management in cities with similar urban profiles) of the research results and conclusions associated with the research scope, methods and analysis of the collected data.

1.6. Research Methodology

The research aims to examine the current practice in design, implementation and functioning of a congestion charging system by using qualitative data and analysis. The focus is also put on the preconditions and practicalities for congestion charge implementation in selected cities forerunners such as London, Stockholm and Singapore. The research elaborates on the challenges and opportunities of eventual adoption of congestion charging in Sofia examining the views and attitudes of the selected panel of experts including policy makers', particularly road users, experts and sector associations' representatives having an influence on the public opinion and acceptability and development of the necessary environment and conditions.

In the Chapter II substantial improvements are provided to the conceptual model also used in other similar studies. They assure additional guidelines (identification of the role of congestion charging within sustainable urban policy mix) and framework assessment criteria (s.c. critical level of urban traffic and congestions' intensity/load). They complement to the elements of already proposed conceptual model and its basic elements - the types of charges and important basic necessary implementation preconditions. This approach aims at a better structured analysis of the congestion charge implementation in the cases where it is still not addressed as a viable policy option by authorities and other interested parties.

This approach is based on the literature overview, practice evaluation (selected case studies), analysis of the current status of the urban traffic policy and management in Sofia, feed back from the interviews/respondents (primary and secondary data), selection of the experts' panel, reflection of the results achieved in the conclusions and recommendations.

An analytical framework of this research is prepared to outline the overall logics, theoretical design and the entire processes flow of the study presented in Figure 1 below.

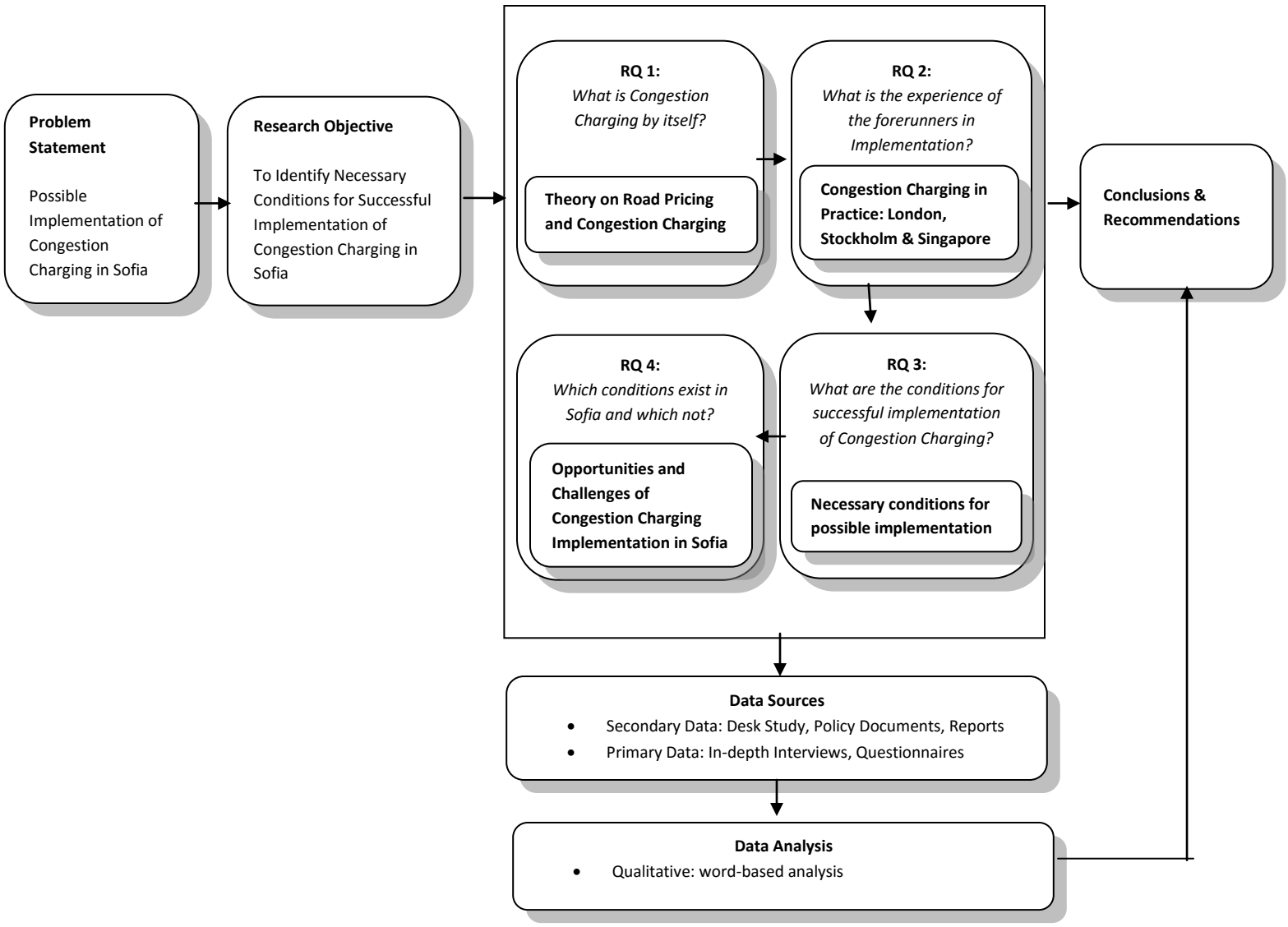

Figure 1 Research Analytical Framework

Literature Overview

The literature review results in the elaboration of theoretical framework of key congestion charge concepts (definitions), preparation of the research framework and conceptual model in particular, selection of the case studies and analysis of the existing practice and preliminary conditions for its adoption in the city of Sofia. It is done through a reflection of the basic concepts introduced by the authors with significant contribution to the analysis, problems' definition and proposed solutions recognized by the academia or proved by the experience of the cities forerunning globally the congestion charging implementation. The reflection is done in the related context through the entire research chapters and parts of this work where the different authors' positions are referenced including the name and year of publication. In order to have an accurate reference, the following research adopts the Harvard Standard Style.

Case studies

The advantages of the explorative case study method are used in order to answer the main research questions. The selection of this method is based on the following reasons. The method is suitable in a given context since Yin (1994) argued that it can be used by investigator who has little or no possibility to control the events. Secondly, it is widely accepted that there are many, different and complicated interests of the major stakeholders in decision making process of congestion charge implementation. For this reason, case study approach is accepted as appropriate and suitable for studying complex social phenomena *(Yin, 1994).* Different elements are distinguished for each of the three case studies – London, Stockholm and Singapore based on the conceptual model developed under this research. This method is further used in the research by using multiple sources of information describing successful practice of congestion charge implementation. Thus implementation barriers were revealed and important common features were identified that helps to derive major conclusions (lessons learned) for examining the possible future implementation of congestion charging in Sofia.

Data Collection

The qualitative research is based on the outcomes from the literature review, primary and secondary data collection to assess the possibilities of implementing congestion charge in Sofia. The primary data collection represents one of the elements of the empirical part of this study. Contributing to answer the fourth research question it elaborates on the analysis of the current transportation framework policy, the level of acceptability and preparedness, and the other basic necessary conditions for the design, opportunities, and challenges in the implementation of the congestion charging in Sofia. This purpose is served by interviewing key members of the target audience and/or influential stakeholders. The interviews' questions are based on the conceptual model of this research, described in Chapter II. The reliability of the results is based on the established clear and unambiguous interview's questions and preliminary assessment criteria.

The respondents to the interviews (experts' panel) were chosen on the basis of their performance, expertise, administrative responsibilities, understanding on the topic and influence on the public opinion and capacity to disseminate information on the basis of preliminary analysis of the role of institutions to which they belong.

Most of the interviews are done by e-mail while additional feedback in a form of face to face interviews was taken from some of the key experts and respondents. The initial contacts with representatives from Ministry of transportation and the Ministry of regional development were found useful in order to reach the potential respondents who have interest, opinion and knowledge in a possible implementation of congestion charging. The key respondents are representatives of local and national government, consultancy agencies, urban planning and architecture organizations, industrial clusters

in transportation, sustainable energy developers and other transportation agencies. Since it was not possible for all of the respondents to meet face-to-face, the interviews were conducted mostly through internet via e-mail.

The primary data was collected in two stages between July - September 2013 and October 2013 – April 2014 in Sofia. Interviews' design consists of a brief introduction to the congestion charging system and interview questions. The interviews were guided by close end questions and a part consisting an open-ended answer under which respondents were expected to provide in depth comments, own conclusions and recommendations. A comparative analysis of the responses is also done taking into consideration the role, type and characteristics of the expertise of respondents. The collection of secondary data is based on the literature review and includes acquiring policy documents, reports, journal articles, newspaper articles, internet sources and data related to the congestion charging system, the experience of forerunners and current conditions of the urban traffic management in Sofia.

Data Analysis

Data analysis is conducted qualitatively using the literature review, in-depth interviews, and desk studies (secondary data) to answer the research questions. The first step includes overview of the literature which is mainly used to analyze the ways of congestion charge application in theory and practice. This step is envisaged to answer the first three research questions. The next step is to analyze the primary and secondary data on the current transportation framework policy of the city of Sofia for its suitability for congestion charge adoption. The interview method is chosen for the primary data analysis accepted that it could explore more issues that the researcher might not have previously anticipated which assures a wider and a deeper analysis and understanding of the issue *(Valantine, 2005). Based on this assumption a critical a*nalysis is undertaken by comparing and rethinking the information gathered from the interviews and literature review. This approach has assured broader understanding of the specifics of the policy environment, the successful patterns, opportunities and challenges in eventual implementation of congestion charging in Sofia thus answering the last research question.

Research Logics, Research Design and Process Flow

A triangulation technique is used to provide clear description of the design and logics of the research, distinction and consequence and interrelation of the research objective, inputs, outputs and overall processes' flow. It also reflects the elaborated conceptual model, research tools, literature review, primary data (collection of interviews), secondary data analysis and conclusions and recommendations (Figure 1 above).

Research Scope, Limitations and Actuality

The interpretation of the research outcomes (achieving the research objective, answering the research questions, data analysis and associated final conclusions and recommendations) is restricted and depends on defined scope and limitations of this work including – elaborated methodology (research design), research bounders, data availability, representativeness, assumptions, conditions and limited resources for conducting the empirical part of the work.

In terms of representativeness the limitations are related mostly to the restricted number of the interviews and sample distribution of the respondents. They were partly overcame through the approach undertaken (the conceptual model), the elaboration of the criteria for selection of the experts' panel and assessment of the results. It should be mentioned that there is a significant potential for further improvements, extension of the bounders for a better understanding of the practicalities of the eventual congestion charging implementation in Sofia.

The research outcomes might be also utilized in the practical work in assessment of the maturity development of the necessary preconditions in preparation, initial and follow up planning and implementation process in a case of eventual decision to be taken by Sofia Municipality for adoption of congestion charging.

The associated conclusions and recommendations could be also used in other cities abroad with similar urban and socio economic profile for achieving an improved and a better informed policy approach on this issue. An obligatory condition

is to take an appropriate consideration of the differences and maturity of the start up conditions and urban traffic policies. The appropriate consideration has to be given to the application of the criteria proposed in the improved conceptual model associated with the s.c. critical level of urban traffic and congestion intensity and related benchmark indicators.

The proposed approach tries to contribute in solving actual problems associated with the current practice of implementation of the congestion charging in the EU member states. In this respect it is no accident that the EU Commission in its latest document on the matter states that: *"So far only a few EU cities have implemented urban road user charging schemes, while others give it close consideration. Initial evaluations indicate that such measures are effective and can generate net revenue for investment in other mobility measures but it is not clear if these types of access regulation schemes are more or less cost effective than other type of access regulation. There is a risk that a diversity of incompatible approaches and technologies develop and occasional users are not treated fairly."*[2]

An example of the potential practical use of the major research outcomes is provided in the form of a mentioned template - Sustainable Urban Mobility Policy Matrix presented in the annex to this work which received positive feedback during collecting answers to the interviews used in Chapter IV. Although falling out of the scope of this work it provides basis for further elaboration by designated Sofia Municipal authorities of Mid to Long term Scenario of implementation of congestion charging in Sofia incorporating a time framed "check list" of the changes of the "maturity" of the preconditions, based on the assessment criteria of the conceptual model. It also frames out the basics of the necessary actions of a draft plan for its adoption.

More detailed explanation on the methodology of the research approaches and tools developed under this study is given in the related parts of the remaining chapters.

[2] SWD(2013) 526 final COMMISSION STAFF WORKING DOCUMENT A call for smarter urban vehicle access regulations Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Together towards competitive and resource-efficient urban mobility., pp. 6.

Chapter II: Theoretical Framework

The proper understanding of sustainable urban mobility principles and implications of their practical implementation is essential for exploring the needs and preconditions of congestion charging implementation.

The chapter provides the theoretical framework of this work discussing the urban transport and sustainability in relation to the concept of congestion charging via close look to the literature and valuable contribution of the widely recognized authors. Examining the content and substance of the congestion charging the related part of the chapter provides a simplified conceptual model to the congestion charging implementation. It is used further in the analysis of accumulated appropriate experience including the selected case studies, the current status and developments of the urban traffic policy and management in the city of Sofia, for the design of the research tools such as research questionnaire and selection of the experts' panel and for deriving of the associated conclusions and recommendations.

2.1. Urban Transport and Sustainability

The most frequently referred definition of sustainable development is associated with the work of the s.c. Brundtland Commission and could be shortly described as a development that "meets the needs of the present without compromising the ability of future generations to meet their own needs".

Sustainable transportation can be viewed as an implementation of the sustainable development principles in the transportation sector. Sustainable transportation addresses local, regional, national, and global issues and therefore requires considerable coordination. It is important to apply the principles of sustainable transportation in a holistic and integrated manner across the various sectors (external to transportation). This approach have to ensure that key environmental concerns such as depletion of resources, global climate change, disruption of ecosystems, air pollution, noise and other impacts are effectively addressed along with social and economic requirement, goals and restrictions.

According to the European branch of the US Rand Corporation, the definition of sustainable transport adopted by the Ministers of Transport of the 15 European Union countries should be favored because it is concrete, comprehensive, and "has been reviewed by political mechanisms and received general political acceptance". The definition referred to is as follows: „A sustainable transport system [is] defined as one that:

- allows the basic access and development needs of individuals, companies and societies to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations;
- is affordable, operates fairly and efficiently, offers choice of transport mode, and supports a competitive economy, as well as balanced regional development;
- limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and, uses nonrenewable resources at or below the rates of development of renewable substitutes while minimizing the impact on the use of land and the generation of noise."

It should be mentioned that the EU definition was taken almost word for word from the definition developed in 1997 by the Toronto-based Centre for Sustainable Transportation. The Centre's definition is now as follows:

Based on the 1987 Brundtland report definition of sustainable development, William R. Black (1996)[3] has provided the following definition "Transport that meets the current transport and mobility needs without compromising the ability of future generations to meet these needs." He has also analyzed a broad range of major definitions of sustainable transportation and the ways these definitions impacted urban transport policy, practices and planning.

Taking into account the vast number of attempts to define the sustainable urban mobility this part is focused on the *restricted review of the major definitions* (which constitutes the base for concepts' development) in order to frame out the place and potential role and potential of the congestion charging as one among many available tools of the basic policy alternatives.

Herman E. Daly (1992) and D.W. Pearce, et al. (1993): "Transport and mobility with non-declining capital, where capital includes human capital, monetary capital, and natural capital." Daly has also defined the conditions for any sector being sustainable:

- rate at which it uses renewable resources does not exceed their rates of regeneration;
- rate at which it uses non-renewable resources does not exceed the rate at which sustainable renewable substitutes can be developed;
- rate of pollution emissions does not exceed the assimilative capacity of the environment.

As Lee Schipper (1996) mentioned: "Sustainable transport is transportation where the beneficiaries pay their full social costs, including those that would be paid by future generations. He generally attributes non-sustainability to the negative externalities generated by transport."

Mobility report (MIT and Charles River Associates, 2001) defines sustainable mobility as "the ability to meet the needs of society to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological values today or in the future."

As Banister (2007) suggests there are several key elements that need to be addressed if transport investment decisions and economic development, policy scenarios are to conform to the principles of sustainable development and mobility:

1. Growing congestion: In some urban areas congestion has been increasing and cities have no capacity to deal with growing traffic.
2. Increasing air pollution: Because of the traffic, air pollution levels increase. Air pollution affects health, environment and quality of life. Presently 70% of air pollutants in the EU urban areas are attributed to transport (MVV Consulting, 2007; Commission Communication COM, 2006).
3. Traffic noise: Noise affects the urban life with estimation by the EEA (2001) that more than 30% of the EU population is exposed to road traffic noise level higher than 55 Ldn dB5. Levels above 65 dB LAeq are detrimental to health (WHO, 2000). Noise psychologically people and influence well-being.
4. Road safety: Traffic accidents are a matter of a great concern and are extremely costly for the society.
5. Degradation of urban landscape: Building new roads and transport facilities results harmful on historical heritage and capacity of urban space. Also, new parking space affects side walking and cycling. Transport contributes to the decaying urban fabric and neglect of central city areas, as well as to urban sprawl (Ewing and Cerveo, 2002).
6. Global warming: As it is well proven the anthropogenic known of carbon dioxide emissions by traffic and other sources impact/cause the global warming.

[3] William R. Black. "Sustainable Transport: Definitions and Responses", TRB/NRC Symposium on Sustainable Transportation Baltimore, MD July 12, 2004;

7. Decentralization of cities: Trips within the city are not anymore concentrated on the city center, (Banister, 2007). The traffic is spread all over the urban area. This results on increased car dependence and reduces the possibilities of promoting efficient public transport.

There are seven main objectives identified that should be met in order to establish a policy that addresses the key issues in sustainable transport development, mentioned above (OECD 2000; Kenworthy, 2005):

1. Reduce the travel need;
2. Reduce the car use in urban areas;
3. Promote more energy efficient types of transport;
4. Reduce noise and emissions;
5. Encourage a more environmentally sensitive use of the vehicles;
6. Improve safety of drivers and pedestrians;
7. Improve the city's attractiveness for residents, visitors, workers, etc.

It is important to address all of the basic environmental, economic, social and institutional aspects of sustainability while approaching a concrete case – specific urban (city) mobility situation and adequate policy design, planning and implementation process. The major possible implications to be addressed include - depletion of fossil fuels reserves, global warming, air quality, risk of fatalities and injuries, congestions, low mobility and access, noise, public health and biodiversity, social justice, equity, fairness, effectiveness and efficiency of public investment and spending and overall external cost placed to the society, local communities and business.

As Black fairly states that the attempt to address all significant dimensions of sustainability in practical terms could be overdone so "We must not place so many requirements on the concept, for if we do we may fail to achieve anything approaching a sustainable system.".

For this reason it is important to address the relationship between different policy alternatives, their tools and options aimed at sustainable urban mobility in an acceptable and appropriate way. In this respect, we acknowledge the Commission's Action Plan on Urban Mobility adopted in 2009 (COM), 2009, 490final[4] as a suitable platform for sustainable mobility policy integration. The summarized basic policy options (each consisting of its sub policies, measures and tools)[5] to be considered during the process of policy design, planning and implementation are as follows (not in priority order):

- Clean fuels and vehicles
- Sustainable (green) transport infrastructure
- Access restrictions
- Integrated pricing strategies (incl. congestion pricing, integrated ticketing, parking management etc.)
- Collective passenger transport
- Travel information

[4] Other recent important documents adopted at EU level: "White paper on Transport - Roadmap to a single European transport area - Towards a competitive and RESOURCE -EFFICIENT transport system (COM (2011) 144 final of 28 M arch 2011 , which summarizes the problems, impacts and intelligent clean urban transport and commuting solutions, including higher share of travel by collective transport, demand management and land-use planning lowering traffic volumes, facilitating walking and cycling as an integral part of urban mobility and infrastructure design etc.; EU Urban Mobility Package - " Brussels, 17.12.2013 COM(2013) 913 final COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Together towards competitive and resource-efficient urban mobility"; Brussels, 17.12.2013 SWD(2013) 526 final CSWD A call for smarter urban vehicle access regulations Accompanying the document.

[5] Presented in details in Annex I and II to this work.

- Less car intensive lifestyle
- Soft measures
- Transport management
- Sustainable Urban Freight Transport.

It is also important to quote the contribution of H. Geerlings, J. Lohuis and Y. Shiftan[6] proposing the s.c. multilayer approach in developing a priority pyramid or ladder for the purposes of policy integration and transition management of the sustainable mobility. This is a fruitful attempt to identify the available basic policy options and alternatives in a priority order as follows:

1 Spatial Planning
2 Transport Prevention
3 Pricing
4 Stimulating Public Transport
5 Mobility Management
6 Modal Shift
7 Infrastructure Capacity Management
8 Infrastructure Upgrading
9 Infrastructure Construction.

This approach could be used both for analytical purposes and in the forecasting and planning process. It is also suitable in reflecting the consequence (selected urban development time frame, policy mix or "logics") of the planning and implementation process in a specific city or region context[7].

Obviously as practice has proven in many cases the achievement of adopted goals and implementation of the sustainable mobility principles is possible through implementation of different range of policy mix and instruments – with or without adoption of congestion charging, in a proper location (area, city, zone or road/s), time period, consequence, magnitude or coverage. Regardless of the classifications and specification of the available measures and options, the main two policy alternatives or their specific mix are associated with the **supply side** (more and better roads infrastructure, means of transport etc.) and **demand side urban mobility development or management** (diminishing travel needs, transport prevention or car use, modal shift and alterative transport such as public transport, walking, bicycling etc., or adoption of road/cordon zones congestion charging etc.).

The above summary of main definitions and concepts of the sustainable urban mobility outlines the framework for the policy and goals' setting to cope effectively and efficiently with the critically important urban traffic problems in a specific context. However, identification and integration of the strategies, policy and goals into effective, efficient and feasible programs, projects and actions to be taken is a key challenge to the local and city governments. Therefore an undertaking a preliminary tailor made assessment and testing of (pre)conditions for implementation is needed to address the principles of sustainable urban mobility in every particular case.

Moreover, possible different scenario, appropriate criteria and verified alternative solutions (policy mix) should be elaborated, assessed and compared in every particular case. This also implies a clarification of the right context framework (analysis, monitoring, policy alternatives and implementation) within overall (city) urban mobility planning

[6] Transition towards Sustainable Mobility: The Role of Instruments, Individuals and Institutions. H. Geerlings, D. Stead, Y. Shiftan. 2012., and other previous works.

[7] For example: Geerlings, H. & Kuipers, B. (2013). Smart governance and the management of sustainable mobility. An illustration of the application of policy integration and transition management in the Port of Rotterdam. In T. Vantrouve and & A. Verhetsel (Eds.), Smart Transport networks; market structure, sustainability: An decision making.

specifying the appropriate level of priority, technical and economic feasibility of the available policy options and in particular the congestion charging as one of many possible instruments and alternatives.

2.2. Definition of Congestion Charging

As part of the supply side oriented urban mobility policies, the road construction and improvements reduce congestions and associated negative impacts. In many cases and very often the efforts spent are more likely to fail, because they usually accelerate traffic demand, car use and intensify of noise, pollution and other negative impacts. These consequences are addressed by alternative policy options for a smarter (intelligent) management of the overall traffic demand including congestion charging as one of available tools.

The scheme aims to charge drivers for operating their vehicles at congested roads and/or locations (cordon zones) during specified (peak) time in order to reduce car use and travel time and improve the state of environment and living conditions. Many policy-makers and planners around the world have already found congestion charging to be an important and effective policy tool and strategy to increase livability and reducing pollutant emissions in the cities.

In the same time in a recently adopted staff working document[8], European Commission admits that initial evaluations of the urban road user charging "indicate that such measures are effective and can generate net revenue for investment in other mobility measures but it is not clear if these types of access regulation schemes are more or less cost effective than other type of access regulation. There is a risk that a diversity of incompatible approaches and technologies develop and occasional users are not treated fairly."

Next sections elaborate on achieving a better understanding of the concept of congestion charging and its Implementation.

2.2.1. What is Congestion Charge?

Congestion charging is a system based on distribution of the scarce road space to its most valuable use. The road users should pay a fee based on the travelled distance and the imposed congestion (Lindsey, 2006). The amount and the assessment of the charge vary. Usually, drivers pay a fee to enter a zone/road during certain hours of the day. The collection of fees is mainly made by online payment, SMS payments, prepaid and is based on vehicle identification either by cameras or equipment installed into the cars. The aim of the system is to address and solve the problems caused by congestion in urban areas.

There are a several general types of systems in use. The most widely used solutions include a cordon or ring area around an area (city centre), with charges for passing the cordon line and wide area of congestion pricing where charges are applied for being inside the area. Congestion pricing is currently limited to a small number of cities including London, Stockholm, Singapore, Milan and others and other group of smaller towns having typically an well preserved old historical parts (e.g. Kristiansand and Bergen in Norway, Middlebury in the UK etc).

Congestion charging zones/roads are created to discourage a significant part of the drivers to use their cars, aiming to reduce the intensity of the traffic and congestions, emissions, overall travel time associated. The collected funds from the fees could be used for better road maintenance, environmental programs or for solving other urban mobility problems.

[8] SWD(2013) 526 final COMMISSION STAFF WORKING DOCUMENT A call for smarter urban vehicle access regulations Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Together towards competitive and resource-efficient urban mobility.

There are some exemptions from fees collection within the known well functioning congestion charging systems. These exemptions are valid for the public transport vehicles, alternative fuel vehicles, emergency services vehicles and human-powered vehicles (bicycles) or disabled people (drivers). Some congestion charge zones/roads also reduce the fee in a case of advance payment.

Congestion charge has been used in several cities around the world such as Singapore, London and Stockholm where the tool has shown already many positive results. This approach has reduced the congestions, emissions and the travel times, (Pike 2010, Dennis et al. 2009). After the implementation Singapore reduced the congestion with 13%, London with 30% and Stockholm with 25%.

Economic impacts
Even though there are disagreements on the best forms of pricing, the congestion charging is economically viable. Some businesses consider themselves harmed, because they rely on customers who drive cars. However, other economic activities have benefited due to improved access by other modes, reduced delay for trips that are highly valued by motorists willing to pay, and significantly improved environmental conditions.

Environmental impacts
Environmentalists widely share the view that the congestion charge is a positive tool for reducing traffic congestion, because that leads to reduced level of pollution and carbon dioxide emissions in the urban areas *(Emmerink, Nijkamp & Rietveld 1995)*. Pike *(2010)* stated that after the implementation of congestion charge in Stockholm and London the emissions from the greenhouse gases were reduced up to 20%. In Singapore it was concluded that the exhaust emissions most likely declined in the priced zone due to the large reduction of cars traffic. In the same time, public transport expands due to the congestion charge revenues rises the potential to reduce pollutants and sustain reductions over time *(Herczeg, 2011).*

Concerns and criticisms
As mentioned the implementation of congestion pricing is proved as an effective tool for reduced congestions in urban areas. On the other hand it has also have created criticism and wide public, political and experts' debates. Main criticism is related to the point of view that congestion charging is not socially fair and socially equitable favoring the rich and corporative car users, places an economic burden on neighboring communities and has a negative effect on certain retail businesses *(Herczeg, 2011).* Furthermore, the impact assessments are often criticized the lack of the attribution of reduced emissions to other factors such as improvements of vehicle technology, changes in the transport infrastructure and other significant factors of impact.

2.2.2. Types of congestion charges
According to Ingles (2009) there are four main types of congestion charge (for more detailed information see Appendix I). They are as followed:

2.2.2.1. Cordon area pricing charges drivers a fee to enter a particular area. Singapore first implemented this approach in 1975 with manual tolls changed in 1998 to the electronic road pricing. In 1986 Bergen (Norway) implemented this type of charge. Similar schemes were introduced in Rome (2001), Durham (2002), London (2003), Stockholm (2006), Valletta (2007) and Milan (2008), (Ingles, 2009). The schemes in London and Stockholm use cameras for number plate's recognition. They both charge a fee when a driver crosses the cordon boundary. This type of technology and charging system are pretty expensive but they are well proven in terms of efficiency (BITRE, 2008 see also the own comparative assessment in p. 3.3.3.5. of this work).

In Stockholm, for example, the bill is sent to the vehicle owner in the end of the month and he has to pay within a month. In London, the vehicle owners have to pay before or after the trip, using different payment methods. Residents, living I the charging zone have a 90 per cent discount *(Hensher, 2008).*

2.2.2.2. Multi-road congestion charges are based on electronic tolling when drivers pass toll points. The whole area tolled by this system can be thought of as the cordon area (Ingles, 2009). The Singapore Land Transport Authority (SLTA) has an electronic pricing system based on gantries erected across busy roads and highways. It is possible to pass several gantries on one trip and each time a charge is deducted from the motorist's electronic account, similar to the Sydney e-TAG system. In the Singapore scheme there are some 90 gantries, levying charges according to time and place, (SLTA, 2009).

The SLTA suggests that the policy has successfully achieved optimal speed on highways and arterial roads, with average road speed increasing by about 20 per cent and traffic falling by 13 per cent in the restricted zone, (SLTA, 2009). Traffic peaks have also been reduced, with car use spreading out to off-peak periods. However, the inflexibility of the gantry system means that traffic can sometimes move elsewhere (known in Australia as 'rat running'), with bottlenecks transferred to smaller roads, (Ingles, 2009).

The administrative cost of the Singapore system has been estimated at 23 per cent of revenue received (SLTA, 2009). Singapore's system is more sophisticated and cheaper to operate than London's but London also claims substantial benefits from the charging, with a significant reduction in traffic within the zone and a large switch by commuters to bus travel,(Ingles, 2009). Similar improvements have been cited for Stockholm.

2.2.2.3. Single facility congestion charges are tolls that vary throughout the day, becoming higher when the facility is most used. The Sydney Harbor Bridge and Tunnel tolls are one of the examples and the system is used as well in France and the US. A variant of this approach is the *high occupancy toll* (HOT) scheme used in the US and Canada, whereby motorists are able to pay extra to use a fast lane. These have been dubbed 'Lexus lanes' as they are seen as a perk for the well-off *(Gibson, 2008).*

2.2.2.4. Road-user charges are based on satellite technology that registers the driven distance. The scheme uses vehicle tracking by GPS, calculated by onboard electronic accumulating odometers, which assess travel for remote central computers capable of applying a range of charging regimes. Motorists are no longer paying road tax or sales tax on new cars, instead, they pay fees related to kilometers travelled *(Ingles, 2009).*

There were a lot of discussions in the UK and the Netherlands on the implementation of this system, but due to the lack of political support its introduction has failed. Germany also has experience with road charging. In 2005 a new toll system, called LKW-MAUT, was introduced on German highways for all trucks with a maximum weight of 12t. LKW-MAUT is a governmental tax, based on the driven distance, number of axles and imposed emissions by trucks (Road Traffic Technology, 2012).

An actual overall review of the types of the road and congestion charges implementation outcomes is provided in the quoted Commission staff working document (SWD(2013) 526 final). The adoption of this document clearly indicates intentions for an implementation of a common EU approach, recommendations (guidelines) or possible binding rules on implementation conditions and types to future "prevent overcharging or discrimination of occasional users and ensure that clear and transparent information is available to users, and that payments can be made easily 24 hours per day. Any on board units required for electronic fee collection are already required to be interoperable across the European Union" (p. 6).

2.3. Implementation

2.3.1. Smeed's Criteria

The idea of establishing specific technical criteria for implementation, testing and improvement of the price model of the congestion charging is not a new one. In 1962 s.c. Smeed's panel was appointed to resolve the issue and prepare a *report on the technical feasibility of different methods for improving the pricing model of road use*. In 1964 the Ministry

of Transport in the UK has published the panel's report recommending the use of *direct road user charges*[9]*. Many follow up assessment of the report have accepted that road pricing* would achieve far better results than other forms of tax or charge also because they have taken into account large differences in congestion costs between different journeys *(Dix, 2002).*

The Smeed's requirements (criteria) of road pricing scheme are presented as follows:

1) Charges should be closely related to the amount of use made of roads

2) It should be possible to vary prices for different areas, times of day, week or year and classes of vehicle.

3) Prices should be stable and readily ascertainable by road users before they embark upon a journey.

4) Payment in advance should be possible although credit facilities may also be permissible.

5) The incidence of the system upon individual road users should be accepted as fair.

6) The method should be simple for road users to understand.

7) Any equipment should possess a high degree of reliability.

8) It should be reasonably free from the possibility of fraud and evasion, both deliberate and unintentional.

9) It should be capable of being applied, if necessary to the whole country and to a vehicle.

10) The system should allow occasional users and visitors to be equipped rapidly at low cost.

11) The charge recording system should be designed both to protect individual users' privacy and to enable them to check the balance in their account and the validity of the charges levied.

12) The system should facilitate integration with other technologies, particularly driver information systems.

Figure 2 Smeed's requirements (criteria) of road pricing scheme Source: Based on the Ison, Stephen G. and Maria Attard, The Smeed Report and Road Pricing: The Case of Valletta, Malta. Bank of Valletta Review, No. 47, Spring 2013.

[9] Road pricing: the economic and technical possibilities: report of a panel set up by the Ministry of Transport. UK, 1964.

It is important to underline that it is widely accepted that Smeed's criteria have to be regarded as a "*list of operational requirements*" forming *"the basic specification for a road pricing*"[10].

The Smeed's criteria address different but ***mostly technical aspects*** **of the congestion charges and the price model** to be chosen such as accountability, transparency, safety, simplicity, clarity, feasibility, reliability etc.

In this respect the originally developed Smeed's criteria and their extended versions have to be taken properly into account at a **design stage of preparation of different options and different price models** for congestion charging implementation.

The above conclusion is proved by the experience of London, Stockholm and Singapore considered being among the most effective and successful examples of congestion charging price models having met most of the extended Smeed's criteria (Szendro, 2010). This has been also verified in the analytical part of the next chapter.

Further many authors went beyond from the technical aspects into analysis of the additional criteria or necessary conditions mostly related to the public acceptance, political considerations, economic affordability and cost effectiveness.

Taking Smeed's criteria as a starting point, the next parts of this work attempt to test an improved conceptual model in assessing the *necessary (pre)conditions for successful implementation of the congestion charging*. It is further applied to the analysis of the experience of selected cities, to the urban mobility conditions and policies in Sofia and to the feedback received under the empirical part of this study. The responsible authorities, urban mobility experts and other interested parties might consider appropriate an adaptation of the analysis outcomes in assessing the "maturity status" of the necessary preconditions in a specific context. In this way the effects of ever increasing mobility demands, congestions, and pollution could be effectively and efficiently addressed by the responsible authorities of the city of Sofia and possibly in the cities with similar urban and socio economic profile.

2.3.2. Necessary Conditions for Implementation of Congestion Charging

The comprehensive review of the literature starting from the Adam Smith (1776) and Pigue (1920) to 2004 provided by R. Lindsey (2006)[11] shows a constantly growing interest in the road (congestion) pricing. It is important to mention the substantial contribution of T. Hau (1992) in developing the conceptual framework of road pricing from the economic

[10] For example: Ison, Stephen G. and Maria Attard, The Smeed Report and Road Pricing: The Case of Valletta, Malta. Bank of Valletta Review, No. 47, Spring 2013. The same study quote other extended versions of the s.c. Smeed's criteria.

[11] Lindsey, R. Do Economists Reach A Conclusion on Road Pricing? The Intellectual History of an Idea. Econ Journal Watch, Volume 3, Number 2, May 2006, pp 292-379. A. Smith A. The Wealth of Nations. 1776 (Смит, Адам. Богатството на народите. София, Рата, 2006). and A.C. Pigou, The Economics of Welfare, Macmillan, London, 1920. For the classic contribution in determining s.c. Pigouvian tax see: Henderson T., Jon Crowcroft, and Saleem Bhatti. Congestion Pricing Paying Your Way in Communication Networks. University College London, 2001 (http://tristan.host.cs.st-andrews.ac.uk/research/pubs/ieeeic01.pdf). Lindsey also mentioned the particular contribution of other authors reviewing the appropriate literature Hau (1992, 2005), Roth (1996), Thomson (1998), Ison (2004), Richards (2005).

point of view, both short term, long term and the cost recovery[12]. Unsurprisingly Lindsey states that by 2006 the successful pricing (charging) schemes designed to control the traffic congestions are rather few[13] than the notable failures[14] *mostly due to the lack of political acceptability*.

Many authors including Osland and Leiren (2007)[15] who particularly analyzed the Swedish and Norwegian experience, went in depth in the analysis of the of the institutional and political conditions, procedures and urban financial infrastructure. As they mentioned: "Several factors seems crucial for the establishing of toll cordons: ***the experience of having a congestion problem*** *(bolded and underlined by the author of this work - N.B.)*; that someone takes leadership in the process; high level of trust among the actors, and the establishing of incentives, i.e, that toll cordons are likely to trigger extraordinary funding from the government or at least that the revenue will not lead to a reduction in such funding." This brings focus to the critically important necessary (pre)conditions for implementation of the congestion charging related to the institutional capacity (legislation, technology and enforcement), political support, and development of the public transportation, road network system and public acceptability. The listed necessary conditions differ substantially from the **specification of the operational requirements of a very technical nature to the price model of a particularly designed congestion charging scheme** well defined by the original Smeed's criteria and its further improvements.

The above bolded and underlined part of the Osland and Leiren's statement brings our focus to the other not in depth analyzed but seemed as critically important factor for congestion charging implementation. In this respect in this part of the thesis we attempt to define **the critical level of urban traffic (congestions') intensity in relation with integrated policy options part of which is eventual or "indispensable" implementation of the congestion charging.** The importance of identification of predetermined level of the critical traffic and congestions' intensity in an urban zone or roads and its impact on the planning decisions is addressed within the limitations of the scope and objectives of this work before description of the necessary conditions for implementation of the congestion charging alternative. In this respect the evaluations and selection of the congestion definitions and costing methods to be used[16] is not a scientific but a critically important policy issue to be properly considered by designated authorities, local communities and other interested parties.

It should be also mentioned the importance to undertake more detailed research on definition of a clear simple benchmark(s) specific for each individual (urban/city) conditions indicating that the congestion charging alternative

[12] Timothy D. Hau. Economic Fundamentals of Road Pricing. A Diagrammatic Analysis., The World Bank, 1992.

[13] Singapore's electronic road pricing system (1975 and 1998), Norwegian toll rings (1986), London's congestion charge (2003), US High-Occupancy Toll lane projects (1995), urban toll roads, Brisbane, Sydney and Melbourne (1999), Highway 407 in Toronto (1999) and toll cordon in Stockholm (2006).

[14] Hong Kong, mid-1980s, Randstad area, the Netherlands (1998), Cambridge UK (1995), Edinburgh (2005), several false starts in London prior to 2003, attempts in 1970s to initiate congestion pricing demonstration projects in US cities, the Maine Turnpike (1997), a section of the Trans-Canada Highway in New Brunswick (2000), and New York City (2002), Trondheim (1991), terminated in 2005) and others.

[15] Osland O. and M. Leiren , INSTITUTIONAL AND POLITICAL CONDITIONS FOR THE ESTABLISHMENT OF CONGESTION CHARGING REGIMES: A COMPARISON OF NORWEGIAN AND SWEDISH EXPERIENCES. Institute of Transport Economics, Norway, 2007. R. Dewi (Implementing Congestion Charge in Jakarta. 2011.) also contributed in implementing conceptual model to the specific analysis of the socio economic and infrastructure conditions necessary for implementation of congestion charging taking the case of Jakarta.

[16] Litman T. Congestion Costing Critique. Critical Evaluation of the "Urban Mobility Report". 5 November 2013. Victoria Transport Policy Institute., p., 16 (http://www.vtpi.org/UMR_critique.pdf) provides a comprehensive overview of the difference between the congestions definitions and cost models of s.c. "engineering-based methods that use freeflow baseline speeds, and economic-based methods which reflect users' willingness-to-pay for faster travel".

should be considered as a high priority and (eventually) accepted among the available most suitable options. In this respect proper answers have to be given to the basic questions for identification of: - appropriate set of indicators (benchmarks) for identification of critical urban (city, zone, roads) traffic intensity (congestions) and *predetermined* alarming levels *of their values/levels* **(a benchmark aspect** as presented below**);** and, *assessment of implementation impacts or expected outcomes of other alternative congestion reduction strategies and policies (supply or demand side) options, projects and measures* **(a policy integration aspect** as defined in part "2.1 Urban Transport and Sustainability" of this work**)**.

In every particular case the assessments and forecasts analyzing or anticipating approaching the ***critical point of intolerable traffic intensity*** have to consider a wide range of factors e.g., culture heritage to be preserved, limitations of the public funds and municipal budgets, exhausted opportunities of alternative supply side policy alternatives and instruments such as public urban transport and road infrastructure development (subway, tram lines, streets extensions etc.), growing population, car ownership and use etc. The concept proposed of identification of intolerable traffic intensity (critical load, point or peak), associated with eventual or indispensable adoption of congestion charging has to be taken as a complex issue in relation to:

a) methods and indicators measuring urban transport system performance (traffic congestions, congestion costs and congestion reduction strategies' potential) and particularly used for identification of the critical point (peak) not tolerated by the (established) urban mobility policy and specific (city) context as mentioned above;
b) data availability, quality and functioning reliable system of records;
c) assigned mechanism and responsibilities for monitoring, reporting, analysis and ongoing (periodical) review by designated agencies and municipal authorities (city councils);
d) review of the outcomes and impacts associated with the implementation of other alternative congestion reduction strategies and policy (supply or demand side) options, projects and measures;
e) comparative analysis and assessment of all identified viable alternative solutions against congestion charging option (cost benefit analysis, sensitivity analysis, return on public investment, etc.).

The identification of the critical point (peak) of traffic intensity not tolerable by an established (specific) urban mobility policy is strictly limited by the scope, purposes, research objectives and time and other constraints related to this work. Taking this into account we strictly limit further below analysis to the use of the **most appropriate core traffic congestion intensity and congestion costs' indicators** (the above point "a") partly leaving aside the rest of the mentioned and other relevant aspects. The congestion intensity could be simply defined as a decline of the traffic speed during peak periods on particular roads. There is a wide variety of traffic **congestion intensity evaluation indicators** e.g. level of daily car entries per sq. km in a particular zone (or car entries per hour for a particular road entry), travel time, speed (km/h), flow (veh./hour/lane), density (veh./km), average motorized trip travel time (min/average day, 7-day week), average motorized trip length (km), total number of motorized trips in the city per day, of which external or commuting (%) etc. They evaluate directly congestion intensity or are used as additional input data and could be distinguished for a particular country, city or urban zone and time frame such as morning and evening peaks, week days and weekends, quarterly, per year etc. Based on the literature review, data availability and coverage, wide acceptance and international recognition, we assume the following definitions of the **commonly-used congestion intensity indicators**[17] to be considered as suitable for the preliminary analysis and short term decisions as follows:

- Texas Transportation Institute's (TTI) Travel Time Index: "The ratio of the travel time during the peak period to the time required to make the same trip at free-flow speeds. A value of 1.3, for example, indicates a 20-minute free-flow trip requires 26 minutes during the peak period";
- INRIX Index (II): "The INRIX Index represents the barometer of congestion intensity. For a road segment with no congestion, the INRIX Index would be zero. Each additional point in the INRIX Index represents a percentage point

[17] http://mobility.tamu.edu/ums/media-information/glossary/ ; http://scorecard.inrix.com/scorecard/methodology.asp ; http://www.tomtom.com/lib/doc/trafficindex/2013-1101%20TomTomTrafficIndex2013Q2EUR-mi.pdf .

increase in the average travel time of a commute above free-flow conditions during peak hours. An INRIX Index of 30, for example, indicates a 20-minute free-flow trip will take 26 minutes during the peak travel time periods with a 6-minute (30 percent) increase over free-flow.";

- TomTom's Traffic Index (TomTom's congestion level): "Compares travel times during non-congested periods (free flow) with travel times in peak hours. The difference is expressed as a percentage increase in travel time.

Basically the above indicators account for: - average trip time in free flow situation for commuters (30 minutes for Tom Toms Index, 25.3 minutes in 2010 for US according to INRIX etc.); number of annual commute trips equivalent to traveling to and from work (230 days for Tom Toms Index and 220 for INRIX); and, peak hours - 40 of the 168 hours of a week (from 06:00 to 10:00 and 15:00 to 19:00, Monday through Friday). The outlined indicators present individual (country, city or urban area) specific data such as the most congested day, average free flow speed, time delay per year for commuters and congestion levels on highways and local roads. The Table 1 below provides a sample for the value of traffic index and annual time delay and types of congestion charging for selected cities based on the TomTom European Traffic index for 2013 and European commission Staff working document - SWD(2013) 526 final.

City	Rank out of 59 cities TomTom Traffic Index	2013 TT Traffic Index - congestion level (%)	Annual time delay - 30 min commute TT Traffic Index (hours)	Congestion Charging's type - EC SWD(2013) 526 final
Moscow	1	65	127	N.A.
Istanbul	2	57	118	N.A.
Warsaw	3	44	110	N.A.
Rome	6	36	97	Cordon based and parking
Stockholm	***8***	***36***	***102***	***Cordon based***
London	***14***	***29***	***84***	***Cordon based***
Berlin	15	28	74	Cordon based
Prague	20	26	81	Zone access restrictions
Munich	26	24	74	Zone access restrictions
Manchester	28	23	81	Cordon based
Genoa	36	21	63	Cordon based
The Hague	39	20	73	Cordon based
Rotterdam	42	18	69	Cordon based
Barcelona	44	18	65	Zone access restrictions
Amsterdam	47	17	61	Cordon based
Helsinki	49	17	61	Cordon based
Zaragoza	59	7	24	N.A.

Table 1 Traffic index, annual time delay, types of congestion charging and city typology for selected cities. *Source: TomTom European Traffic index, 2013; SWD(2013) 526 final COMMISSION STAFF WORKING DOCUMENT A call for smarter urban vehicle access regulations Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Together towards competitive and resource-efficient urban mobility. Annex II.*

The above data give an overview of the congestion level intensity in the selected EU cities align with the type of congestion charging adopted (if any, depending on data availability). It allows identifying the critical level of traffic and congestion intensity under preselected criteria in relation to congestion charging as an alternative to further addressed and assessed. The quoted EU study proves that with two exceptions by 2010 ***all investigated EU cities have implemented just one particular type of congestion charging – paid access to the cordon zone***. Further an identification of the typology of the different cities (urban zones) in relation to the threshold (levels) of traffic intensity, stages of urban mobility development and maturity of the policies in addressing the congestion charging implementation need to be clarified in every particular case. In this way the methodology and focus of the analysis would take better into account the differences of the cities' profiles and specific local circumstances. For this purpose overall review of the levels of sustainability parameters for cities clusters and urban zones related to the traffic congestions are presented in the following Table 2. It is based on the interrelated study (TREN/A4/103-2/2009, Study on Urban Access Restrictions, Final Report. Rome, Dec. 2010) which forms the basis for the recently adopted of the EU Commission Working Staff Document (SWD(2013) 526 final). The data derived from the TomTom European Traffic index, 2013) above presented is also used to determine the range of congestion levels and time delay per year.

Indicator/City cluster	**Value/description**		
	High	**Medium**	**Low**
Population density Inh./km2	> 3000	1000 ÷ 3000 **(4492, 2011)**	< 1000
Modal share Private Vehicles	> 50%	30% -50% (17% - 1999, **32% 2009 morning)**	< 30%
Public Transport	> 35% (65% 1999; **49% 2009 morning)**	20% -35%	< 20%
Walking & Cycling	> 30%	10% -30%	< 10% **(11% walk, 1% cycling 2009)**
Road network (Public Transport Net extension density)	> 10 km/km2	3-10 km/km2 (RN 3,7; PTN 2,1; **3,8**)[18]	< 3 km/km2
Cars/1000 inhab.	> 600	400 – 600 (**528, 2012**)	< 400
Main city clusters	"Critical cities" - very high traffic intensity combined with a high use of private cars and relatively low shares of collective transport and non-motorized modes; most likely affected by acute air quality problems and high congestion levels.	"Semi-critical cities" - although the traffic intensity is high thus entailing high congestion level – modal shares are more favorable (Public Transport and/or walking and cycling play a significant role), thus mitigating the overall picture.	"Non-critical cities" - even an unfavorable modal split does not offset the major advantage of relatively low traffic intensity.
Examples[19]	Tollhouse, Rome, Manchester etc.	Minich, Genova, **Stockholm, London**,	Berlin etc.

[18] RN density based on the extended city area and PTN on city and urbanized area (City area - 492,03 km2, settlements and other urbanized area – 267,7 km2, and total extended area - 1349 km2 with suburban villages). Population density calculated for the population with current address registration in the city area – 1, 203 mil (1,292 mil) 2011 census and 1,309 mil inh, in 2013 by the civil registration agency – GRAO (http://www.grao.bg/tna/tadr-2013.txt). We assume that the population (4492 inh/km2), and public transport network (3,8 km/km2) density have to calculated on the basis of the urbanized area of 267,7 km2. Road network is calculated on the basis of total extended area (3,7 km/km2). Additional reference in the Table 10 to Chapter IV of this work.

[19] According to the mentioned criteria in TREN/A4/103-2/2009, Study on Urban Access Restrictions, Final Report. Rome, December 2010; TomTom European Traffic index, 2013, pp. 169-171.

		Rotterdam, etc.	
TT Traffic Index - congestion level - % and time delay per year (hours) per commuter	> 15% (> 60)	10 % (32) – 15 % (60) **(TTT congestion level Index - 20% for car commuters, 2009 and 45 hours annual delay)**	< 10 % (32)

Table 2 Congestion levels, time delay per year, types of congestion charging and sustainable urban traffic typology for selected cities. *Source: TREN/A4/103-2/2009, Study on Urban Access Restrictions, Final Report. Rome, December 2010; TomTom European Traffic index, 2013; General Traffic Management Plan on the territory of city of Sofia. Mott MacDonald. 2009 (in Bulgarian). The underlined data and comments in brackets represent conditions for Sofia based on the latter source.*

The criteria related to classification under **"High/Medium/Low" range** of congestion level and time delay per year (last row of the above table is author's proposal based on the assumption of 15% critical threshold over which an impact on the employment (corresponding to annual delay of more than 60 hours per commuter – work traveler) is appeared.[20]

Other reasons despite impact on the employment associated with the capacity-maximizing speeds (speeds that maximize vehicle traffic capacity on each road or economic efficiency-optimizing (also called consumer-surplus maximizing or deadweight loss minimizing) speeds (reflecting users' willingness-to-pay for faster travel), analyzed by Litman (2013)[21] in the quoted source also indicate the appropriateness of the proposed critical threshold. The 20% for Sofia is valid for the travel time of the car commuters which corresponds to 45 hours of annual delay (230 working days per year).

Based on the data presented in the previous two tables we assume the following two types of critical benchmarks to be considered in the following part of this work:

a) **Types of the city cluster** - "critical", "semi critical" and "non-critical" as defined in the previous footnote No. 19 below. It is important to mention that this classification helps to identify a right set of policy goals options and instruments for a structured sustainable urban traffic strategy and management;

b) **Critical threshold associated with the necessity of addressing and consideration of the congestion charging adoption** proposed to be measured by the congestion level (in percent) and time delay per year, per commuter (in hours). Further we assume the congestion level above 15-20% and/or annual time delay per commuter above 60 hours to be acceptable as a measure (alarming value) of critical threshold associated with the necessity of consideration of the congestion charging adoption.

As for the first criterion (above point "a") we could characterize Singapore as a "critical" city. It is important also to mention, that **Stockholm and London are classified as "semi critical" cities** by the quoted study (TREN/A4/103-2/2009) associated with the adoption of the European commission recent Staff working document - SWD(2013) 526 final. Based on the data provided in the above table, **we also assume Sofia to be considered as a "semi critical" city.** All three cities analyzed further in the next chapter of this work and Sofia are over the defined critical threshold of the congestion level exceeding 15-20%. London and Stockholm (and possibly Singapore) are characterized with annual time delay per

[20] In a study of U.S. cities, Sweet (2013) found evidence that congestion delays that exceed 4.5 minutes per one-way commute (widely accepted standard one way trip of 30 minutes) reduces employment but no evidence that it impedes per-worker productivity. Matthias Sweet Traffic Congestion's Economic Impacts: Evidence from US Metropolitan Regions. Urban Studies, October 10, 2013.

[21] Litman T. Congestion Costing Critique. Critical Evaluation of the "Urban Mobility Report". 5 November 2013. Victoria Transport Policy Institute. (http://www.vtpi.org/UMR_critique.pdf)

commuter above 80 hours (20 hours above the critical threshold). The city of Sofia is still below reaching 45 hours as mentioned.
It is also worth to mention that even Sofia has not implemented the congestion charging it is already has achieved the critical level of urban traffic loads where the congestion charging alternative have to be considered thoroughly among other alternatives which forms current and future policy mix.

The identification of suitable set of benchmark indicators and their critical (alarming) values have to be addressed, monitored and reviewed by designated authorities. Further suitable additional indicators might be elaborated, analyzed, amended or improved depending on the specific urban or city needs and policy context. Litman (2013) provides the following comparison of congestion indicators (the Table 3 below) mentioning that: *"Various indicators are used to evaluate congestion. Only a few are comprehensive and multi-modal."*

Congestion Indicators ("Congestion Costs" Litman 2009) **Indicator**	**Description**	**Comprehensive**	**Multi-Modal**
Roadway Level-Of-Service (LOS)	Intensity of congestion on a road or intersection, rated from A (uncongested) to F (most congested)	No	No
Multi-modal Level-Of-Service (LOS)	Service quality of walking, cycling, public transport and automobile, rated from A to F	No	Yes
Travel Time Index	The ratio of peak to free-flow travel speeds	No	No
Avg. Traffic Speed	Average peak-period vehicle travel speeds	No	No
Avg. Commute Time	The average time spent per commute trip	Yes	Yes
Congested Duration	Duration of "rush hour"	No	No
Delay Hours	Hours of extra travel time due to congestion	Yes	No if for vehicles, yes if for people
Congestion Costs	Monetized value of delay plus additional vehicle operating costs	Yes	No if for vehicles, yes if for people

Table 3 Congestion Indicators ("Congestion Costs" Litman 2009). Source Litman (2013), pp. 9.

One suitable indicator as a part of possible extended urban mobility scoreboard is daily *vehicle entries per sq km (th., cars/sq km) in a particular (cordon) city zone*. Without going further into in-depth analysis and based on the brief comparative analysis presented in the Table 6 (point 3.4 of this work), the value of this indicator for the examined cities is - Singapore (32,4), London (13,3), Stockholm (10,1).

This illustrates the experience of the Singapore in early 70-ies of the last century when it faced necessity of urgent immediate solution to the severe congestions. The comparison of the value of this indicator (daily car entries per sq. km in a particular zone) for the rest two examined cities - London and Stockholm (further referenced in Chapter III) proves its appropriateness despite the option to use other similar suitable indicators.

In the same time it is important to mention that the indicators (under above point "b") measure the congestion intensity, namely *the degree that traffic declines during peak periods*. In this respect the evaluations and selection of the

congestion definitions and costing methods to be used[22] is not a scientific but a critically important policy issue to be properly considered by designated authorities, local communities and other interested parties.

As T. Litman fairly mentioned "Such indicators do not account for exposure, the amount that people must drive during peak periods and therefore their total congestion costs. Intensity indices are useful for short-term decisions, such as how best to cross town during rush hour, but are unsuited to strategic planning decisions that affect the quality of transport options or land use development patterns, and therefore the amount that people must drive. For planning purposes, the correct indicator is per capita congestion costs."[23] T. Litman (2013) defines the congestion costs as "Monetized value of delay plus additional vehicle operating costs".[24] In this respect we assume necessary collecting suitable input data on the average compensation per hour paid to employed persons or value added per capita in the specific urban or city area when calculating "monetized value of delay".

The limited scope and resources assigned to this work does not allow undertaking a further in-depth examination of other cities' experience to come up with other additional or alternative (set of) indicators and to evaluate their possible critical (alarming) value. A follow-up research in this matter might probably also prove the appropriateness of the proposed concept of the critical level of urban traffic intensity associated with necessity of addressing eventual implementation of the congestion charging as one of sustainable urban mobility policy options. It is also need to be underlined that the moment for entering into public discussions need to be chosen at the earliest possible stage (which is still not the case of Sofia) before reaching the critical **technically and publicly intolerable levels of traffic intensity** and consecutive congestions. Further, this approach allows to take into account properly the most sensitive public concerns, to assure necessary time lag for achieving maturity of the public opinion and to develop and present analysis of different alternatives (sensitivity analysis, impact assessment) and congestion pricing models as described in the examples in the Chapter III of this work.

2.3.2.1. Institutional Capacity

The implementation of congestion charge involves coordination between authorities on different governmental levels, such as Ministry of Transport, Police Agency, Municipality and other interested parties. These institutions/ organizations are responsible for preparing the legal framework for applying congestion charging in the form of suitable secondary legislation and government regulations. The regulations cover the technical aspect of implementation of the system, including criteria for a road or area to implement congestion charge, financial criteria, maintenance and coordination. Technology and enforcement are also considered as important elements on the institutional capacity in order to implement congestion charge. Both of them cannot be separated, as technology is a necessary tool for enforcement. If there is no enforcement people will violate the rules. The technology must be simple, affordable and sustainable in the long-run. The congestion charging system must have a good track record in terms of user-friendliness, reliability and accuracy. Camera-based recognition, radio-frequency identification, dedicated short-range communications, and global

[22] Litman T. Congestion Costing Critique. Critical Evaluation of the "Urban Mobility Report". 5 November 2013. Victoria Transport Policy Institute., p., 16 (http://www.vtpi.org/UMR_critique.pdf) provides a comprehensive overview of the difference between the congestions definitions and cost models of s.c. "engineering-based methods that use free flow baseline speeds, and economic-based methods which reflect users' willingness-to-pay for faster travel".

[23] T. Litman. Smarter Congestion Evaluation – An Example. 2014 (http://www.planetizen.com). He also provides the following example – "a compact, transit-oriented city may have a 1.3 Travel Time Index (traffic speeds decline 30% during peak periods), 60% automobile commute mode share, and 6-mile average trip lengths, resulting in 34 average annual hours of delay per commuter; while a sprawled, automobile-dependent city has a 1.2 Travel Time Index, 90% automobile mode share, and 10-mile average trip lengths, resulting in a much higher 45 average annual hours of delay. Intensity indicators imply that the compact city has worse congestion due to greater peak period speed reductions, although its residents experience lower total congestion costs because they drive less during peak periods."

[24] Congestion Costing Critique: Critical Evaluation of the "Urban Mobility Report". 2013. Victoria Transport Policy Institute. pp. 9

positioning satellite systems combined with cellular radio communications *(Ueckermann and Venter, 2008)* are among the technologies, proven in tracking records within the congestion charging system.

2.3.2.2. Political Support

The political support for implementing congestion charge is extremely important. For successful implementation strong political position and support is needed from politicians with strong leadership at all governmental levels.

Referring to London and Stockholm experiences, congestion charge is a very sensitive political issue. London had a very strong political leader who initiated the congestion charge implementation, the incumbent Mayor at that period, Ken Livingstone. On the other hand, due to unstable political agreement, the congestion charging in Stockholm has its ups and downs throughout the years, (Dix, 2002). Another example is the Netherlands, where the introduction of the congestion charge scheme failed due to the lack of political support.

2.3.2.3. Public Transportation System

The well-developed public transportation system is one of the most important elements to implement congestion charging. The public transport should be comfortable and affordable, as it serves as an alternative of private car transportation. Congestion charge is more effective when it provides benefits for the majority of citizens by reduced travel times, improved access and reliability *(Replogle, 2008).* Revenues generated by congestion charging can be used for transport improvements and other benefits, such as pedestrian sides or cycling lanes. The key to public acceptance lies in showing the public that congestion charges leads to better traffic system performance with less congestion and better travel alternatives *(Replogle, 2008).*

2.3.2.4. Road Network System

Before the implementation of the charging scheme the road infrastructure and network should be maintained well and in good condition. The choice of scheme type should be determined based on considerations such as the layout of the road network, the extent and location of congestions and the implementation in combination with other TDM (Transport Demand Management) measures. Aspects such as traffic diversion and land use impacts are important considerations. The road hierarchy has to be clear and to cover the standards. It should divide the road network system by different types of roads, differing by their function and status. This differentiation will facilitate the decision which roads/zones to be charged.

2.3.2.5. Public Acceptability

One of the challenges and important key element in the implementation of the congestion charging is public acceptability. Public acceptability is related to the common perception on the congestion charging scheme regarding on how people evaluate it before, after and during its implementation, (OECD, 2010). Surveys of public opinion show that acceptance rises as the general idea is first discussed, then gets down when the details are defined, but rises to its highest level once the system is operational, (OECD, 2010). As Banister (2007) stresses public acceptability is achievable when consultations are taking place with all the parties. Successful implementation must involve community and stakeholder commitment in the process of decision-making and implementation. “The process needs to build up trust and respect between the different actors over time, so communication and active involvement are essential.” (Banister, 2007). Initial public acceptance can be difficult to sheltered, and implementation of congestion charging can require time to build consensus. In London and Stockholm the public opposition could not prevent the implementation of congestion charging, and public support increased after the system began to operate.

2.4. Conceptual Model

An improved conceptual model is below proposed to be used as an analytical tool and framework guideline for analysis and eventual implementation of Congestion Charging System in the city of Sofia. It is built on the three major aspects: *Critical level of urban mobility (congestions’) intensity in relation with integrated policy options, Types of Congestion Charges and Basic Necessary Conditions for Successful Implementation.* A table of different elements of the Conceptual Model is below provided. It should be noted that relevance of the different elements of the model differentiates

substantially depending on the level of maturity of urban infrastructure, implementation of the different options of the sustainable urban transport policy mix and approximation to the critical level of congestions' intensity in every particular case. For example cities where the authorities are already have taken (or are very closed to) the decision to adopt of the congestion charging the selection and concrete design of the price model thus implementing the Smeed's criteria are more relevant. In the case of the immature road infrastructure and lower levels of traffic (congestion) intensities the key important factor such as critical level of urban mobility (congestions') intensity, assessment (review) of the implementation of integrated policy options (current, possible or planned) and all necessary conditions such as institutional and political capacity, procedures and urban financial infrastructure might play more significant role.

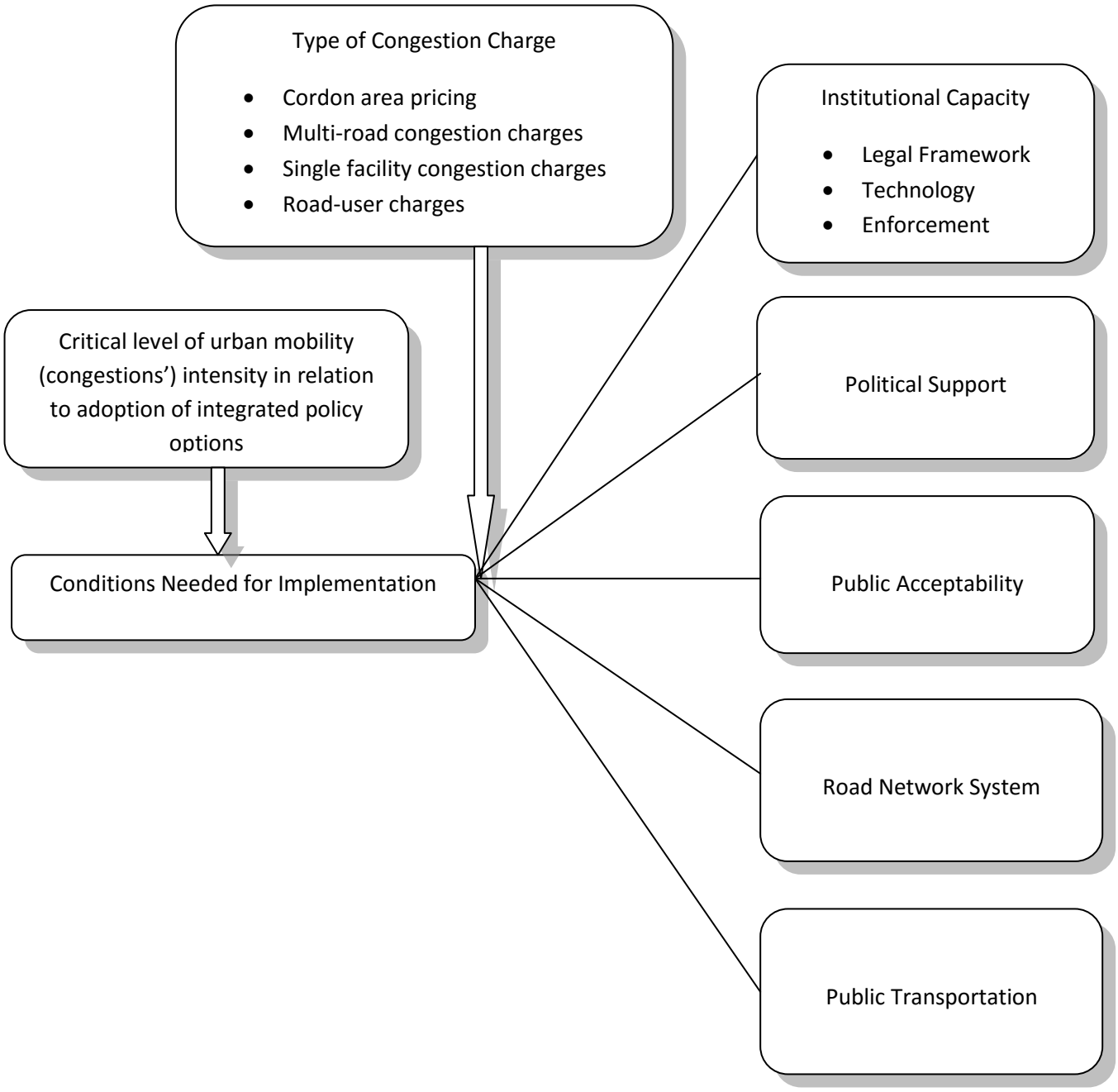

Figure 3 *Conceptual Model for Implementation of Congestion Charging System. Source: Authors improvements to concept use*[25].

[25] As mentioned Osland O. and M. Leiren (2007), R. Dewi (2011) and other authors have contributed to the use of similar conceptual models in the specific analysis of the socio economic and infrastructure conditions for implementation of congestion charging.

The above described Smeed's criteria are directly related to the design phase of the congestion charging and particularly to the selection and implementation of the type of price model to be adopted. Therefore the adoption of the proposed conceptual model or other similar analytical tools are more relevant to the specific conditions of cities and urban areas where the congestion charging as an policy option is not yet considered or is at the very initial stage of preliminary (''experts based") discussions and debates as in the case of Sofia. Thus the relevance of the Smeed's criteria to the analysis of the necessary conditions (part of conceptual model) has to take into account:

a) that the most part of the these criteria fit into the technical aspects closely related to particular selected or designed price model;
b) the "maturity" and feasibility of the concept among major stakeholders, policy makers and institutions in a given specific city or urban context.

In the next Chapter III on the basis of the Conceptual Model, different elements are distinguished for each of the three case studies – London, Stockholm and Singapore, where the implementation of Congestion Charging System gave already many positive results. In Chapter IV the Conceptual model is used to determine the preparedness of Sofia for eventual implementation of congestion charge.

The application of an analytical and planning tool - Sustainable Urban Mobility Policy Matrix is further proposed as presented in Annex I and Annex II to this work.

In order to facilitate the analysis and identification of a viable policy mix and projects it incorporates the identification of policy mix in relation to its separate and overall impact on the urban traffic intensity and congestions including eventual implementation of the congestion charging (option No. 4.1 in the first column of the table presented in Annex I to this work).

The **hierarchy of the sustainable urban mobility policy options or specific policy mix (**as shown in the second column of the table in AnnexI) is based on the model of the Commission's Action Plan on Urban Mobility (2009) but other alternative policy integration models are also possible to be used accordingly[26]. The proposed matrix also elaborates on the concept of **the critical level of intolerable urban traffic (congestions) intensity** associated with the key important indicators and their alarming values as presented in part "2.3.2. Necessary Conditions for Implementation of Congestion Charging" of this work. The practical application of the proposed Policy matrix allows:

- assessment of the current urban mobility policy mix from the point of view of the sustainable urban mobility principles;
- review and better planning;
- identification of traffic intensity reduction potential of the congestion charging, its proper placement and timing in comparison to other available policy options.

As mentioned in the previous part the concept of the sustainable urban mobility clustering of the cities as "critical", "semi critical" and "non-critical" allows the identification and adoption of a right set of major policy directions and goals for a structured long term sustainable urban traffic strategy and management. The following possible typology outlines

[26] As presented in part 2.1 of this work.

the basic policy options and goals in relation to (eventual implementation) of congestion charging based on the concept of the city clustering and :

a) **the case of the "non-critical city"** (under critical threshold of traffic and congestions' intensity) – the main goal is associated with active preventing policies for preserving the status and not allowing to fall in the next category ("semi critical"). Most properly the congestion charging option is not considered as feasible and appropriate taking into account all local specifics and conditions (presence of well-preserved historic city center or other, including economic reasons might impact the decision to adopt the congestion charging);

b) **the case of "semi critical city"** (close or slightly above critical threshold of traffic and congestions' intensity) – overall goal is to bring back the situation to the profile of a "non-critical city" or to abate traffic intensity significantly under critical threshold while keeping the profile of "semi critical city". Congestion charging has to be addressed as one of the viable policy options and instruments and further adopted if found feasible, effective and efficient;

c) **the case of the "critical city"** (very much above the critical threshold of traffic and congestions' intensity) – overall goal to bring back the situation to the profile of a "semi-critical city" to abate traffic intensity significantly (if possible close or under critical threshold). Most probably the congestion charging has to be adopted alongside with other smart demand side policy options.

The figure below summarizes the time periods and important moments in addressing the implementation of the congestion charging in a hypothetical city case. It allows clarifying the specific framework for conducting the analysis, policy context, stages of design and implementation and further functioning, follow-up reviews and future possible developments.

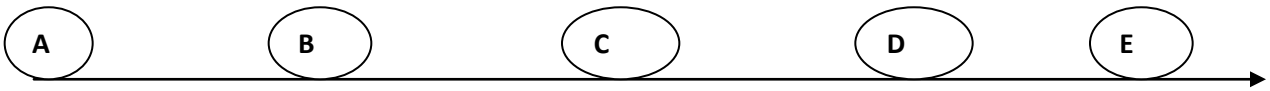

Figure 4. Congestion Charging Life Cycle. *Source: Author's proposal.*

The content of the related symbols of the scheme are as follows:

A – initial moment in time – lack of public discussions, available and recognized studies and policy proposals addressing congestion charging assuring political support for further actions and decisions to be taken. We assume that the current context in Sofia urban mobility policy and management and many other cities with similar profiles illustrate this case.

B - announcement of the official (political) intensions or proposal of designated municipal authorities and/or leading (ruling) local political party or coalition for forthcoming adoption of the congestion charges as part of the urban mobility policy mix;
Usually it is preceded by intensive public discussions and communication campaigns, preliminary studies, cost benefit and impact analysis for clarification of the necessity, expected advantages, operational and investment cost of different congestion charging options in comparison to other sustainable urban policy options and instruments.

C – Moment of taking decision by designated authorities (Municipal or City Council) for adoption of the congestion charging. Related follow-up preparatory actions such as conducting the pre-investment (conceptual) and technical design, enhancement of the institutional capacity, public referendums and trials (tests) etc are usually undertaken.

D – Official adoption of the scheme.

E – Follow-up reviews, improvements, modifications or even an eventual abolishment[27] of the adopted congestion charging scheme. Singapore, London Stockholm and other cities already implemented congestion charging fall under this cluster of cases.

The analysis of the specific cases might vary substantially depending of the profile of city in question i.e. which time period on the above scheme characterizes the current status in addressing congestion charging issue. The next Chapter III provides analysis of the experience already passed the prevailing part of the congestion charging life cycle. As clarified by the analysis in Chapter IV Sofia is in the very begging of addressing the viability of the congestion charging option.

As proved by the proceeding and follow-up analysis the specific profile of Sofia and other similar cities could be further characterized as follows: "semi critical city", already reached the critical level of congestion intensity (although approaching lower values), with no official policy on the adoption of the congestion charging of designated authorities.
In relation to the specific profile of Sofia, the follow up analysis implies focus on the political support, public acceptance, developing and enhancement of the institutional capacity while addressing of the technology issues, alternative pricing models etc., are mostly related to far more advanced stages of design and implementation in a given city context and model of congestion charging.

[27] As mentioned in the footnote No 14 under p. 2.3.2 of this work, Hong Kong, mid-1980s, Randstad area, the Netherlands (1998), Cambridge UK (1995), Edinburgh (2005), several false starts in London prior to 2003, attempts in 1970s to initiate congestion pricing demonstration projects in US cities, the Maine Turnpike (1997), a section of the Trans-Canada Highway in New Brunswick (2000), New York City (2002), Trondheim (1991), terminated in 2005) and other cities have abolished already adopted scheme.

Chapter III: Case Studies Overview

This chapter tries to analyze and reflect in a structured way the experience of London, Stockholm and Singapore in order to provide better understanding and use of learning outcomes in deriving the related conclusions and recommendations. Based on the clear evidence of the positive results achieved, the experience of London, Stockholm and Singapore in congestion charging is chosen as a successful model to be followed in the implementation of this alternative traffic management tool.

For example it is estimated that the high congestion pricing in London have reduced by 20-30% the downtown passenger car traffic intensity and promoted the alternative forms of motorized transport. In Singapore the average traffic speeds increased by at least 15 km/h. In 2006, Stockholm experienced an immediate reduction of at least 20% in the daily car use. In all three cities a reduction in CO2 emissions between 10-20% was estimated, along with health benefits from reducing the local air pollutants and noise *(Menon and Guttikunda, 2010).*

On the other hand, there were many other concerns and problems related to the introduction of the scheme. The business in the charging zones is concerned about the productivity and profitability as far as in many cases it relies heavily on the customers entering the zones to be charged using their private cars. Potentially it could lead to a hidden or publicly demonstrated influence on the public opinion and politicians in power. This raises the question of critical importance on the overall process of identification of interests of all concerned parties including timing, communication tools, preliminary analysis and impact assessment etc.

Another important consequence widely discussed in the literature is that congestions on the alternative or free of charge roads would increase dependence on the road infrastructure development and improvement of the traffic management. Some critics argue that road pricing is unfair as it is a “double charging” since motorists have already paid registration and fuel taxes. Other authors underline high level of implementation cost - direct (investment and operational) and indirect. In contrary, the congestion reduction benefits valuation proves that the tool is worth its implementation from economic, social and environmental point of view. It is proven especially when taking into account the additional opportunities if critically important concerns are addressed properly by special charging exemptions and compensatory policies. The overview of the known best practice clearly show that failures, concerns and fears have declined over time as all interested parties gained experience and adapted to the new system.

Having analyzed pros and cons, the implementation of congestion charging system in these cities is considered to be successful in terms of achieved positive results. As noted earlier, the Conceptual model, provided in the previous chapter is used as a guideline and framework tool for conducting the analysis of the three study cases – London, Stockholm and Singapore. For each of these three cities a brief overview of the type of implemented congestion charge, necessary conditions and experience gained is provided. In conclusion, important lessons learned from the implementation experience were drawn up. This approach serves further the analysis and modeling the basic conditions for eventual future implementation of congestion charging system in city of Sofia.

The three cases are defined regarding the type of the city cluster (“critical”/“semi critical”/“non-critical) in Table No. 8, pp. 68 presented in the Chapter IV of this work. It is needed to underline that classification of London and Stockholm as semi critical cities is done by the authors of the quoted “Study on Urban Access Restrictions, Final Report. Rome,

December 2010 (TREN/A4/103-2/2009), while assumption that Singapore falls into "critical cities' " category is authors assumption based on application of the criteria listed in the Table No. 2 proposed by the later study (TREN/A4/103-2/2009).

Table No. 8, p. 68 of this research provides comparative analysis related to the urban traffic profile of the city of Sofia as well. However this chapter is not focused on the types of the city cluster and the proposed critical threshold associated with the necessity of addressing and consideration of the congestion charging adoption (measured by the congestion level and annual time delay per year, per commuter). It is based on the practical consideration that all three "case studies'" cities have already implemented the congestion charging option while cities similar to Sofia that might consider its adoption will benefit much more better out of this concept.

3.1. London

3.1.1 Overview

The first big European city successfully implemented the congestion charge scheme is London. The implementation occurred in 2003 aiming to reduce air pollution and road traffic with the great support of the mayor Mr. Ken Livingston. Since then the driver are obligated to pay a fee to enter the city center during weekdays between 7:00am and 6.30pm with exception for public transport vehicles, emergency vehicles, etc *(Transport for London, 2009).*

The system was implemented in a highly congested 22 square kilometer area containing about 200,000 residents and five times as many jobs (see map on *Figure 2*). Right away after the implementation of the charging the vehicles entering the zone were reduced up to 25% decrease *(Transport for London, 2009).*

Positive economic and productivity gains resulted from the implementation of the system are due mostly to the decreased delays and increased traffic speed. The improved transport system influenced the sustainable economic development, population growth and business efficiency. The implementation of the new system encouraged also the bike use. Public transport use increased by 16%, cycling by 66%, carbon dioxide emissions were reduced by 19%.Public acceptability increased after the implementation. The charging zone doubled four years after the first introduction due to the positive results achieved *(Szendro, 2010).* As a negative result on the Inner Ring Road the alternative traffic increased by 5%, but this had a little effect on the travel time (Transport for London, 2009).

As a matter of fact, the congestion charge influenced the decisions of road users on whether to take a trip, the mode used and the time of the day chosen, but also produced a virtuous circle for bus transportation according to Leape (2006). This virtuous circle is based on the idea that decreased congestion increases bus average speed which leads to more passengers and as a result more revenues to improve the urban mobility *(Small, 2005).*

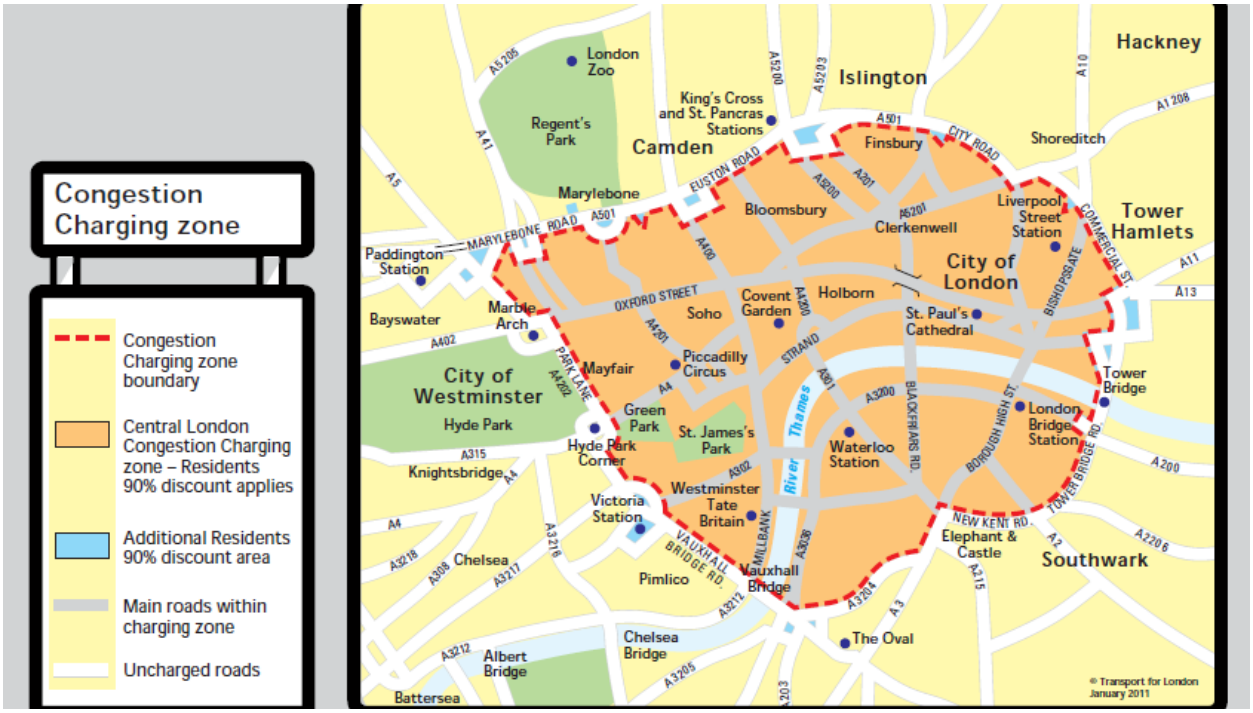

Figure. 5 Map of Congestion charging zone in Central London*. Source: Transport for London, 2011*

3.1.2. Type of Congestion Charge

The type of the congestion charge in London is Cordon area pricing. London's scheme is based on the number plate recognition using cameras, and charges a fee when a user crosses the cordon boundary. The system charges a single daily fee. The scheme also applies charges on road use internal to the cordon area. The fees are a deductible expense for individuals and businesses. Fleet owners are billed but private motorists must pay before the trip or the day after, using either a website, a text message, shops equipped with Pay Point, or a telephone. Residents of the charging zone have a 90 % discount.

3.1.3. Conditions needed for implementation

3.1.3.1. Institutional Capacity

- *Legal Framework*

In 1999, Parliament approved the Greater London Authority Act. This act adopted a unique form of strategic urban government in London assigning managerial role to the Mayor authority. Along with main responsibilities, the Act establishes the framework of the transport policy. The GLA as legislative instrument gives the Mayor the power to introduce the congestion charging scheme in London (Transport Act 2000) setting out that:

- The charging authority is given to Transport for London, whose role is to implement the Mayor's transport strategy. It also manages the transport services.
- The Mayor can influence the design process of the charging scheme. The Government decides on the level of penalty, charges, exemptions and discounts.
- For the next 10 years all revenues must be spent on improvement of the public transport.

- *Technology and Enforcement*

The Automatic Number Plate Recognition (ANPR) technology was chosen to enforce a standard cordon area charging scheme. Optical Character Recognition (OCR) is used to read license plate numbers recorded by the video cameras.

Video cameras are put at every entry point within the zone for capturing images of entering and leaving vehicles *(Transport for London, 2005).*

At the end of each day, the captured numbers are checked in the database of paid or exempt vehicle registrations. If a vehicle exists in this database its details are deleted from the system. If the vehicle does not exist a bill is sent to the owner of the vehicle (Transport for London, 2005).

Within no automated payment system drivers must pay the £8 (€ 9.30) fee before or after the day trip. Payment can be made via Internet, call or by text message. Next-day payment is accepted but the owner of the vehicle has to pay a £2 (€ 2.30). Later payments impose fines of up to £120/€ 140 *(Commin, 2009).*

3.1.3.2. Political Support

The origin of the measure comes from the political restructuration in the area of London in2000, when Ken Livingstone (Labor Party) won the elections becoming the new Mayor of the area of London (Greater London Authority). He came with a platform that included congestion charging implementation *(Litman, 2006).* National government (Labor) also supported the Mayor's plan and public consultations reported enough public support to the project mainly due to the understanding of the severity of congestion in the city center. This plan was criticized by various interest groups, including politicians, motorist groups and some labor organizations.

The Conservative Mayor candidate promised to end the congestion pricing program if elected. In fact, the City of Westminster council as a local authority ruled by conservatives was responsible for governing the district covered by the system. It was the most difficult obstacle faced since it challenged the project claiming that it was unlawful and would produce even more pollution *(Banister, 2003).*

The British High Court rejected that claim and Mayor Livingstone considered a "radical" politician have proceeded with the charge *(Litman, 2011*). Following a shift in London's political structure and the appointment of Ken Livingstone as mayor in 2000, London's long-awaited Congestion Charge was finally introduced in February 2003 *(Commin, 2009).* Nonetheless, after some years of implementation the system enjoys popular support and the political opposition have not questioned congestion pricing anymore *(Albate and Bel, 2008).*

3.1.3.3. Public Acceptability

The congestion pricing scheme was discussed four decades before its implementation in 2003. During these forty years many discussions, studies and reports were undertaken. In many ways the public, experts and authorities had developed a decent perspective on the concept, the possible impacts (both positive and negative), implementation obstacles and its potential role in London's transportation plans.

As CURACAO *(2007, p. 6-13)* reports, "The level of acceptability of road user charging before the introduction was rather stable about 40%. This also holds true in comparison with other scenarios such as workplace commuter tax schemes. After the introduction acceptability has risen above 50%. Unfortunately, no time series data is available later than October 2003 to observe any long-term trends in acceptability and the influence changes to the schemes, such as the western extension, might have. The re-election of the Mayor in June 2004 with the western extension already announced suggests that London residents accepted this change as part of their future government as well."

There are two main reasons for this rather high level of acceptability before and after its introduction. First, traffic intensity in London had reached intolerable levels and the citizens felt some drastic measure was needed. Evidence for this is cited in the ROCOL report (2000): 90% of London residents, polled in 1999, thought that there was too much traffic in the capital, and were concerned about its impacts on travel times and air pollution. Some 41% of a representative sample polled for the ROCOL report also felt that a congestion charge was the best way to raise money for improved public transport in London.

Second, in London the concentration of power in the hands of the Mayor meant that "local" political concerns were less important, and thus resources could be concentrated on key projects, such as the implementation of congestion charging. In doing that the Transport for London and the Mayor himself did an excellent job of engendering trust through open communication, a clear and well-composed presentation of the problem and the proposal, and the development of first-rate communication tools, including a highly effective website. In this way through consultation as well as promotion better understanding of the scheme and its benefits was achieved.

3.1.3.4. Road Network System

The capacity of the city center reached its limit. As Transport for London announced the road network in Central London has not been extended since the medieval age. Furthermore, the extensive uses of the infrastructure within the City of London have led to high congestions.

With the implementation of Congestion Charge a lot of projects and improvement schemes for road network were developed. Pedestrian, cyclist and bus priority measures were established. For example in 2007/2008 the revenues from the scheme (€ 18million) were invested in improvements of road infrastructure (Transport for London, 2009).

3.1.3.5. Public Transport System

The congestion charge forces the use of public transportation rather than private cars. The ROCOL (2000) report predicted that the public transport travels would rise by 3% after the implementation. The rise in the number of individuals entering central London by bus actually reached almost 50 percent. From the 2002 autumn to the autumn of 2003, bus passengers entering the charging zone in the morning peak period by bus rose by 29,000, an increase of 38 percent. Transport for London (2004) estimates that half of the increase is due to the improved bus service and half to the congestion charge.

The reason that the rise in bus ridership exceeded expectations can be found in the "virtuous circle" principle as mentioned above. Because of the higher price of individual car use, many people switched to public transport, which increased the investment in this sector *(Small, 2005).*

The revenues were used for improvements in public transport, which includes expanded bus lanes, with enforcement of roadside video cameras *(Litman, 2011*). Congestion charging has been harmonized by a range of measures designed to make public transport and other alternatives to car use cheaper, easier, faster and more reliable.

3.2. Stockholm

3.2.1. Overview

The Stockholm experience is unique. The congestion charging system was turned off after a six-month trial in the beginning of 2006. During the trial, the system reduced road traffic by 20 %, (U.S. Federal Highway Administration, 2008). When the trial ended, traffic got back to its previous stage. This correlation influenced the public positive opinion of the congestion charge system. In autumn 2005, before the trial, about 55 % of the citizens in Stockholm viewed the congestion charge negatively. After the trial this percent reduced up to 41. 59% supported the congestion charge - enough for the system to be implemented permanently *(Stockholmsforsoket, 2006).*

The system covers 34 square kilometers with 17 charging points. The cost of passing the cordon on weekdays is € 2 during peak hours (7:30-8:30, 16:00-17:30), € 1.5 during the shoulders of the peaks (30 minutes before and after peak period) and € 1 during the rest of the period 6.30-18.30. The charge is levied in both directions, implying that a return trip during peak hours costs € 4. The maximum charge per day is € 6 *(Borjesson et al., 2012).* The daily passes are about

345,000 *(Lamba, 2008).* The system uses cameras that automatically detect license plates *(Stockholmsforsoket, 2006).* Payment options include automatic account debiting, online payment, and in-person payment at shops and banks.

The system was found to be extremely cost-effective, with the primary benefits of shorter travel times valued at 600 million SEK (€ 68 million) annually, increased road safety valued at SEK 125 million (€ 14 million) and health and environmental benefits valued at SEK 90million/€ 10 million *(Stockholmsforsoket 2006).* Operating costs were 25 % of the annual revenues *(Replogle, 2008).* In addition, carbon dioxide emissions were reduced by 15 % *(EDF, 2007).*

3.2.2. Type of Congestion Charge

Similar to London, Stockholm adopted the Cordon area pricing. The system caps the daily charge. The bill is sent to vehicle owners at the end of the month and they have another month to pay.

3.2.3. Conditions needed for implementation

3.2.3.1. Institutional Capacity

- Legal Framework

In 2004 the law that authorizes the congestion charging was adopted. It has a focus on environmental protection and demand management *(CURACAO, 2007; Bhatt, et al., 2008)*

- *Technology and Enforcement*

The control points are positioned all around the charging area (Figure 6). The same ANPR technology is used in the London scheme as well.

Figure 6 Control points around Stockholm. *Source: Swedish Transport Agency, 2011*

Contrary to the London scheme, the charges are summarized in a bill ("tax decision"). The bill is sent to the owner of the vehicle. Also, they can be viewed on the Swedish Road Administration web page. The tax has to be paid by the end of the next month. The bill is sent either by regular mail, via internet, or the amount due is deducted automatically via a direct debit arrangement for maximum convenience of the end user. If the bill is not paid in time, a reminder is issued along with a 50 EUR penalty fine *(Szendro, 2010).*

Vehicle Identification Process

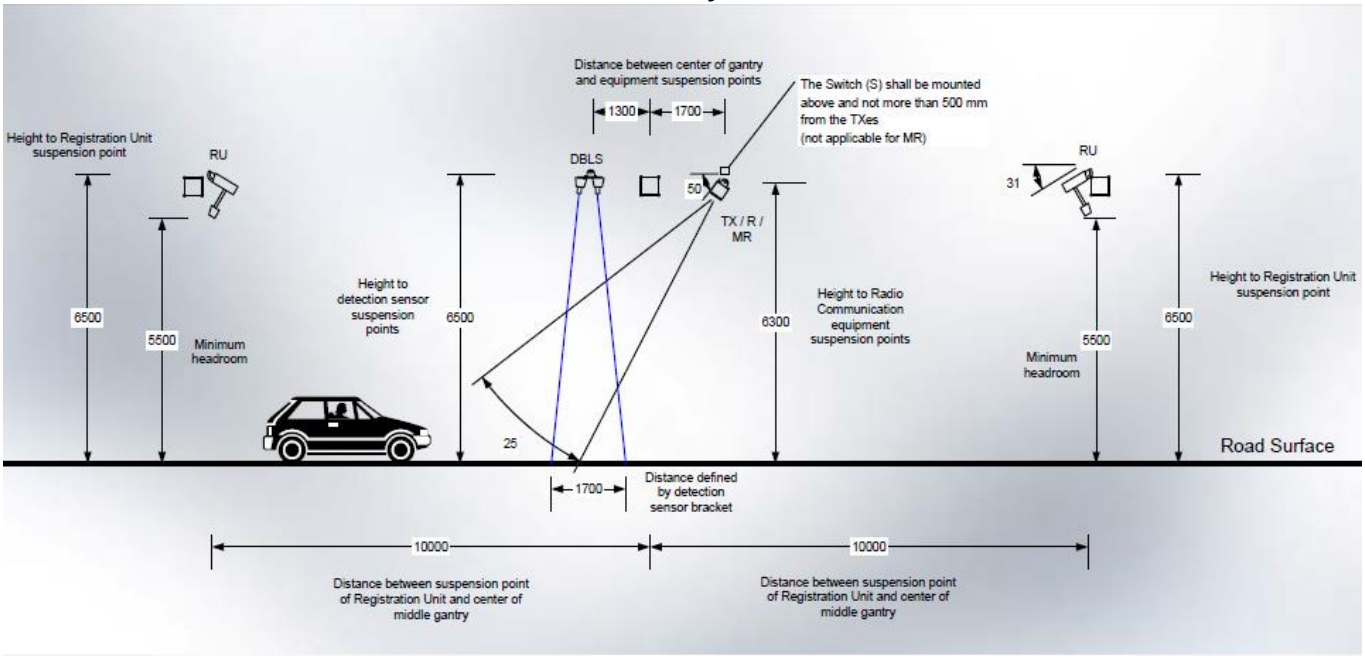

Figure 7 Vehicle Identification Process. *Source: IBM Corporation, 2006*

3.2.3.2. Political Support

In 2002 the Green Party came to power and coalition with the Social Democratic party, announced to introduce a full-scale congestion pricing program, (Bhatt et al., 2008). Decision was made to carry out a "congestion charging trial" in Stockholm. It was followed by a referendum as general and local-government elections were held. After the election, the center/right coalition gained power both at the national level and in the city of Stockholm. The center/right coalition in Stockholm had opposed the congestion charges, but had promised to follow the outcome of the referendum, so they had to ask the national Government to reintroduce the charges permanently. After a few weeks of consideration, the new center/right Government said it would do so, but as part of a broader investment package in transport infrastructure of Stockholm, to be negotiated. After the decision to include the charges in a broader city and transport investment package, no political parties have proposed abolishing them anymore.

Although the city of Stockholm was responsible for designing the charging system and carrying out the congestion charging trial, the responsibility for levying and administering the charges had to be assumed by the national government. More important, this meant that it is the national government that has the formal power over both scheme design and revenues. Although the Government promised to refund the revenues to the Stockholm region, disagreements quickly emerged regarding how the revenues should be calculated and used and which vehicles should be exempted. Further disagreements, such as whether and how charge levels should change along with inflation and economic growth can be expected. Many politicians have stated that their main argument against introducing the congestion charge was the uncertainty about the political power and ownership over scheme design and revenues.

There were also uncertainties on how the new revenue stream would affect the complicated negotiations between national and regional levels about national infrastructure grants. Most of the major transport investments in Sweden are paid for by the national government, whereas municipalities and regions are responsible for local streets and transit operation. As expected, there is often disagreement on where the boundaries between different responsibilities should be established. The politicians in Stockholm, regardless of political color had long argued they were not receiving their fair share of national infrastructure grants. Whether this claim was founded or not it meant that the arrival of a new revenue stream in the form of congestion charges was not necessarily welcomed.

Several politicians feared this would mean that Stockholm would have to pay an even larger share of transport investments with its own resources. The government, they argued, would point to the revenues from the congestion charges and claim that Stockholm obviously needed even fewer national infrastructure grants than before. The solution to this dilemma was the so-called "Cederschiöld agreement", named after the chief negotiator was appointed by the Government. In this agreement, the charge revenues were funding parts of a major transport investment package, where the national government also made a major funding commitment – much larger than had been the case for a long time. The charge revenues were earmarked for the road investments in the agreement, while the substantial rail investments were claimed to be paid from other sources. An agreement was settled in late 2007, eventually only between center/right parties on the national and regional levels.

This task was assigned to the National Road Administration, and later moved to the National Transport Agency. The Stockholm congestion charging has five years of experience proving the vital importance of the support to be secured on behalf of the regional politicians from all major parties. Ironically the Cederschiöld agreement contained several investment projects the Left and Green parties (the original main proponents of congestion charges) had been opposing for many years. The result was a situation where all parties agreed to keep the congestion charging having different leading motives (ranging from car traffic reduction - Lefts and Greens, to investment funding - Centre/Right parties) and different opinions on how the revenues should be used *(Borjesson et al., 2012).*

3.2.3.3. Public Acceptability

Implementation of congestion charging in Stockholm has been discussed for over twenty years. During this time many studies and pricing proposals and public consultations were carried out. The government implemented the congestion charging after conducting of six months trial test in 2006, and adopted it on a permanently basis in 2007.

It could be concluded that in general there is a preliminary time period necessary for public attitude to be changed and become more positive. For example in 2005, just before the implementation of the trial test about 55% of the citizens were against the congestion charge while in 2006 right after the trial 53% from the citizens were against it (CURCAO, 2007).

Municipalities surrounding Stockholm were not eligible to vote and the people were not satisfied since most of them were supposed to drive every day to work throughout the congestion charged zone. The majority of residents were against the permanent implementation of the congestion charging in Stockholm. Nevertheless, the program had been put in place permanently in August of 2007 and since then gains more positive public attitude *(Bhatt et al., 2008).*

3.2.3.4. Road Network System

The Stockholm region is divided into 1246 zones. For easier and clear management the municipalities have been divided into ten zones as shown in Table 4 according to *Berdica (2000).* Each zone is under control and maintenance of the Stockholm municipality. The road infrastructure is constantly renovated and the network system is well organized providing good connections with each part of the city.

Denomination	Description	No of zones
0 External areas		6
1 Western Stockholm		88
2 North inner City		133
3 South inner City		44
4 Southern Stockholm		135
5 North-western region	Solna, Sundbyberg, Sigtuna, Upplands-Väsby, Sollentuna, Upplands-Bro, Järfälla, Ekerö	250
6 North-eastern region	Danderyd, Lidingö, Vallentuna, Täby, Österåker, Vaxholm, Norrtälje	248
7 Eastern region	Nacka, Värmdö	87
8 Southern region	Tyresö, Haninge, Nynäshamn	96
9 Western region	Salem, Huddinge, Botkyrka, Södertälje, Nykvarn	159
		Sum =1246

Table 4 Description of the aggregated zones*. Source: Berdica, 2000*

3.2.3.5. Public Transportation System

Before the implementation of congestion charge, the public transportation system was improved by extending bus lines, new buses, and improvements of rail-bound lines, new park-and-ride places and bus stops *(Algers, 2008*).

However, the efforts to improve public transport have not led to any visible effect on the total number of public-transport journeys during autumn 2005 - before the start of the Stockholm trial test. However, it boosted the effect of the congestion charge by making the switch from car to public transport easier.

Public-transport travel was about 6% higher in spring 2006 than in spring 2005. The congestion tax seems to increase the public-transport use by about 4.5% while higher petrol prices and other external factors were most probably responsible for the rest relatively small increase (about 1.5%). Between autumn 2005 and spring 2006 the number of new passengers, who earlier used their cars for transport, was relatively low compared to the reduction in the number of passages over the charge cordon - 22% *(Hugosson and Eliasson, 2006).*

3.3. Singapore

3.3.1. Overview

Singapore has along experience with congestion charging. After one year of public debate, Singapore implemented s.c. paper system in 1975 based on daily licenses for vehicles entering the central zone during peak traffic hours. After the implementation the traffic in the charging zone decreased by 44% and the traffic speed increased by 16% *(Keong 2002, EDF 2006).* Ten years later the traffic levels remained 30% below the original level, even though the car ownership increased by 77% and the jobs increased by one third *(Keong, 2002).*

In 1998, the system was upgraded by implementing Electronic Road Pricing (ERP).This transition was fundamental for the Singapore's urban mobility. The ERP provides greater flexibility for the congestion charges to be fixed based on different locations and day time depending on the prevailing traffic conditions *(Der and Yan, 2009) and t*he charge is deducted by In-vehicle Unit (IU) installed on board *(Chin and Menon 2004).*

As Raymond Lim, Singapore Minister for Transport, (2008) says: *"Of all the different measures to deal with congestion, ERP is the only one that addresses the problem directly by requiring individuals to take into account the costs of congestion caused by their driving to others… Without ERP, Singaporeans would be spending many hours in traffic snarls, just like people in Tokyo, Los Angeles and many other US cities, who pay for congestion, not with their wallets, but with the time that they have lost, stuck in traffic gridlock."*

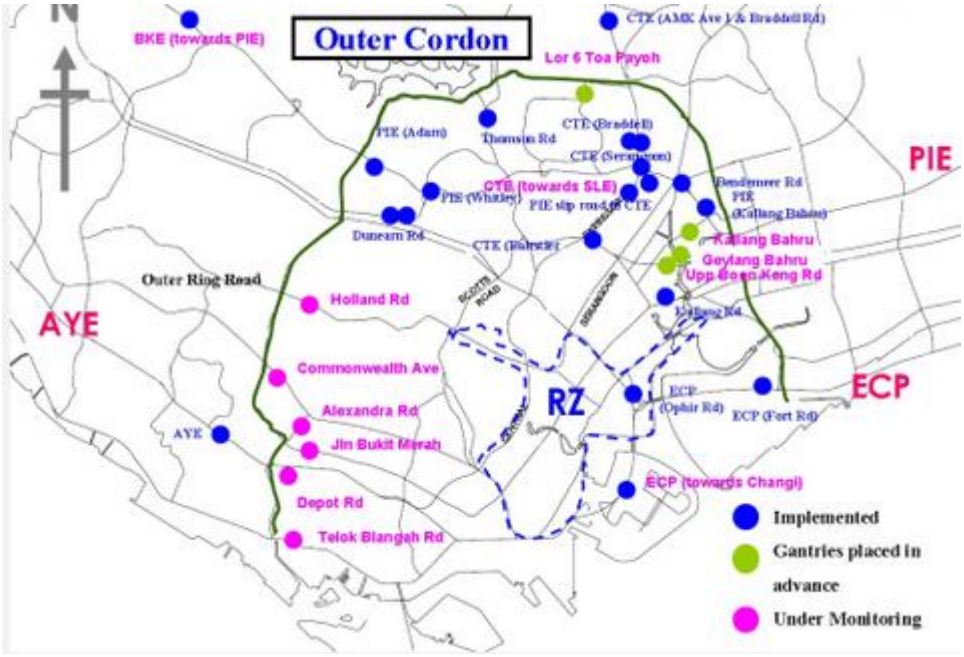

Figure 8 Congestion charging map. *Source: land Transport Authority, 2007*

3.3.2. Type of Congestion Charge

Singapore adopted the Multi-road congestion charge. The electronic tolling system triggers drivers when they pass the toll points. The Singaporean electronic pricing system is based on gantries placed across busy roads.

3.3.3. Needed conditions for implementation

3.3.3.1. Institutional Capacity

The In-vehicle units (IUs), which detect the vehicles, are installed permanently in 680,000 cars at no charge to the user, *(Keong 2002, Singapore Land Transportation Agency 2008).* The units communicate with overhead gantries at charging points and deduct the appropriate charge from a smart card (which can also be used for other transactions such as parking and public transportation) inserted into the IU. The IU and smart card used by the system work without collecting any other information to avoid any privacy concerns. In addition, the government has committed to erasing bank transaction records within 24 hours *(Keong 2002).*

ERP System in Singapore

Figure 9 ERP System in Singapore Source*: Menon and Guttikunda, 2010*

The enforcement is done by cameras which make a photograph if a vehicle does not have an IU installed or the balance in the smart card is not sufficient. Then the fine is sent to the vehicle's owner. The fine for not having sufficient balance is S$10/€ 5 and much higher for those who do not have an IU. Foreign drivers can rent an IU; otherwise they have to pay a flat fee (Singapore Land Transportation Agency, 2008). The expansion in 2008 that was projected to raise an additional S$70 million (€ 39 million) coupled with decrease in vehicle ownership taxes and also an additional bus service in the expanded zone (Lim, 2008).

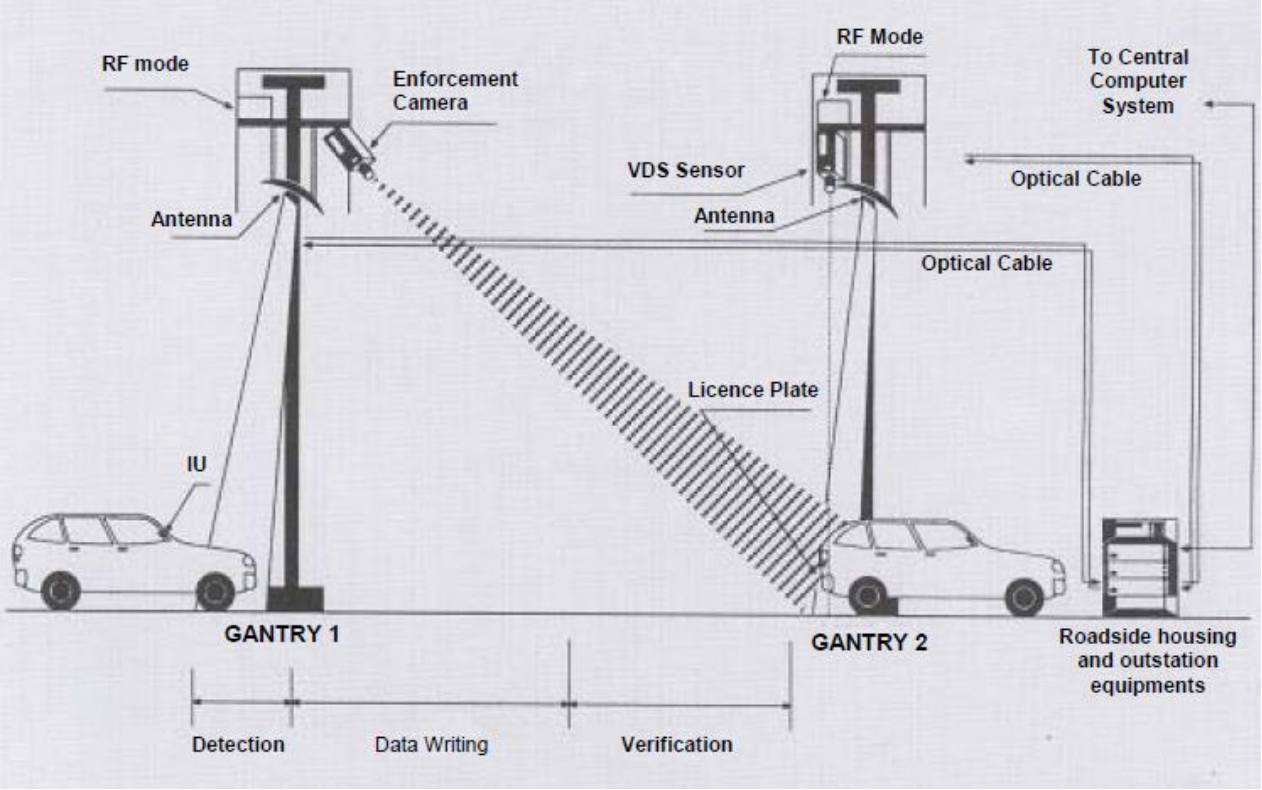

Figure 10 System enforcement. *Source: Land Transport Authority in Singapore*

3.3.3.2. Political Support

The political support is strong from the very beginning of the system implementation till now. The government and all the political parties were supporting the system, since it gave many positive results. The government still modifies and expands the system since its implementation in 1975. Nowadays, the urban mobility in Singapore is not possible to be managed without the congestion charging system (ERP).

3.3.3.3. Public Transportation system

Great developments of rapid transit, light rail and deluxe bus services were followed the implementation of the congestion charging scheme and also public transport increased its average speed due to the introduction of the scheme. This influenced the citizens to leave their cars and start using the public transport intensively. Responding to the additional demand the use of public transport has increased by 20% *(Albalate and Bel, 2008).*

3.3.3.4. Road Network System

The whole Singapore road network system has over 12600 nodes and 30700 road segments. Out of this, about 1100 nodes are major road junctions *(Liu, 1995).* The large road network system is well managed by the Singaporean Land Transportation Agency (LTA) responsible for the maintenance of the transport infrastructure. The whole road network is constantly renovating, guarantying the safety and comfort of the roads, conditions needed for any kind of road charging implementation.

3.3.3.5. Public Acceptability

It is important to underline that in this particular case the implementation of congestion pricing was possible without demonstrated public involvement. Even though the government carried out a year-long intense assessment and education program which surely influenced the implementation and also some adjustments were made in order to respond to the eventual public reaction.

The implementation of the system was deeply appreciated by the public due to the improved public transportation and the reductions in car ownership taxes. As Bhatt et al (2008) "Pricing came on board at the same time as other highly visible and welcome government actions such as large-scale provision of modern, new, subsidized housing outside the central area replacing old dilapidated "slum" housing in the center".

3.4. Lessons Learned from the Case Studies

There are important conclusions to be drawn up from the experience presented that could help the policy makers and other interested parties challenging the eventual congestion charging implementation. Particularly the specific aim is to use the derived analytical outcomes in serving the expert community and other relevant stakeholders in the city of Sofia in the initial public debates, further development of the concept and preparation of appropriate decision in a near or long term future if the situation come closer to the identified critical point of intolerable urban traffic intensity incompatible with the goals and principles of sustainable urban management.

Some basic lessons learned derived from the analyzed experience of the examined cities forerunners are presented below. The main aspects to be considered by the policy makers and city planners on distributional effects and the challenge of making congestion charging acceptable for the public are highlighted.

The associated general conclusions and recommendations are summarized in more profound and systematic way in Chapter V in accordance with the key five elements of the conceptual model developed. The related analysis associated with the prospects and implications of congestion charging implementation in the city of Sofia further elaborated in the Chapter IV is also used for achieving the necessary thoroughness and comprehensiveness.

Making Congestion Charging acceptable and assuring Political Support

The public acceptance and political support are among the main drivers of implementation of congestion charging. The associated problems usually appear due to the difficulty of explaining and convincing the public in terms of the cost of functioning, goals and positive impacts of the scheme. As *Viegas (2001)* mention in general too much focus is put to the efficiency criteria which are the most difficult to understand and convey the public. In addition the lack of public understanding and confidence shifts fears to the politicians. They also accept the pricing solution as politically not acceptable, since citizens' preferences are major determinants in the policy decisions and they usually turn into alternative ways of controlling car use *(May and Nash, 1996).*

One important obstacle to achieve public acceptance is a difficult and usually long lasting transition from enjoying free access to mandatory payment for the same access. This access is usually considered by the public as a common and individual right since it is generally assumed that demand for driving is highly price inelastic and that road pricing produces unfair effects (Jones, 1998).

High levels of public acceptance were found in London, Singapore and Stockholm. The explanation could be found in one of the most important aspects of congestion charging – the types of the revenues usage (the related projects) and their political importance and accountability. In those cases the revenues are used mostly to fund road projects. In the cases of Stockholm and London the resources are channeled to improved public transportations. Probably for this reason the opposition decreased in short time after adoption. Oberholzer-Gee and Weck-Hannemann (2002) argue that the revenues coming from the congestion charging can also be used to overcome the political resistance since policy makers favor instruments that weaken the government's budget constraint and funds can be returned through compensations.

In terms of the alternative use of revenues, some surveys also have pointed out that the public is more prone to support environmental programs rather than traffic management reforms *(Glazer and Niskanen 2000; Jaensirisak, Wardman and*

May 2005). This partly explains why Jones (1998) defends the importance of claiming for other adoption of other objectives and goals instead of simple raising of public funds. Other authors also support the view that financing environmental investment packages might help achieving sufficient levels of public acceptance *(May and Nash, 1996; Oberholzer-Gee and Weck-Hannemann, 2002).*

As mentioned in most cases a clear pattern could be recognized that opposition against congestion charging diminishes shortly after its implementation. Therefore, trial testing and referendums are among the instruments proving to be extremely efficient before official adoption of the scheme. The trial test in Stockholm was a key factor in achieving public support to the measure. Another possibility is to impose congestion charges on the basis of preliminary concluded political agreement thus preventing the political use of this issue against the government or municipal authority. Depending on the specifics of the political context such kind of agreements might relay that after short time the public will get used and approve the measure and opposition intensity would fail without significant negative impact on the electoral attitudes and preferences. Shade and Shlag (2003) state that similar reaction appears as well when the measure is imminent and the opposition is worthless.

Road charging and Social Equity effects

Besides improved urban traffic performance and cost efficiency, other objectives are usually pursued or taken into consideration under the congestion charging adoption. Environmental goals and social equity concerns should be integrated and properly addressed in the project in order to facilitate overall justification and positive attitudes. Moreover, these dimensions in some cases might play vitally important role in assuring minimum required level of public acceptance of road pricing as was previously mentioned. Viegas (2001) includes social equity among the critical acceptability factors since it strongly relates to the perception of social fairness. The main problem from the social equity point of view is the exclusion of the broad range of users from the previously free of charge access when switching to the congestion charging. This range of users is usually the low to middle -income group of citizens who are forced to shift to other public transport modes.

It is important to analyze the distributional effects and consider the impact of the type of alternative use of the revenues in order to compare them with the s.c. net welfare surplus. May and Nash (1996) consider that the net effects are crucially influenced by how the revenue from road pricing is used. In the same way, Eliasson and Mattsson (2006) consistently find for Stockholm that the net impact of the project is decided on the criteria how to spend the accumulated revenues.

On the other hand, residents and employed in the city center are the most affected by the charges, and discounts have to be adopted in response to the eventual negative impacts on the low income, vulnerable and other specific groups of citizens. Therefore, the use of the revenue raised by congestion charging becomes a central aspect of social equity effects and their public perception (Small, 1992). In most cases this revenue has been channeled to fund public transport supply. Viegas (2001) identifies two major advantages associated with this policy. First, it reduces the costs (loss of utility) from mode change and second, it favors the low-income group of citizens who are usually mostly use the public transport. In addition, this policy helps obtaining a wide public support. Banister (2003) also concludes that charging revenues must be reinvested in the transport system in order to overcome equity concerns favoring the low-income groups of citizens.

General results

Urban road charging once implemented and after accumulation of sufficient experience has shown interesting results explaining the success of this tool in the reduction of peak-time traffic, an overall transport demand and associated environmental cost. In the cases of London, Stockholm, Singapore this measure has provided significant reductions in the congestion costs associated with the entrance to the city centers, providing revenue invested in public transportation or road construction and improvement projects. Moreover, the measure increased city average car speed and improved the private and public transport use performance *(Albate and Bel, 2008).*

Table 5 below presents a comparative assessment of some basic indicators and features characterizing the overall performance of the Singapore, London and Stockholm Congestion Charging' Systems.

Comparison of Singapore, London and Stockholm Congestion Charging System

	Singapore	London	Stockholm
Year of introduction	*1975*	*2003*	*2007*
Area coverage	*7,25 sq km*	*22 sq km*	*34 sq km*
Vehicle entries into the zone (week day)	*235,000*	*292,000*	*345,000*
Vehicle entries per sq km per day (th. Cars)	*32,4*	*13,3*	*10,1*
Operational cost (annual)	*€ 6.75 mln*	*€135 mln*	*€ 19.5 mln*
Revenues (annual)	*€ 39 mln*	*€ 270 mln*	*€79 mln*
Cost effectiveness	*82,7%*	*50%*	*75,3%*
Operational Revenue per sq km (mln)	*5,3*	*12,3*	*2,3*
Net operational revenue per sq km (mln)	*4,5*	*6,1*	*1,8*
Average charge	*€ 1/trip; € 0,46 /day*	*€ 11.8 /day*	*€2.7 /day*
Average charge per car entry (under assumption of 220 week days annually)	*€ 0,75*	*€ 4,2*	*€ 1.0*
Congestion reduction	*13 %*	*30 %*	*25 %*

Table 5 Comparison of Singapore, London and Stockholm Congestion Charging System*. Source: Own comparison based on the case studies' overview*

Specific results distinguishing gender suggest that men are more affected than women by the transportation reform which at the same time received more passengers and as a consequence more revenues. In fact, modal split is found since a decrease of private cars use in favor of public transportation is easily achieved. It is also considered that road pricing improve the environment in the city since reductions of air pollutants and greenhouse gases are found in all cases. On the other hand, re-routing and the use of other time periods to shift trips are recognized and must be considered by the planning authorities.

The political context and actual situation may also play an important role in decision making as show the experience of London and Stockholm where the opposition used the issue against the incumbent government *(Albate and Bel, 2008).*

On the contrary when big parties agree on the need to use congestion charges to restrict traffic intensity, the measure is easily introduced in despite public opposition.

Trial testing periods are also recommended before any referendum to take place since it is found that opposition against the measure declines after its introduction, especially if the revenues collected can provide better public transport and it is made visual for the citizens. The revenues usage and the fairness or social equity implications are considered crucial to achieve sufficient levels of public opinion support *(Albate and Bel, 2008).*

Chapter IV: Implementation of Congestion Charge in Sofia

The fourth chapter examines the possible implementation of congestion charging system in the city of Sofia by means of basic review of the mobility situation, current developments and prospects in relation to the necessary conditions under the proposed improved conceptual model and feedback received from the . The conditions that are not already met or the evidence of information is unclear will be outlined on the basis of feedback provided by interviews of preselected panel of experts including representatives of authorized institutions. At the end basic recommendations and conclusions are made for the eventual future congestion charging implementation in Sofia further extended in the Chapter V of this work.

4.1. Current mobility situation in the city of Sofia

As a capital, Sofia is the economic and administrative center of Bulgaria and a national gravitating point for business, industry, transport. It is also a crossroad of s.c. Pan European Transport Corridors Network.

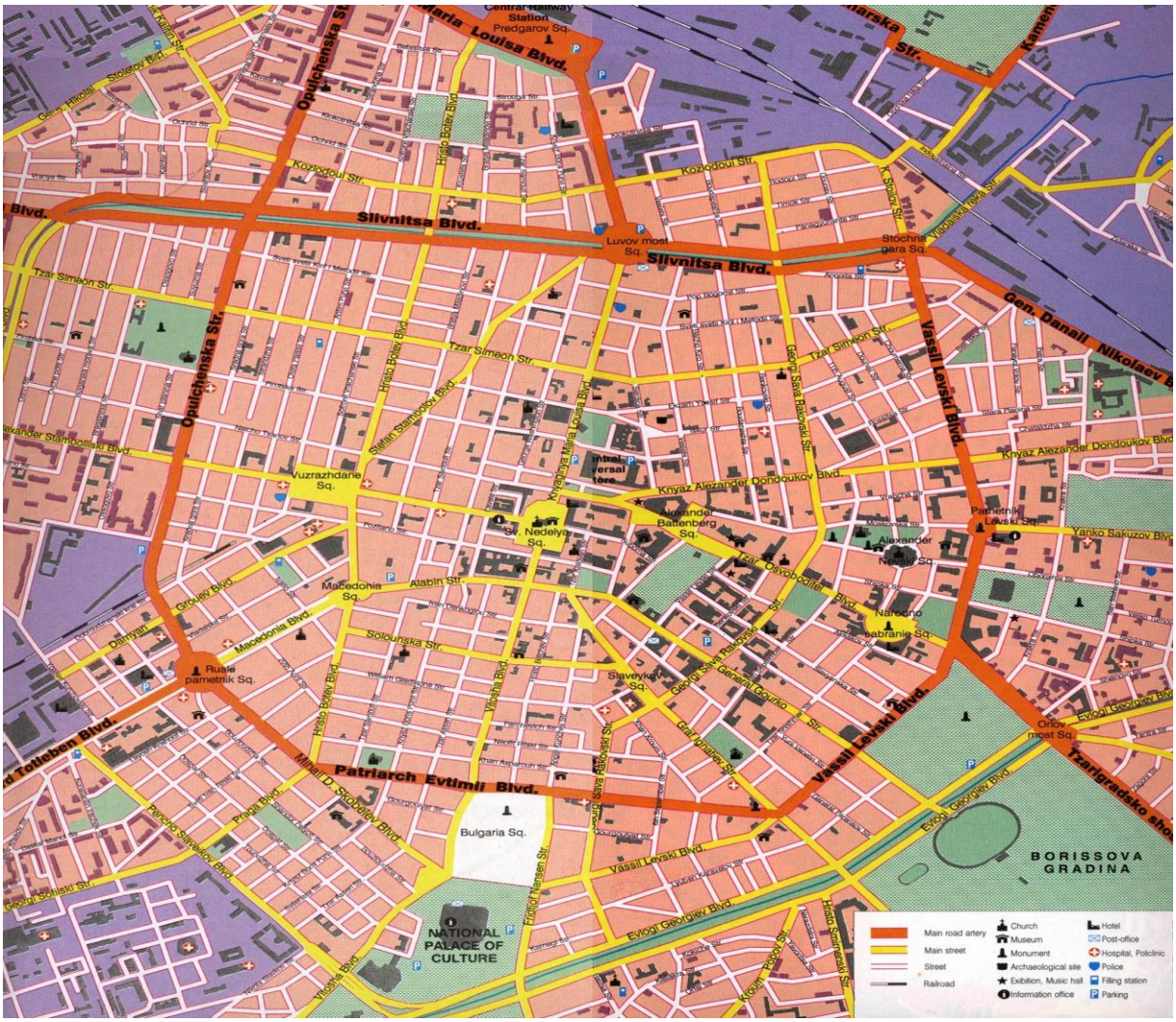

Figure 11. Sofia Centre Map. *Source: mappery.com, 2013*

The public transport system has been well developed and still is the dominant mode of urban transport (49% of trips in 2009 according to the Masterplan of Sofia, 2009). Its modal share has been rapidly decreasing in the past decade (by 16% within 9 years) at a simultaneous increase of car modal share. One of the reasons is the low speed of public transport mostly due to the traffic congestions. Decrease in public transport modal share correlates with increase of per capita income and many people seem to switch to car as soon as they can afford it.

Sofia public transport is largely impaired by traffic congestions and thus remains always slower that private car. On the other hand the modal share of walking is distinctively low compared to other cities in Europe - 11% in 2009, and cycling is still not popular as it takes 1% of the trips *(Masterplan, 2009).* There is still no culture to use the bicycle as a congestion resistant and fast way of short distance transportation, mostly due to the underdeveloped infrastructure.

The car ownership has progressively grown as far as Sofia is among the leaders on an EU wide scale. According to Eurostat in 2006 the city ranked very high among the European capitals in terms of cars per capita (see the table in Annex V) ahead from Paris, London, Vienna or Budapest.

As expected the average car registrations for European countries is significantly below the average number related to capital cities.

It is important to mention that the number of automobiles has risen significantly in the last 25 years from 205 cars per 1000 inhabitants registered in Sofia municipality in 1988 (250 000 total registrations in 1989) to 800 000 in 2005 according to Stanilov (2006), to one million according to some statements of the municipal authorities' officials or to 612 cars per 1000 inhabitants in 2011 according to Eurostat overestimations above presented.

Nevertheless as clarified by our own estimations this means that the predicted motorization levels for 2020 of 520 automobiles per 1000 inhabitants have already been reached as noticed by many authors (Mott McDonald, 2009 and 2011). Increase in the car ownership levels has been historically coupled with increased car use and growth in travel intensity if no compatible alternatives (e.g. reliable public transport, cycling routes etc.) are made available. This trend has been confirmed empirically in many European cities and is clearly observable in Sofia nowadays (Raeva, 2007).

It is also important to mention that it is widely accepted that growth of the car ownership could not be directly linked to the increase of personal income or overall GDP growth or level achieved. As mentioned there are many examples theoretically and practically proven that the point (level) of saturation after which in many cases the economic development, associated with high level of GDP per capita and personal income turns into more effective, efficient and sustainable urban mobility management and behavior. With some exceptions this means that the level of car ownership will reach a peak and even will decrease over time reaching the point of saturation which is largely described in the literature and proved by the statistics[28].

After the post 1989 market and political liberalization, car ownership has increased from around 200/1000 to more than 520/1000 vehicles per 1000 inhabitants the forecasted level for 2020 under Sofia *Masterplan (2009).* Since then the car ownership has almost tripled reaching **655 754 or 528 cars per 1000 inhabitants by the end of 2012**[29] which is accepted

[28] E.g. Brad. "What Happens When We Reach 'Peak Car'?", TIME, Sept. 25, 2012 (http://business.time.com/2012/09/25/what-happens-when-we-reach-peak-car/)

[29] Own calculations based on the Ministry of Internal Affairs registration data announced in October 2013 (http://www.vesti.bg/novini/v-sofiia-ima-655-754-koli-5996910) and National statistical Institute's data on the city population by the end of 2012. As mentioned there are also other different unreliable quotations of the number of registered cars in Sofia cited by

as most reliable data. As Sofia's streets' network was never designed for today's levels of car traffic, this also lead to an increased level of traffic congestions at many crossroads and connecting arteries of the city and thus to common societal and economic losses in efficiency. The pick of congestions has been reached in 2008 before the worldwide economic recession which impacted severely the Bulgarian and Sofia economy. Several major factors played decisive role – high level of economic and employment growth, positive real growth contributing to the highest level of salaries and lowest unemployment rate in comparison to the rest of the country and migration to the city due to better employment prospects.

All these and other factors including legislation which facilitates concentration of administrative institutions and businesses in the capital city have attracted companies, organizations and employees and their families from the entire country. After crisis and the end of s.c. construction and real estate's bubble, the economic situation has changed significantly effected in a higher level of unemployment, diminishing rate of new construction undertakings and massive withdraw of labor force attracted for temporary residual and employment in Sofia in the time of economic pick. Despite all these developments, including significant improvements of the transport infrastructure (extension of subway lines, crossroads and viaducts etc.) the car use is still more desirable which led to the increasing level of congestions. A short illustration at the national level of the individual behavior in this respect gives the figure in Annex VI.

As mentioned in Chapter II of this work applying the criteria outlined in the quoted study assigned by the EU Commission - TREN/A4/103-2/2009 (including - Population density, Modal share - Private Vehicles, Public Transport, Walking and Cycling, Public Transport Net density) and car ownership, **Sofia could be classified as a "semi critical" city**. It also went beyond the alarming value of the proposed criteria in this work of the s.c. "critical level of traffic intensity" (above 20% TomTom Traffic Index with annual time delay per commuter of 45 hours) associated with the necessity of proper consideration of the congestion charging alternative.

There are clear evidences that in a case of more significant economic revival in a short or medium term perspective (achieving 4% growth in the National GDP and local unemployment rate of less than 3-5% etc.) the situation between 2006 and 2008 (high congestion levels) could be easily repeated. The expected impact of the counter factors such as improvements of the public transport (extension of the subway lines, tram and bus transport) and road infrastructure such as extension of lanes, more multilevel junctions (while neglecting the s.c. induce travel effect) will not probably overcome the effect of economy and income's growth and additional migration on the raising traffic intensity and congestions in the mid to long term perspective.

This has to bring attention of the politicians, policy makers and city planners to the necessity of adoption and following of an overall city mobility policy and management goal that could be formulated as follows: assuring all necessary measures and conditions to (keep or) improve the city current position not allowing it to turn into situation typical for the cluster of s.c. "critical cities" (for reference - Table 2 of this work).

4.2. Conditions for congestion charge implementation

The proposal for introducing a congestion charging has been raised for the first time by former Deputy Mayor of the city of Sofia, Mr. Velizar Stoilov in 2004 in relation to the discussion of introduction of the paid parking alternative which later become effective. In 2006 the congestion charging alternative has been further discussed on the seminar organized

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local officials such as of 850 thousands and even more than one million. It is important to mention that the significant number of new car registrations are combined with high rate of deregistration due to export by private individuals and physically depreciation of the old car park inherited.

by the Center for economic development[30]. Some follow-up Internet discussion has contributed to the initial testing of the public opinion as presented in part 4.2.5 of this work. Later on at a conference held in 2010 Deputy city Mayor, Mr Christov stated that the implementation of the congestion charging in Sofia is not feasible due to the intensive road construction and improvement of the alternative routes which bypass the city center.[31] Briefing the experience of London, a recent study concludes shortly that "unless public transport conditions are not improved and the motorization rate halted, the city will experience severe mobility problems in the upcoming years. Thus, implementing a congestion charge scheme that is similar to the London model seems to be the best option"[32].

To the best of our knowledge these are the only examples related to the publicly or expert held discussions on the congestion charging implementation in the city of Sofia. More importantly the official urban planning documents including the Master plan of Sofia (2009), most representative and thoroughness studies assigned by the municipal authorities and other relevant documents[33] have not addressed the issue at all.

The above arguments prove the previous conclusion that ***Sofia is positioned at the very beginning stage of s.c. Congestion Charging Life Cycle*** *(point "A" of Fig. 4 of this work).* It further underlines the fact that all necessary steps related to addressing congestion charging alternative are forthcoming if the follow-up officially assigned preliminary assessments and studies found this policy alternative feasible, effective and efficient. This include but not limited to the clarification of its role in the sustainable urban mobility policy mix (as referred in the Table 4 of this work), conducting comparative, cost benefit and impact analysis, initiating communication and public campaigns, changes in the relevant legislation and regulations, enhancement of the institutional capacity, taking the official (political) decision etc.

4.2.1. Institutional capacity

The transport policy, planning and administration in the municipality is shared between four major entities: 1) Standing Committee to the Municipal Council on Transport, Transport Infrastructure and Transport Safety; 2) the Transport Directorate to the Deputy mayor of transport consisting of three sections - General Transport, Public Transport and technical surveillance and Transport maintenance; 3) Transport infrastructure directorate consisting of two sections – Traffic organization and safety and Construction and repair of road infrastructure; 4) The Sofia Urban Mobility Centre EAD (SUMC) as presented in the Figure 13 bellow.

We assume that all four entities would play critically important role in a case of the eventual congestion charging adoption, including coordination of initial assessment and investigation, public communication, preparation and advancing the decision to be taken, interaction with the designated national authorities, preparation of draft amendments to the existing legislations and regulations, surveillance of the technical design and commissioning of the equipment, follow-up administration and maintenance. At the level of two directorates reporting to the Deputy City Major of transport the most critical role would play:

[30] A press release followed the conference has quoted a quite optimistic judgment that "If the city Council adopt the idea its technical and overall adoption will take about six months" (http://www.segabg.com/article.php?id=297062).

[31] http://www.vesti.bg/pari/taksa-zadrystvane-bila-neprilozhima-v-sofiia-2846031

[32] Zeyghami, A. and David Gogishvili. Urban Mobility Issues in Sofia: Between Public and Private. Sofia 2013, pp. 44.

[33] General Traffic Management Plan on the territory of city of Sofia. Mott MacDonald. 2009 and 2011 (in Bulgarian); Stoyo Stoev. Development of the public transport in city of Sofia. Sofia, 2012 (in Bulgarian) and other authors.

- the Public Transport and technical surveillance section of the Transport Directorate responsible for the analytical tasks, forecasting, strategic planning, including amendments to the General Transportation scheme, Modal split, pre investment assignment, Public communication,
- Transport infrastructure Directorate (presented in the Annex VII) responsible for traffic organization and planning, construction and maintenance, and coordination of tendering procedures etc.

The Sofia Urban Mobility Centre EAD (SUMC) consists of the following directorates:

•Public Transport Directorate,
•Parking and Mobility Directorate
•Development and Administrative Activities Directorate,
•Internal Control Directorate,
•Marketing and Economic Activities Directorate.

The main functions and responsibilities of SUMC are as follows:

•development of analysis of environmental and operational aspects of public transport in Sofia;
•implementation and operation of intelligent transport systems for public transport;
•organization, management, supervision and finance of the Sofia public transport as an integrated process;
•issuing of transportation documents and collection of the transportation revenues;
•operation of information-management system for monitoring and supervision of the traffic, based on GPS-identification;
•operation of unified automated fare collection system (ticketing system);
•advertising and information services in public transport;
•finance, construction, operation and maintenance of parking, garages and open space parking spaces in Sofia – owned by Sofia Municipality;
•lending of parking spaces;

As the public transport company in Sofia SUMC EOOD is responsible for:

• organization, management, supervision and finance of the Sofia public transport as an integrated process;
• issuing of transportation documents and collection of the transportation revenues;
• unified transport operations planning in Sofia, vehicle movement time-tables, routes optimization;
• operation of information-management system for monitoring and supervision of the traffic, based on GPS-identification;
• implementation and operation of unified automated fare collection system (ticketing system);
• advertising and information services in public transport;
• infrastructure maintenance, repairing and construction, including: railways, contact and cable nets, rectifier stations and outdoor equipment
• parking and mobility.

The SUMC' TRAFFIC COORDINATION, CONTROL AND SAFETY DEPARTMENT receives permanent information for the overall conditions and changes in the performance of the city public transport through its chief dispatcher (imposes coordinates and controls its performance). The department has decision-making power under provisional organizations of the traffic, which have been necessitated by emergency situations and have the relevant skills, experiences, technologies and previous projects

One of SUMC's main goals is to continuously improve the quality of public transport service. With this respect during the last few years the company has implemented a range of projects:

- GPS surveillance system – developed and implemented in cooperation of Bulgarian company MUSAT. The system coordinates controls and monitors the operation of all the public transport vehicles.
- Electronic information boards in public transport stops in Sofia and GPS for surveillance of the position of each vehicle. Electronic information boards are installed in most of the stops in the centre of the city for providing information to the passengers on real time movement of the vehicles.
- Virtual electronic boards – a pilot project allowing passengers to access the information from GPS system (time-table in real time) through SUMC's web page.
- Announcement of stops in the vehicles using GPS system.
- Electronic ticketing system - SUMC has installed and implemented a new electronic ticketing system in the Sofia public transport.
- Parking – SMS parking

In a case of eventual decision for adoption of the congestion charging **the Parking and Mobility Directorate** might need to be further restructured for developing new functions and responsibilities for administering of the system. Further the city council need to take an advance decision for development of additional and enhancement of the existing administrative capacity and expertise.

The strengths, weaknesses, skills, knowledge, competence, and overall capacity of designated governmental and municipal institutions responsible for urban mobility management in Sofia were assessed in the General Traffic Management Plan on the territory of city of Sofia (Mott MacDonald, 2009 and 2011). Since 2007 when Bulgaria joined the European Union, the Bulgarian governmental institutions became more transparent, organized, responsible and able to operate at high operating standards with better expertise panels and complying with the stricter requirements and rules. Especially this valid to enhanced the capacity in managing big infrastructural projects financed by the EU structural and cohesion funds (subway extension, improvement of the primary roads and highways etc.).

The basic legislation and secondary regulations (Decrees of the Councils of Ministers and Sofia Municipal council) relevant to the eventual adoption of the congestion charging alternative could be summarized as follows:

- Law on Regulation of the Territory
- Law on Regulation and Build-up of Sofia Municipality
- Law and Regulation on the road traffic
- Ordinance No 1 (17.01.2001) from for organization of the road traffic
- Ordinance No 2 (17.01.2011) on signalization used for road marking
- Ordinance No 2 (29/06/2001) on planning and design of transport – communication systems in the urbanized areas
- Ordinance No 18 (23/07/2001) on road signalization with road marks
- Norms for Planning and Design of Transport Communication Systems in Human Settlements of 11 October 1994
- Municipal ordinance on the organization of road traffic on the territory of the Sofia Municipality (last amended 2009)
- etc.

In a case of eventual adoption of the decision to implement congestion charging the above and other regulations need to be reviewed thoroughly and amended in accordance with the initial design and model selected and identified legal gaps. As mentioned the eventual implementation of congestion charging has been discussed in narrow experts' circles occasionally but no practical steps took place even for preliminary assessment, comparative studies, clarifying its potential and role as a part of the urban mobility policy mix. We assume that the he most prevailing reasons are not associated with the eventual lack of institutional capacity. This is also proved in the implementation of other similar though comparatively softer but effective measures such as parking charges, in order to manage traffic problems and minimize traffic and car use demand during economic peak (2006-2008). Nowadays, municipal institutions have the minimum required initial capacity to carry out all necessary preliminary assessment and preparatory measures and in a case of political decision to adopt congestion charging as far there are available expertise and designated authorities, able to operate the implementation process and follow-up functioning.

As Ivan Kostov (interviews' annex) states "*Congestion charge could be introduced by a decision of the Sofia Municipal Council, and there is an available expert capacity."* Apart of his opinion that the Institutional Capacity is available and adequate, he thinks that there is still a need of supervisory bodies and engineering controls.

On the other hand, Nedelcheva (interviews' annex) says that according to the developed models of blue and green parking zones, it is possible to introduce the congestion charge, because of the gained experience from these urban mobility control instruments. However, the process requires expertise and careful study and implementation.

4.2.2. Road network

As mentioned the capital is the most developed transport center of Bulgaria being major junction point of the key road and rail routes in Bulgaria – Trakiya Highway and Hemus Highway, Class A roads E 80, E 871, E 79 etc., the railway destinations Sofia-Burgas, Sofia-Varna, Sofia-Kulata, Sofia-Vidin, Sofia-Kalotina and Sofia-Svilengrad. The biggest international airport in the country is also located here. As clearly explained on the web page of the Municipality of Sofia, it is an "unique juncture of four global transport destinations: the inter-continental diagonal main Northwest-Southeast route (London-Budapest-Sofia-Istanbul-Calcutta), the meridian-bound Euro-African main route (Helsinki-Moscow-Sofia-Thessalonica-Cairo), the diagonal Euro-African main route (Tunis-Duras-Sofia-Bucharest-Odessa-Omsk) and the emerging transport corridor around the 40th parallel from the Caspian Sea via the Black Sea towards the Adriatic Sea (Potti-Varna-Sofia-Skopje-Duras). Three of the Pan-European Transport Corridors cross on the area of Sofia District:

- Corridor No. 4 – Budapest-Vidin-Sofia-Thessalonica (Istanbul);
- Corridor No. 8 – Duras-Skopje-Sofia-Burgas-Varna;
- Corridor No. 10- Belgrade-Sofia-Plovdiv-Istanbul."

As Mot MacDonald (2009) states the structure of the main city street network is of a hierarchical nature (Figure 15 below), with the classification of the network and its parameters having been worked out in compliance with the Norms for Planning and Design of Transport Communication Systems in Human Settlements of 11 October 1994. The proposed structure and configuration of the network outlines the following characteristics:

- It encourages the transition from a mono centric spatial structure of the city to polycentric spatial structure with tangential-radial configuration of the main street network[34];
- The major entry and exit points are developed further as follows: Tsarigradsko Shosse Blvd., Botevgradsko Shosse Blvd. and Vladimir Vazov Blvd. from the east and Slivnitsa Blvd. and Lyulin Highway via a by-pass of Lyulin Housing Estate from the west and southwest;
- Development of systems of tangents provides an opportunity for high-speed transition of the traffic flows;
- The proposed network features a density of 3.7 km/sq.km, with an estimated level of car ownership of 520 vehicles per 1000 inhabitants (as proved already overcome) and a modal split level of 45 percent of car trips.

[34] The concept adopted by the General city spatial plan. 2009 (http://www.sofproect.com/Images/web_maps19112009/33.pdf

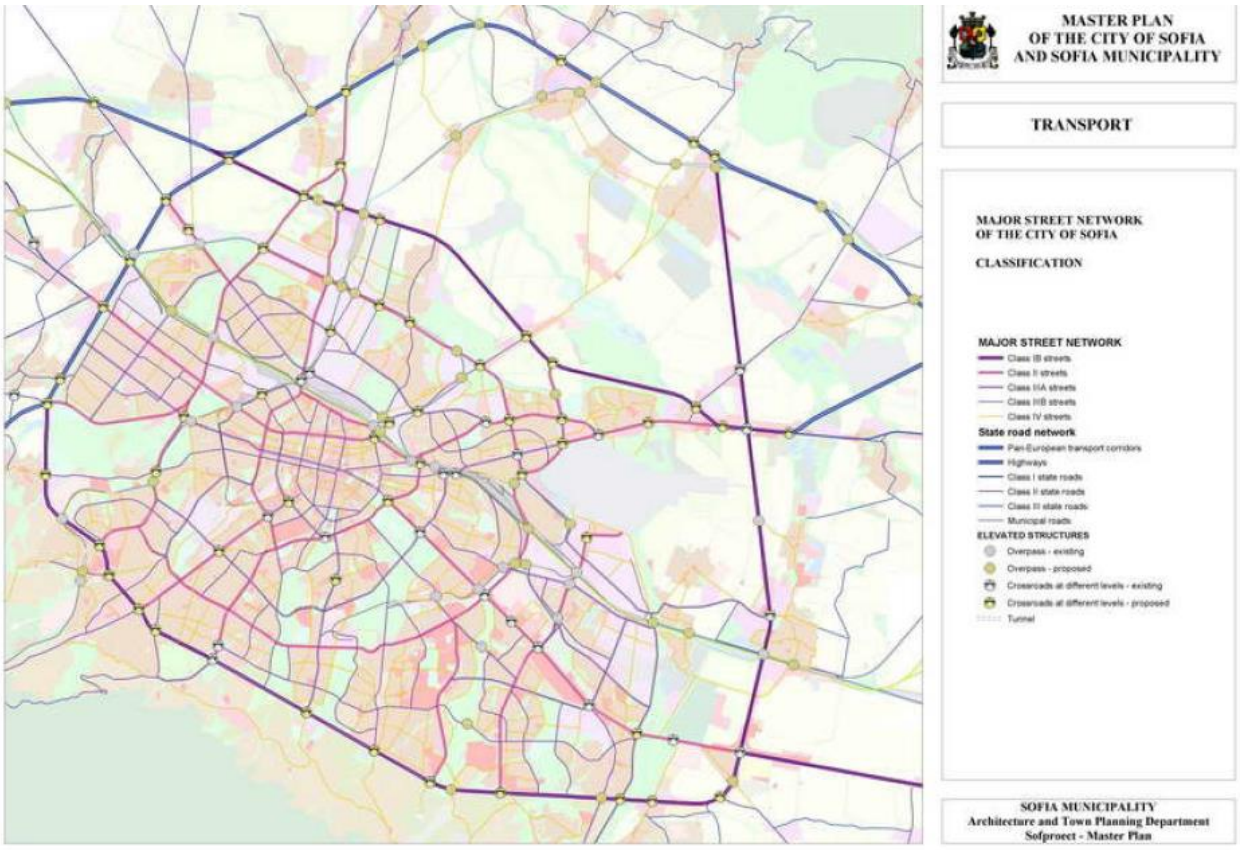

Figure 12 Structure of the main street network, 2004 *Source: Masterplan of Sofia, 2004*

The functional classification of the main street network comprises four categories of the streets: Class I (high-speed city highways), Class II (city highways), Class III (district arteries), and Class IV (main streets). Classification of the streets is aimed to serve the traffic management, road construction, facilities extension and maintenance. On the other hand, it constant monitoring and review could enable eventual selection of zones and streets to be considered for eventual congestion charging. The next Figure presents the routes of the public transport the urban area which entire length is 1465 km. It is important to clarify again two parameters such as Road network extension density and Public transport density which play an important role for comparative research, urban and traffic planning and eventual congestion charging adoption of the city of Sofia. A reflection based on the EU commissioned study to the main classification of the city clusters is already provided (Table 2 to this work). Taking account the data unavailability the following Table provides a framework for further data collection and clarification of the values and benchmarks of these parameters important for characterizing the Sofia urban mobility profile and relevant comparison in addressing eventual congestion charging implementation.

Indicator	**Total extended city area**	**City area**	**Settlements and other urbanized area**
Area size	1349 km2	492,03 km2	267,7 km2
Road network extension	4991 km	NA	NA
Road network extension density	3,7 km/km2	NA	NA
Public transport extension	1465 km	765 km	765 km
Public transport extension density	1,1 km/km2	1,6 km/km2	**2,9 km/km2**

Table 6 Road network Public transport network density for the total city area (with suburbs), city area and net urbanized area. Source: Municipality web page and Optimization of the Public Transport, Mott MacDonald, 2009.

The following two figures illustrate the tram and subway (the projected expansion given in green color) networks

For the last decade the Municipality of Sofia has done a lot in order to provide more comfortable and well-connected transport system. Fundamental shift of the mass transport was the renovation and particularly the expansion of the subway network.

However, it is need to be underlined that the streets and junctions and overall road infrastructure a not well managed and to some extent poorly financed.

As T. Kostov explains (interviews' annex) "*The road network of the city is in poor condition and this would cause problems due to the extra load*". In some places in the city center lanes are destroyed (illustration on Figure 13 below) and need significant improvement of the maintenance.

Figure 13 Poor condition of the road infrastructure on one of the main streets in Sofia. *Source: Own taken photo*

It need to be concluded that further development of the road network and particularly rail, tram and metro network as a part of smart sustainable mobility policy mix have to be considered as main direction for keeping the profile to the lower level of s.c. "semi critical city cluster" as counter factor to the expected expansion of the car traffic and congestions thus overcoming the necessity of congestion charging adoption.

4.2.3. Public Transportation

As reported by the Municipality Sofia public transport network consists of 41 bus lines, 16 tram lines, 9 trolleybus lines and 1 metroline.

Sofia public transport infrastructure consists of ground and underground rail tracks, catenary and rectifying stations, ticket offices and kiosks, stops and signs.

Recent improvements

- GPS surveillance system – it is developed and implemented with cooperation of Bulgarian company MUSAT. The system coordinates, controls and monitors the operation of all the public transport vehicles.
- Electronic information boards on public transport stops in Sofia – thanks to the GPS system we are able to define the position of each vehicle and calculate the real time of its arrival at the stop. Electronic information boards are installed in most of the stops in the centre of the city. They show the passengers the information about real movement of the vehicles – at what time the next vehicle will be at the stop.
- Automated ticketing system – a new electronic ticketing system is installed in trams and trolleybuses. The system is based on a contactless technology and it allows us to identify the number of passengers travelling in the vehicles of the city public transport, to track and analyse passengers flow.
- Refurbishment of 18 Bulgarian trams – contract is signed with the Czech company Inekon for modernization of 18 Bulgarian trams and recently acquired trams, together with new busses and trolleys (see pictures below)
- Virtual electronic boards – this is a pilot project. This is a new service developed recently and it allows passengers to access the information from GPS system (time-table in real time) through the web page of Sofia Urban Mobility Centre.

NEW ***OLD***

Self-made pictures of the renovated of the public transportation cars

Public transport operators

Public transport service on the territory of Sofia Municipality is provided by 3 municipal companies – Stolichen avtotransport EAD, Stolichen eletrotransport EAD and Metropolitan EAD (14 metrostations) and 3 private transport operators. Private transport operators have their own garages and service facilities according to the requirements of their contracts with Sofia Municipality.

In 2009 transport operators had provided in total 792 vehicles in peak hour.The transport service is awarded to transport operators by Sofia Municipality. In 2009 463 529 000 passengers have used the services of Sofia Public Transport System. For the same period transport operators had performed 62 957 977 km in total.

The distribution of passengers between different modes of transport is as follows (the data is from the last passenger counting in 2010):

- Bus transport -54%;
- Tram transport-22%;
- Trolleybus transport-13%;
- Metro-11%.

The 2009 Sofia Masterplan provides a high level strategy for transport development in the city which includes provision of a road network suitable for traffic demands, creation of routes for transit traffic (traffic that passes through the city) using corridors to bypass Sofia city center without using the southern section of the ring road; creation of tangential links, supplementing the radial road network; provision of free-flow traffic movement along the most intensively used transport arteries through multilane crossroads and synchronized or coordinated traffic management; provision of capacities for re-distribution of the transport flows via parallel routes, one-way twin streets, ban on freight traffic, adequate traffic regime in the Central City Area, etc.; provision of the necessary distances from the street network to residential and recreation zones; provision of accessible public transport to recreation zones; priority development of electricity-driven transport network (metro, tramway, trolleybus) and creation of conditions for increased use of the public transport; provision of rapid and convenient public transport to the railway stations, bus terminals and the airport; analysis and introduction of park and ride schemes, aligned with the public transport services; general increase in parking areas through provision of multi-store car parks, underground car parks and parking areas, including parking optimization in the central city area, etc.; and cycling organization and promotion through construction of cycle lanes in residential areas and along some major transport streets.

On the other hand, old busses serving the public transportation still need substantial upgrade. The high level of dissatisfaction from the services of the Sofia public transport as Eurobarometer survey conducted in 2012 proves one of the lowest levels of satisfaction similarly to the previous survey (2009) as presented in the figure in Annex IV.

As mentioned by Ivan Kostov (intervies' annex) "The current state of urban transportation (the number and quality of the vehicles and their route and schedule) could not handle the increased load due to the introduction of such a charge.

The public transportation is inadequate to take the load after the introduction of the measure. There is a wide share of environmental unfriendly public transport, which will minimize the positive environmental impact of the introduction of the charge. "

4.2.4. Political support

The whole political process after changes in 1989 and the political turbulences in the beginning and the second half of 2013 underline *the importance of the consensus to be reached between major political parties* – currently the Center Left coalition elected the current Government (Council of Ministers) and the Right wing party – GERB which has a decisive majority in the Sofia Municipal council and appointed the elected Mayor of the city. This conclusion is also relevant to wide variety of issues and problems of a very practical and technical nature including the eventual congestion charging adoption in the city of Sofia no matter– in mid or long term time horizon.

In this respect one of the interviewed Ms. Nedelcheva says (September, 2013): "*Due to the destabilized situation in the country at this moment, the implementation of congestion charge is a sensitive issue".*

On the other hand Sergisova believes that "The decision to implement this or other charges shall not be politically bound in order to be effectively applied and pure. It would have benefit from getting support from different political backgrounds, but only if that support ensure the effective management and implementation of such a project", (interview, see appendix).

As stated by Mr. Angel Yanev – Senior planner at Sofproect, involved in elaboration of the Sofia‟s Master Plan (May 10, 2013) "the implementation of a congestion charge scheme in Sofia will not require huge funds, but it might cost a lot in terms of politics and cause severe pressure and critique from car owners" and that "these changes are very much political matters"[35].

It is essential Municipal council to undertake a thorough consideration of the necessity and viability of the congestion charging alternative as a part or alternative to a broader sustainable policy mix including:

- Initiating broader public and expert discussions;
- Commissioning of comprehensive, comparative studies, pre investment appraisals, cost benefit and impact analysis;
- Public opinion pools,
- Disputes with participation of major political parties represented at national and local level etc.

4.2.5. Public acceptability

As shown by the experience of the cities analyzed in previous chapter of this work the public acceptability rises within the operational phase of the congestion charge system implementation. A strong resistance is expected in the beginning of discussions, public consultations and initial development. The Sofia experience with the implementation of parking charging zones shows that a similar mobility management tool meets public rejection but after while people start understanding and appreciating the new approach and the related benefits.

It is important to mention that the discussion held in the Sofia municipality in 2006 initiated by the Center for economic development previously noticed has played a role of an initial test of the sensitivity of the public opinion on eventual implementation of the congestion charging. It is worth to quote the result from the answers received under Internet

[35] Quoted by Zeyghami, A. and D. Gogishvili (2013).

informal discussion on the mater where more than 150 respondents answered to the questions presented in the Table 7.

Answers	Share (number of responses)
Paid transit (parking) in the city center	27% [41]
Daily schedule according to even/odd car plate number	10% [15]
Other alternative way (don't know)	38% [59]
No restriction – don't about the chaos in the traffic	25% [38]

Table 7 Answers to the question "How to reduce the traffic and congestions in the city of Sofia ?"
Source: http://www.vwclub.bg/forum/viewtopic.php?p=576510

On the other hand, society should not be drastically forced to accept such an innovative measure at once. There is a need of a well managed long term campaign, aiming to promote the congestion charging focusing on the potential benefits. Also, to avoid protests against the new measure, the congestion charge should be implemented in short period of time after longstanding detailed planning, public consultation and preparation. This will help to analyze the situation before and after the implementation, to assess the public attitudes towards the charging and facilitate the decision of the permanent charge adaptation.

"There is a strong need to implement a bonus scheme in which the public can join and will receive a relief from charges set according to conditions, leading to alleviating traffic and avoiding congestion. Otherwise, burdening people with additional charge will cause public outrage and the initiative will not receive an assistance from the citizens, which is actually crucial for achieving the desired result", as Mrs. Sergisova mentioned (interviews' annex).

The public opinion would be positive for the introduction of such a charge. It is possible that the public opinion could change dramatically in case of implementing the charge in certain areas which could affect the residents. In that sense, the same effect will be achieved if there are no preferences for the businesses, restaurants and services in these areas, (T. Kostov, interviews' annex)

Nelencheva says: "*The introduction of such a charge will surely cause a public debate, which is why this step should be carefully considered and submitted with a campaign to promote the benefit",* (interviews' annex).

4.3. General lessons learned

Among 13 respondents, seven answered that Implementation of Congestion Charging in Sofia is possible, even more – it is highly needed as presented the Figure in Annex VIII.

The most important lessons learned from the discussions with the experts from different authorities and organizations, related to the possible implementation of congestion charging could be summarized as follows. At this moment three of the main five requirements for introduction of the scheme are met. These are the positive attitude of the expert panel, 10 out of 13 experts think the public will be positive for possible implementation, (see Figure 21). The condition of the public transportation is also seen more positive rather than negative (8 of 13). It also concern the readiness of the Institutional capacity (8 out of 13 reply the Institutional capacity is sufficient). Securing public acceptability and positive respond is essential in order to avoid public tensions and to convince citizens that implementation of congestion

charging will bring many benefits to the vicinity and will significantly improve the urban mobility situation in the city. On the other hand the Institutional capacity necessary for the implementation of this mobility management tool is supported by the experts and authority representatives.

However, the other two conditions need to be met before eventual adoption of the congestion charging scheme still need a lot of efforts and improvements and serious work to be done such as:

- Road network system (6 out of 13 responds were negative)
- Political support (11 out of 13 respond negatively).

Table 8 below summarizes the overall review of the results from the case studies in relation to the analysis of the specific situation in the city of Sofia. It can be seen that London, Stockholm and Singapore have complied with the main necessary conditions for congestion charging implementation. In all three cases institutional capacity has proved a high level of performance. Congestion charging system is strongly supported by the main political powers or has been introduced applying the top down approach in an emergency situation of unacceptable high level of traffic intensity and congestions.

The public transportation had been improved before the implementation of the congestion charging, and continued to be renovated after the approval of the scheme. Another condition needed for implementation of the system is a well-developed road network system, which can be seen in all study cases. The public tolerance and acceptance in London and Stockholm were essential in order to adopt the new urban mobility mechanism. Even though the Singaporean policy makers did not take into account public acceptability and opinion upon the implementation of the charge, there were many campaigns and consultations among citizens of the city in order to get people familiar with the new road charging system.

It needed to underline the importance of development of the set of appropriate indicators (scoreboard) similar to globally recognized motels (TomTom TTI, INTRIX etc.), data collection and automated recording systems including for E-surveillance in order to monitor and analyze the performance of the congestion level intensity and identification of the urban traffic profile. This is a task to be assigned to the key responsible institutions such Municipal Council, transport and infrastructure directorates and SUMC.

At this moment it is difficult to predict the changes of the attitudes among politicians and major political parties at national and municipal level in terms of congestion charge implementation. The inherited distrust and related potentially unstable political situation brings many tensions between political parties. At this point, we are not aware of a single politician or political party supporting officially the congestion charging alternative with some exceptions of minor parties not presented at National Assembly and Municipal Council.

It is extremely important to initiate as early as possible intensive discussions and comparative studies for speeding up maturing of the public opinion and achieving the possible level of consensus among politicians and changing prevailing altitudes and perceptions in addressing the congestion charging alternative. NGO and expert community have to play vitally important role in this matter.

	London	Stockholm	Singapore	Sofia
Congestion level	**High**	**High**	**High**	**Medium to high** **Importance of:** **- development Monitoring system and set of appropriate indicators; - setting appropriate policy mix**
Urban traffic typology[36]	**Semi critical city**	**Semi critical city**	**Possibly Critical city**	**Semi critical city** **Importance of:** **- development Monitoring system and set of appropriate indicators; - setting appropriate policy mix**
Institutional Capacity	Strong influence of Mayor and leadership. Some deceptions occurred at first, and then the enforcement capacity was improved.	Focus on environmental protection. High enforcement capacity	Flawless and high enforcement capacity	Available enforcement capacity; needs further enhancement. Expected high bureaucracy. Necessary changes and amendments of the legislation and regulations
Political Support	Tension and confrontation among the political parties in the government further resolved	High political support. Consensus and agreement reached among parties with different motivation. Trial test implemented.	Top-bottom administrative approach driven by political system, traditions and emergency in the traffic intensity.	Past and foreseen confrontation among major political parties ruling at national and local level. Necessity of facilitation in achieving consensus by NGO, expert community.
Public Transportation	Comprehensive and well-functioning public transport system, offering good alternatives to road user incl. railway, subway and bus system	Improved time schedule; new vehicles	Covers a variety of transport modes such as bus and rail, ensuring fast and comfortable transportation	Improved time schedule and traffic management; new clean vehicles, subway extension

[36] According to the TomTom Traffic Index and criteria of EU Commission assigned study in TREN/A4/103-2/2009.

Road Network System	Roads using the ring road around inner London as a suitable boundary for the congestion charge	Well-structured with good quality alternative nodes	Good quality of the wider roads but scarce	Bad maintenance of the existing road network. Simultaneously ongoing significant wide reconstructions, tangent highways, multilevel junctions, extension of subway, tram and cycling lines etc.
Public Acceptability	Increasing during the time. Relatively positive before the implementation	Increasing during the time. 20% before, 50% after the Trial	Not influential in the initial implementation. Increased during the time.	Expected to be negative before and during the implementation. Importance of well managed communication with interested parties

Table 8 Overall comparison of Singapore, London and Stockholm Congestion Charging System and the relevant conditions and considerations associated with Sofia urban traffic profile based on the proposed improved conceptual model.
Source: Own analysis (further more specific reference in part 2.3.2 and chapters II and IV of this work)

On the other hand, the road network system and the public transportation need substantial upgrade and repair which is already widely accepted. Many infrastructural development projects and improvement of the public transport system are in process of implementation supported by central budget EU cohesion and structural funds.

The figure provided in Annex IX is an assessment of the traffic intensity among major regions and their boundaries in Sofia. The red colored center of the city and the contiguous south east parts are potentially appropriate for considering and further investigation of the necessity, potential and feasibility of the **cordon based congestion charging adoption** depending on the future developments in the traffic and congestion intensity and implementation of counter alternative policy options and instruments.

Relatively similar results gives the table of the alternative Mott MacDonald Model of forecasted streets traffic intensity in 2020 presented in Annex X.

It can be concluded further that the implementation of the congestion charge is possible in a mid to long term perspective depending mostly on the furfure developments, interaction, magnitudes, appearance in the time and associated **overall resultant impact of the two key groups of counter playing (opposite) factors** expected to take place as follow:

- Those related to expansion of the traffic and congestions such as rapid national and city economic development, demographic and migration positive flows, delay in implementation of road infrastructure (not inducing additional traffic), public transport intelligent mobility and traffic demand management etc;
- Possible opposite trends and development associated with slow path in the economic revival, speeding up of implementation of the wide range of policy options alternative to the congestion charging being part of the sustainable policy mix (intelligent traffic and demand management additional extension of the tram, subway and cycling network etc.).

Chapter V: Conclusions and Recommendations

5.1. Conclusions summary

This chapter contributes to the achievement of the research objective defined as *'to assess the possibility of implementing congestion charge in* Sofia' summarizing part of the conclusions and associated recommendations derived from this work. The answers to the research questions and associated conclusions and recommendations presented below are based on the analysis of the literature review, the comparison of the selected case studies, analysis of the current mobility conditions in the city of Sofia and feedback from the interviews taken from the preselected panel of experts selected.

Congestion charging has been implemented in many cities around the world and EU, mostly located in developed countries or by the cities with matured road infrastructure, public transport development and well-functioning sustainable urban mobility management. Description of the experience of the cities already implemented congestion charging is done focusing on the example of Singapore, London and Stockholm. So-called pros and cons in congestion charging implementation in these three cities were analyzed and attention is given to the achieved positive results showing definite success of the scheme.

As clarified in the previous chapter the pick of congestions in Sofia reached in 2008 before the worldwide economic recession was driven by high level of economic and employment growth, positive real growth contributing to the highest level of salaries and lowest unemployment rate and existing legislation stimulating concentration of administrative institutions and businesses in the capital city. After crisis and the end of s.c. construction and real estate's bubble, the economic situation has turned out into higher level of unemployment, diminishing rate of new construction undertakings and partial withdraw of labor force. Other significant improvements of the transport infrastructure (extension of subway lines, crossroads and viaducts etc.) will contribute to the diminishing intensity of the traffic loads and congestions.

Nevertheless as mentioned in Chapter II of this work applying the multiple criteria outlined in the quoted study assigned by the EU Commission - TREN/A4/103-2/2009 (including - Population density, Modal share - Private Vehicles, Public Transport, Walking and Cycling, Public Transport Net density) and car ownership, Sofia could fall in the cluster of s.c. "semi critical" cities.

It is also important to repeat the conclusion that it went beyond the alarming value of the proposed criteria under this work of the s.c. "critical level of traffic intensity" (above 20% TomTom Traffic Index with annual time delay per commuter of 45 hours).

Furthermore there are many clear evidences that in a case of more significant economic revival in a short or medium term perspective (overcoming 3-4% growth in the National GDP and local unemployment rate of less than 5% etc.) the situation of higher traffic intensity and congestions' levels could be easily repeated and rapidly deteriorated. The expected impact of the mentioned counter factors such as improvements of the public transport (extension of the subway lines, tram and bus transport) and road infrastructure such as extension of lanes, more multilevel junctions (while neglecting the s.c. induce travel effect) will not probably overcome the effect of growth of economy, employment and incomes. Thus additional migration and intensive car use will boost the traffic intensity and congestions in the mid to long term perspective.

This lead to the important general conclusion that all available policy options and particularly congestion charging alternative have to be considered properly at earliest possible stage by designated Sofia municipal authorities and related agencies.

Taking into consideration the proposed concept of "Congestion Charging Life Cycle" (Fig. 4 of this work) the current stage of Sofia urban mobility policy and management (alike many other cities with similar profiles) could be associated with s.c. *"A" phase*, namely - lack of public discussions, available and recognized studies and policy proposals addressing congestion charging assuring political support for further actions and decisions to be taken.

As proposed in the previous chapter this has to bring attention of the politicians, policy makers and city planners to the necessity of formulation and implementation of overall city mobility policy and management goal as follows: assuring all necessary measures and conditions to (keep or) improve the city current position not allowing it to turn into situation typical for the cluster of s.c. "critical cities". Further if the situation typical for the "critical city" is achieved the goal need to be redefined to take all necessary measures to turn it out to the cluster of "semi critical cities" (for reference - Table 2 of this work).

The study put also the focus on the importance of paying attention to the following major aspects of congestion charging adoption to be effectively addressed in the policy development, planning as follows:

- Identification by designated authorities of the s.c. critical level of intolerable urban traffic intensity (load) comparable to selected cities with similar urban mobility profiles;
- Addressing the congestion charging alternative in the context of the specific sustainable urban mobility policy mix;
- Analysis of the maturity of the preconditions for its implementation.

For better service of this purpose an analytical, policy and planning tool called *Sustainable urban mobility policy matrix* is proposed in Annex I and complemented in Annex II of this work. It has received appreciation on behalf of some respondents during communication in receiving feedback from the selected expert panel. This lead also to the conclusion that the existing mix of policy measures, ongoing and future projects in the city of Sofia have to be tested using the proposed tool especially for the purposes of assessing the impact and effectiveness of the congestion charging alternative in comparison to other viable options, for adequate integration of policy options at the initial analytical stage and in the follow up planning and design phase etc. This will assure a proper analysis and policy integration of different options to be taken into account by the decision making authorities. As proved this task needs significant resources, expertise and time and capacity of the designated authorities and goes far beyond the scope and goals of this work.

In Chapter II the special attention is also given to the importance of using alternative definitions and approaches for assessment of the overall cost and impact of congestions to the society and economy. In this respect T. Litman (2013) proves the congestion intensity indicators, namely the degree that traffic declines during peak periods are useful for short-term decisions but are unsuited to strategic planning decisions that affect the quality of transport options or land use development patterns, and therefore the amount that people must drive. He also defined the congestion costs as "Monetized value of delay plus additional vehicle operating costs".

In this respect we assume extremely important collecting suitable input data on the average compensation per hour paid to employed persons or value added per capita in the specific urban or city area context when calculating "monetized value of delay". Further we consider congestion costs in the above definition as a suitable initial quantitative base (point of departure) for determination of the level of congestion charges in the planning and implementation phase if eventually such decision is taken by the Sofia Municipal authorities.

It could be also summarized that the congestion charging as a price model can vary significantly depending on the conditions of the daily, weekly and localization of the traffic intensity (higher prices under congested conditions and lower prices at less congested times and locations) or based on a fixed schedule.

Importantly we found the ***cordon based fee*** is mostly suitable for the current and future traffic conditions in Sofia. It has to be applied in stages focusing on the city center zone as outlined in the previous chapter. It is also advisable that the initial adoption (trial) might cover only certain (test) days, to identify the effect and public response. After a successful test phase, it could be proceed to the permanent implementation of the charge.

The conclusions done in the Chapter II brought also attention to the significant number of failures of attempts to adopt congestion charging in many cities (Lindsey, 2009). Based on this conclusion the thorough consideration of s.c. necessary preconditions for a successful implementation of the scheme was given.

In the theoretical Chapter II the necessary conditions were outlined in a form of improved conceptual framework including Institutional capacity, Political support, Public acceptability, Road network system, and Public transportation system. Those aspects were used in the research to analyze further the possibilities of implementing congestion charge in Sofia. Further summarizing the implication of congestion charging implementation in Sofia requires analysis of s.c. preconditions, follow-up definition and adoption of wide range of measures by looking at wide range of expected challenges and opportunities. The following recommendations in the next part derived from the analytical part of this work (the applied improved conceptual model in Chapter III and IV) provide a preliminary solution to this task restricted by the scope, goals and assigned resources to this work.

Congestion charge could successfully adopted in Sofia after intensive analysis, expert and public discussion on the benefits, opportunities and challenges of implementation of this measure. Collection of revenue from this fee could be also invested in 'green transport', transport infrastructure and services, similar to the experience of London, Stockholm and Singapore. Depending on thoroughness of the preliminary studies and designed model(s) and especially of the effectiveness of communication with all parties concerned, the expected public resistance to the eventual introduction of congestion charging could be overcome. However, intensive public consultations, education and dialogue needed to be initiated well before any attempt to implement the scheme.

On the other hand, the research elaborates on the status of the five preconditions defined in the Conceptual Model in Sofia, considered as important for the implementation of the charging. According to the analysis, the institutional capacity and the public acceptability might be further assed but they are seemed to be sufficient for adopting and maintaining the congestion charging system. In the table above these conditions are assumed to be relatively achievable or partly met thus supporting the eventual efforts for a possible implementation of congestion charging. The institutional capacity is considered to be sufficiently developed (but still a lot need to be done as outlined in the following part) in managing the process of implementation. In this respect the most relevant legal and regulatory acts to be amended are quoted. Though the expert opinions derived from the interviews prove that the public acceptance is predicted to be relatively high after the congestion charging implementation we put again the focus on the necessary communication with the general public and interested parties. Special attention has to be given to the political support as far as the current local and national political context and probably its further development would be complicated taking into account the wide variety of political actors, involved interests and external influence (further addressed in the following part).

5.2. Recommendations

Each city has its own specific profile and obviously there is no single formula to deal with the congestions or to adopt congestion charging option. Planners, experts and designated authorities in Sofia could analyze the experience of London, Stockholm and Singapore in order to to adapt or modify the basic aspects of congestion charging implementation by taking into account the specific characteristics of Sofia urban mobility profile. Herewith below the major recommendations are summarized based on the results achieved under this study in the framework of improved conceptual model and related conditions for implementation of the congestion charging in the city of Sofia.

Political and Policy Support

Based on the previous analysis Sofia could be classified as a "semi critical city" in accordance with the criteria specified of the already quoted research assigned by EU Commission (TREN/A4/103-2/2009)[37]. It went beyond the proposed criteria of this work - the s.c. "critical level of traffic intensity associated with the necessity of proper consideration of the congestion charging alternative".

Even taking into account the current temporary slowdown in the growth of the city population, the ongoing significant improvement in the road infrastructure (which also bring the expected negative effect of s.c. induced traffic) and public transport, extension of the subway network etc., the congestion problem continue to rise having significant negative impact on the environment, health status, local economy and overall development prospects of the city of Sofia. Most probably depending on the speed and magnitude of the economic revival, income and job growth after current economic crisis, the problem will take significant additional rise.

In this respect an indispensable overall goal of the city mobility policy and management is to assure all necessary measures and conditions to keep the position of "semi critical city" not allowing it to turn into situation typical for the s.c. "critical cities" cluster.

Additionally a specific extended set of indicators for identification of the s.c. *critical level of intolerable urban traffic intensity (load)* comparable to selected cities with similar urban mobility profiles need to be elaborated and used by designated authorities, planning agencies and other interested parties. Approaching of s.c. critical level (threshold) of intolerable urban traffic intensity (load) have to be properly assessed by the responsible directorate of the municipality, made publicly available to the all parties concerned and effectively addressed in the policy development (integration), planning, and particularly in consideration of the congestion charging alternative.

Integration of the goals into effective policies, projects and actions has to take into account the congestion charging alternative in the context of the specific sustainable urban mobility policy mix. We assume this issue to be one of the key challenges to the city authorities and policy makers. Possible different scenario, appropriate criteria and solutions, variety of alternative policy approaches and tools for reducing the intensity of the car use should be elaborated and assessed. This implies an initial development, continuous review for appropriateness and upgrade of the specific sustainable urban mobility policy mix (the proposed tool in the annex could be also tested).

As mentioned except the short, narrow and limited expert discussion held in 2006 the congestion charging alternative is still not considered as priority option by designated authorities (all recent policy documents or drafts available – s.c. General transport scheme, Spatial Development plan etc. do not addressed at all this alternative). In this respect an initial discussion and more detailed policy proposals need to be initiated and widely communicated to the public and interested parties.

[37] It is important to mention that the above study has classified the two "case study cities" London and Stockholm as "semi critical cities".

The congestion charging and its alternative, substitutive options should be checked against expected accountability, fairness, transparency, safety, simplicity, clarity, feasibility, reliability, financial affordability and cost effectiveness. Appropriate adaptation of the proposed improved conceptual model for assessment of the "maturity status" of the necessary preconditions could be undertaken by the planners and designated authorities in a way that increasing mobility demand, congestions, pollution and other side negative effects be effectively and efficiently addressed.

Undertaking preliminary trial test of the preconditions for congestion charging implementation will improve an adoption of clear strategy for sustainable urban mobility in every particular case. This approach probably will enhance achieving the necessary strong political positions, consensus and support among politicians from the ruling and opposition parties at local and national level depending on the future changes in the political landscape. Decisive role of leadership at all governmental levels (legislators, municipal councils, designated authorities at national and local level, elected city mayor etc.) need to be properly understood and assured. Proper assessment and clear view on the current and future positioning, structure and distribution of the political power between central government, ruling parties, opposition and municipal authority, including expected changes, turmoil and foreseeable implementation obstacles need to be adequately taken into account and addressed by the major actors, proponents, interested parties and designated authorities.

Implementation of congestion charging might need a long standing discussion (even over twenty years e.g. Stockholm, London etc.) although in an emergency situation the implementation might happen after one year of public debate (s.c. paper system initially adopted in Singapore, 1975). A wide variety of profound, publicly available and well communicated studies, comparative analysis (cost benefits, efficiency and effectiveness, overall impacts and performance etc.), price proposals, predesign documents and public consultations need to be carried out. Early elaboration and implementation of a plan for public consultations based on the discussions of objective studies, reports and assessments of different alternative scenarios, pricing models, income distribution and possible projects' pipeline (also related to other interrelated policy options such as improved public transport, infrastructure, green innovations etc.) etc. Presenting of fair and decent perspective on the concept, the possible impacts (both positive and negative), implementation obstacles and its potential role in the city transportation plans should be also envisaged.

As experience of the analyzed case studies' cities shown the associated implementation problems usually appear due to the difficulty of explaining and convincing the public in terms of the congestion reduction strategies and expected impacts, the cost of functioning, goals and overall positive prospects of the scheme. The lack of public understanding and confidence shifts fears to the politicians and they usually turn the policy decisions into alternative ways of controlling car use. Depending on the specific local context following this approach might be less efficient and effective.

Experience proves the vital importance of the support to be secured on behalf of the regional politicians from all major parties. When most influencing parties agree on the need to use congestion charges to cut the traffic intensity, the measure is easily introduced despite eventual public opposition and initial unacceptance.

As mentioned announcement of introduction of congestion pricing program might be combined with a "congestion charging trial" followed by a referendum at general or local-government elections to be held (e.g. Stockholm experience) especially in cases of political pressure from the oppositions or overheated (exaggerated) and oversensitive public opinion.

It is also important to underline that the responsibilities for designing the charging system (assessment and calculation of changes with the inflation and economic growth), levying, administering and use (distribution) of the collected charges have to be clearly defined and eventually divided between the local and national government. Proper distribution of responsibilities and system need to be assigned and set up for observation, recording of the long-term trends in acceptability and conducting sensitive analysis on the expected impacts of the changes to the scheme.

In a situation where “local” political concerns are less important (depending on the possible mid to long term changes) assigning power and resources to the mayor and focusing on the key measures/projects need to be considered while paying attention the communication and feedback to be assured with the public and major interested parties. Effective open communication including clear and well-composed presentation of the problem and the congestion charging proposal, development of first-rate communication tools, including a highly effective website need to be implemented for engendering trust with the public and major interested parties.

Imposing congestion charging on the basis of preliminary concluded political agreement thus preventing the political use of the issue against the government, municipal authority or responsible agencies should be analyzed and properly addressed. Environmental goals and social equity concerns should be also properly addressed and integrated in the overall congestion charging proposal. Further political consensus on the detailed technical design has to be achieved in order to facilitate overall justification and positive attitudes of the general public. The major groups of users (low to middle and high income citizens) have to be clearly identified and distinguished in terms of affordability, their readiness and ability to shift to other public transport modes for a proper accounting the social equity context.

Institutional Capacity

As experience of the analyzed cities has shown there is a clear necessity of a strong coordination between authorities on different municipal and central governmental levels. The preparation of drafts of the legal framework for applying congestion charges including suitable secondary legislation, government and municipal regulations should d be done well in advance. For this purpose an early assignment of responsibilities and enhancement of existing capacity have to be taken into consideration. The regulations need to cover all relevant technical aspects of implementation (incl. criteria for a road or area to implement congestion charging), financial criteria, maintenance and coordination.

System of record tracking in terms of user-friendliness, reliability and accuracy and overall performance of the congestion charging has to be developed as an important element of the overall technical design.

Camera-based recognition, radio-frequency identification, dedicated short-range communications, and global positioning satellite systems combined with cellular radio communications (Ueckermann and Venter, 2008) and Automatic Number Plate Recognition (ANPR) to enforce cordon area charging are among the key and mostly suitable technologies, proven in tracking records within the congestion charging system. In the case of cordon area pricing which is the type mostly suitable for expected traffic conditions in Sofia, establishing enough and well positioned charging (incoming control points) allowing system to cover the size of the charged zone (automated, or bank machine or “paper” payment system) need to be installed with different discount rates.

Public Acceptability

Public acceptance is identified as key precondition and criteria to be assessed and comply with before adoption of congestion charging. In this respect establishing procedures for assessment of the common perception on the congestion charging scheme regarding on how people evaluate it before, after and during its implementation is well acknowledged in the specialized literature (e.g. OECD, 2010). Consultations have to take place with all the parties concerned and assuring community and stakeholder commitment in the process of decision-making and implementation. Assuring enough time to build consensus and appropriate management of the entire process of communication and building trust among interested parties is also important.

Elaboration of strategies and counter actions well in advance to combat the hidden or demonstrated influence on the public opinion and politicians in power initiated by interested groups with negative attitudes have to be considered in the case of necessity. In this respect attention has to be given to the critical importance on the overall process of identification of interests of all concerned parties including timing, communication tools, preliminary analysis and impact assessment etc.

Critically important concerns have to be addressed properly by special charging exemptions and compensatory policies. Practical experience in all cases definitely shows that initial concerns, suspicions and fears decline over time as all interested parties gained experience and adapted to the newly implemented system. In rare cases such as lack of strong political opposition and emergency situations (increased traffic intensity, exhausted alternative solutions, reaching s.c. critical level of "unavoidable" implementation) the adoption of congestion pricing is possible without demonstrated or low public involvement (Singapore experience).

The responsible authorities have to carry out at least a year-long intense assessment and information campaign to influence and facilitate implementation and to undertake possible adjustments in order to respond to the eventual public reaction. The implementation of the system could be significantly appreciated by the public due to the improved public transport services, introduction of tax reductions for car ownership or other related taxes or provision of subsidies and exemptions.

Road network System

Before implementation of the charging scheme the road infrastructure and network should achieve a certain status of development, "maturity" and maintained in good condition. The road network system has to be well managed by the designated authorities including constant renovation, guarantying the safety and comfort of the roads, nodes are major road junctions.
In this respect recent significant improvements such as intensive subway lines extension, startup of construction of better interconnects, major crossroads (multistage junctions) and bypasses, more and better means of public transport represent a good example of proper identification of right combination of policy options (policy mix). It is expected that following this pattern might lead to avoidance of the adoption of congestion charging alternative or vice versa - enabling development of the necessary preliminary conditions in a foreseeable future.

Wide range of factors facilitates the implementation of congestion charging including increasing car ownership and use due to income and population growth, culture heritage to be preserved, limited municipal budgets, exhausted opportunities for public urban transport development (subway, tram lines and etc.) alternative demand management policy options etc. As experience of the cities successfully implemented the scheme in all cases the congestion charging has been harmonized by a range of measures designed to make public transport and other alternatives to car use cheaper, easier, faster and more reliable. The road hierarchy has to be also clearly identified and planned to cover the recent high standards. It should divide the road network system by different types of roads, differing by their function and status thus facilitating decision which roads/zones to be charged.

The implementation of congestion charging have to be preceded or supplemented by set of projects for improvement of the road network including pedestrian, cyclist and bus priority measures, expanded bus lanes with enforcement of roadside video cameras.

Public Transportation System

Significant developments of rapid transit, light rail and deluxe bus services have to follow and/or precede adoption of the congestion charging. In contrast the public transportation and related infrastructure in Sofia are still in poor conditions, development and maintenance. E.g. big share of vehicles in use are old or incompatible with the new standards, modal share is also still limited, no wide spread culture and infrastructure developed for bicycle use, re-routing and the use of other time periods to shift trips are recognized and must be considered by the planning authorities.

Before implementation of congestion charging, the public transportation system have to reach the s.c. minimum level of maturity or to be improved by extensions of bus lines, new buses, subway, rail-bound lines, new parking places and bus stops, improved interconnects. Appropriate attention and consideration of the eventual side effects – "induced additional trips and traffic intensity" need to be given.

The public transport has to assure more comfortable and affordable service, as it serves as better and faster alternative of the (private) car use. Further improvements should be envisaged such as development of rapid transit options, light rail (tram lines) and deluxe bus services to follow the implementation of the congestion charging scheme in response to the expected increase in the average speed and use of the public transport.

5.3. Reflection

The structure and methodology used aimed to answer the research questions and achieve the specified goals of the thesis. It elaborated on explanation of the congestion charging practice of the selected cities summarized in the analyzed case studies. The research methods used formed the basis for better reflection of the experience in implementation of the congestion charging in London, Singapore and Stockholm by applying comparative analysis. The work is also based on the other main source - the conducted via e-mail interviews took place from July 2013 to April 2014 with representatives of several organizations and municipal departments, related to the mobility management in Sofia.

Due to the limited resources and time assigned the research is strictly limited to the preliminary defined scope and availability of information. These factors have impacted to some extent the information on which the conclusions and recommendations on the implementation of congestion charging in Sofia, Bulgaria were built upon. Irrespectively of the difficulties regarding collection of data relevant to the urban mobility and eventual congestion charging implementation, the information received allowed to derive the necessary conclusions and recommendations.

Further, the analysis of practice of the selected cities and their background as reference and the conducted specific analysis of the Sofia context, allowed a clarification of the perspectives, deriving at realistic recommendations and their eventual implementation for a better informed and feasible policy options and improved urban mobility in Sofia.

In addition, the results of this research should not be generalized and directly used in the context of other cities with similar profiles since the research was focused mostly on the Sofia case. The implementation of the congestion charging in other cities may arrive at different results. Nevertheless there are many advantages of the proposed approach which might contribute to a broader and deeper understanding of the issue by the designated authorities and interested parties in the cities with similar profiles.

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Annex I: Sustainable Urban Mobility Policy Matrix

No. of row / column	Sustainable Urban Mobility Priority Policy Options	Current Status to Short term perspective		Interim Policy/Project implementation Review incl., Impact analysis, follow-up forecasting, planning and redesign	Mid to Long term perspective (forecasted or planned)	
		Policy Mix – Implemented or Projects in progress incl., investment and operational cost	Contribution - Impact on the traffic intensity (congestions) and change of the value of selected core indicators or goals		Policy Mix - Planned projects incl., investment and operational cost	Contribution – Expected Impact on the traffic intensity (congestions) and change of the value of selected core indicators or goals
	1	2	3	4	5	6
1	• **Clean fuels and vehicles**					
1.1	o Hybrid Vehicles					
1.2	o Sailing ships					
1.3	o Biodiesel					
1.4	o Biogas/CNG					
1.5	o Electric Vehicles					
1.6	o LPG					
1.7	o Hydrogen vehicle					
1.8	o Human-powered transport					
1.9	o Animal-powered transport					
2	• **Sustainable transport infrastructure**					
2.1	o greenways and foreshoreways					
2.2	o Bikeways					
2.3	o Busways					
2.4	o Railways					
3	• **Access restrictions**					
3.1	o Access management / Enforcement					
3.2	o Car Restricted Zones /Living Streets					
3.3	o Multifunctional areas					
3.4	o Parking Management					
3.5	o Pedestrian zone					

3.6	o Traffic calming / Speed reduction					
4	• **Integrated pricing strategies**					
4.1	o Congestion pricing					
4.2	o Integrated ticketing					
4.3	o Parking Management					
5	• **Collective passenger transport**					
5.1	o Public transport					
5.2	o Bus services					
5.3	o Rail transport					
5.4	o Intermodal transfers					
5.5	o Integrated ticketing					
5.6	o Marketing					
5.7	o Park & Ride					
5.8	o Demand responsive transport					
5.9	o Accessible transport systems					
5.10	o Paratransit					
5.11	o Bus rapid transit					
5.12	o Quality of service					
5.13	o Security, including Transit police					
6	• **Travel information**					
6.1	o Public transport timetable					
6.2	o journey planner					
7	• **Less car intensive lifestyle**					
7.1	o Car pooling					
7.2	o Car sharing					
7.3	o Car/ driver license exit strategies					
7.4	o Cycling					
7.5	o Bike sharing					

7	• **Soft measures**					
7.1	o Travel plan					
7.2	o Walking school bus					
7.3	o Travel blending					
7.4	o Personalized travel plan					
8	• **Transport management**					
8.1	o Transportation demand management					
8.2	o Transit oriented development					
8.3	o Walkability					
8.4	o New urbanism and New pedestrianism					
8.5	o TDM Toolbox					
8.6	• **Sustainable Freight Transport**					
9	o Clean vehicles / clean fleet					
9.1	o Intermodal freight transport					
9.2	o Dry port					
9.3	o Fleet management					
9.4	o Route planning					
9.5	o Transportation management system Spatial Planning					
9.6						
10	Overall Impact, Efficiency and Effectiveness of the selected policy mix (return on investment, cost benefit analysis, net contribution to the traffic intensity core indicators)					

Source: Author's proposal. The outline of the Sustainable Urban Mobility Priority Policy Options (second column of the table) is based on Urban Transport program of measures adopted by EU Directorate-General for Transport and Energy Urban further referred in following the Annex II.

Annex II:

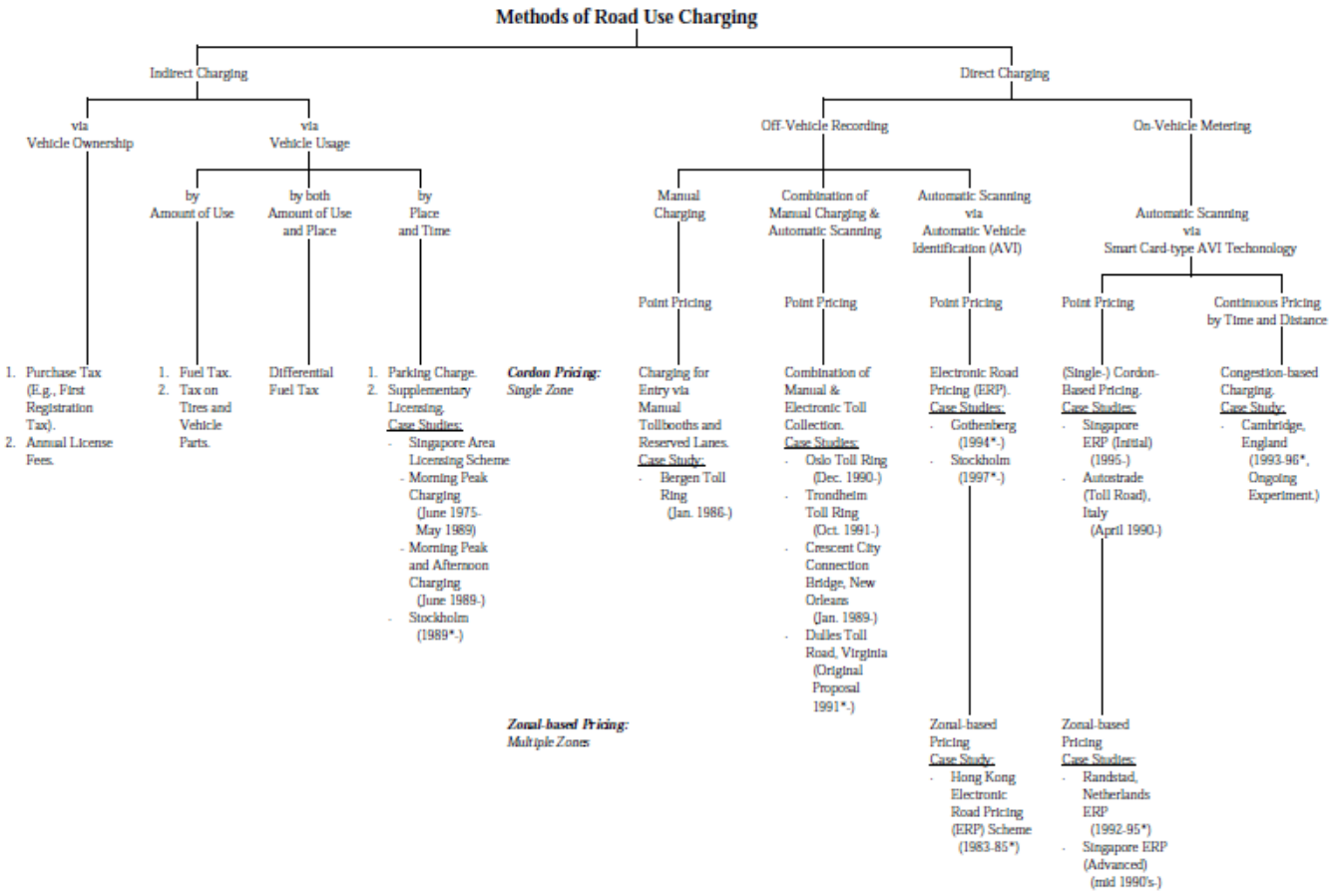
Sustainable transport toolbox: The EU Directorate-General for Transport and Energy (DG-TREN) Urban Transport programme of measures[38]

- Clean fuels and vehicles
  - Hybrid Vehicles
  - Sailing ships
  - Biodiesel
  - Biogas/CNG
  - Electric Vehicles
  - LPG
  - Hydrogen vehicle
  - Human-powered transport
  - Animal-powered transport
- Sustainable (green) transport infrastructure
  - greenways and foreshoreways
  - Bikeways
  - Busways
  - Railways
- Access restrictions
  - Access management / Enforcement
  - Car Restricted Zones /Living Streets
  - Multifunctional areas
  - Parking Management
  - Pedestrian zone
  - Traffic calming / Speed reduction
- Integrated pricing strategies
  - Congestion pricing
  - Integrated ticketing
  - Parking Management
- Collective passenger transport
  - Public transport
  - Bus services
  - Rail transport
  - Intermodal transfers
  - Integrated ticketing
  - Marketing
  - Park & Ride
  - Demand responsive transport
  - Accessible transport systems
  - Paratransit
  - Bus rapid transit
  - Quality of service
  - Security, including Transit police
- Travel information
  - Public transport timetable
  - journey planner
- Less car intensive lifestyle
  - Car pooling
  - Car sharing
  - Car/ driver licence exit strategies
  - Cycling
  - Bike sharing
- Soft measures
  - Travel plan
  - Walking school bus
  - Travel blending
  - Personalised travel plan
- Transport management
  - Transportation demand management
  - Transit oriented development
  - Walkability
  - New urbanism and New pedestrianism
  - TDM Toolbox
- Sustainable Freight Transport
  - Clean vehicles / clean fleet
  - Intermodal freight transport
  - Dry port
  - Fleet management
  - Route planning
  - Transportation management system

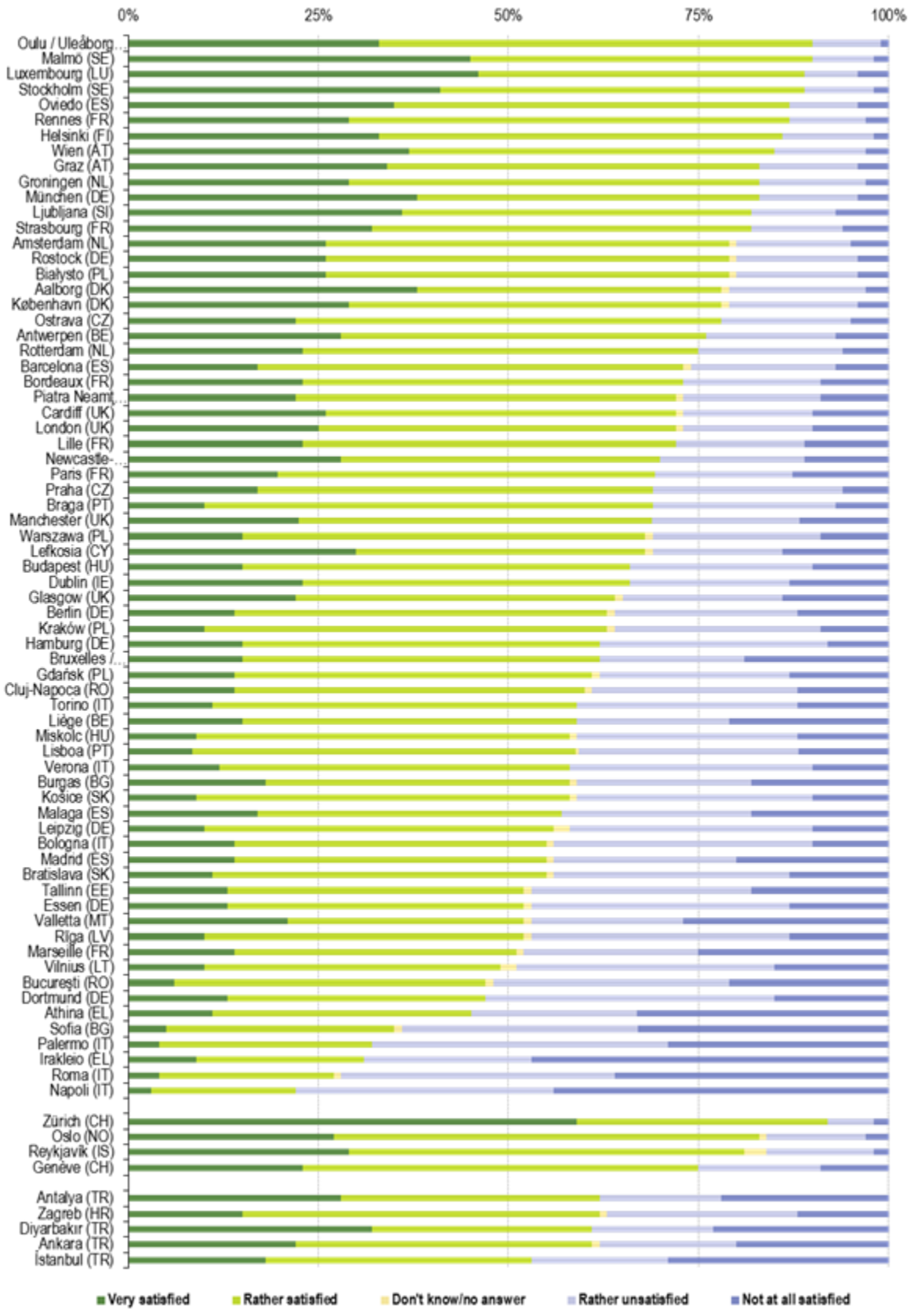
[38] http://en.wikipedia.org/wiki/Sustainable_transport

Annex III:

Methods of Road Use Charging



Annex IV: Satisfaction with public transport services in selected Urban Audit cities (%), 2012.



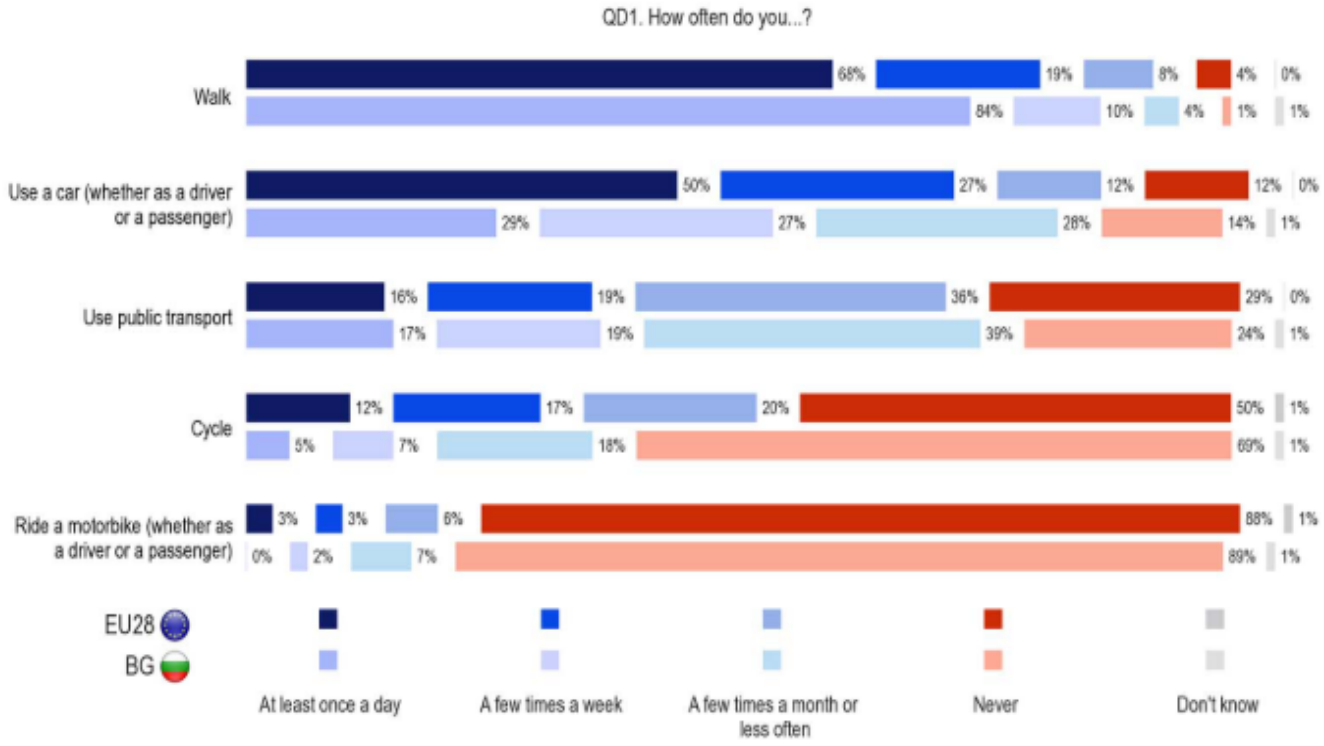
Source: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Statistics_on_European_cities#Further_Eurostat_information

Annex V: Registered cars per 1000 inhabitants in European capital cities, 2006 and available year

Capital	*Number*	
	2006	*Year available*
1. Rome	726	
2. Luxemburg	645	667 (2009)
3. Prague	495	490 (2010)
4. Brussels	481	511 (2011)
5. Sofia	**378**	**612 (2011 E)**
6. Stockholm	366	391 (2011)
7. Budapest	351	
8. Berlin	319	355 (2012)
9. Amsterdam	286	395 (2011)
10. Paris	250	389 (2010)
11. Copenhagen	218	

Source: Eurostat: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=urb_ltran&lang=en

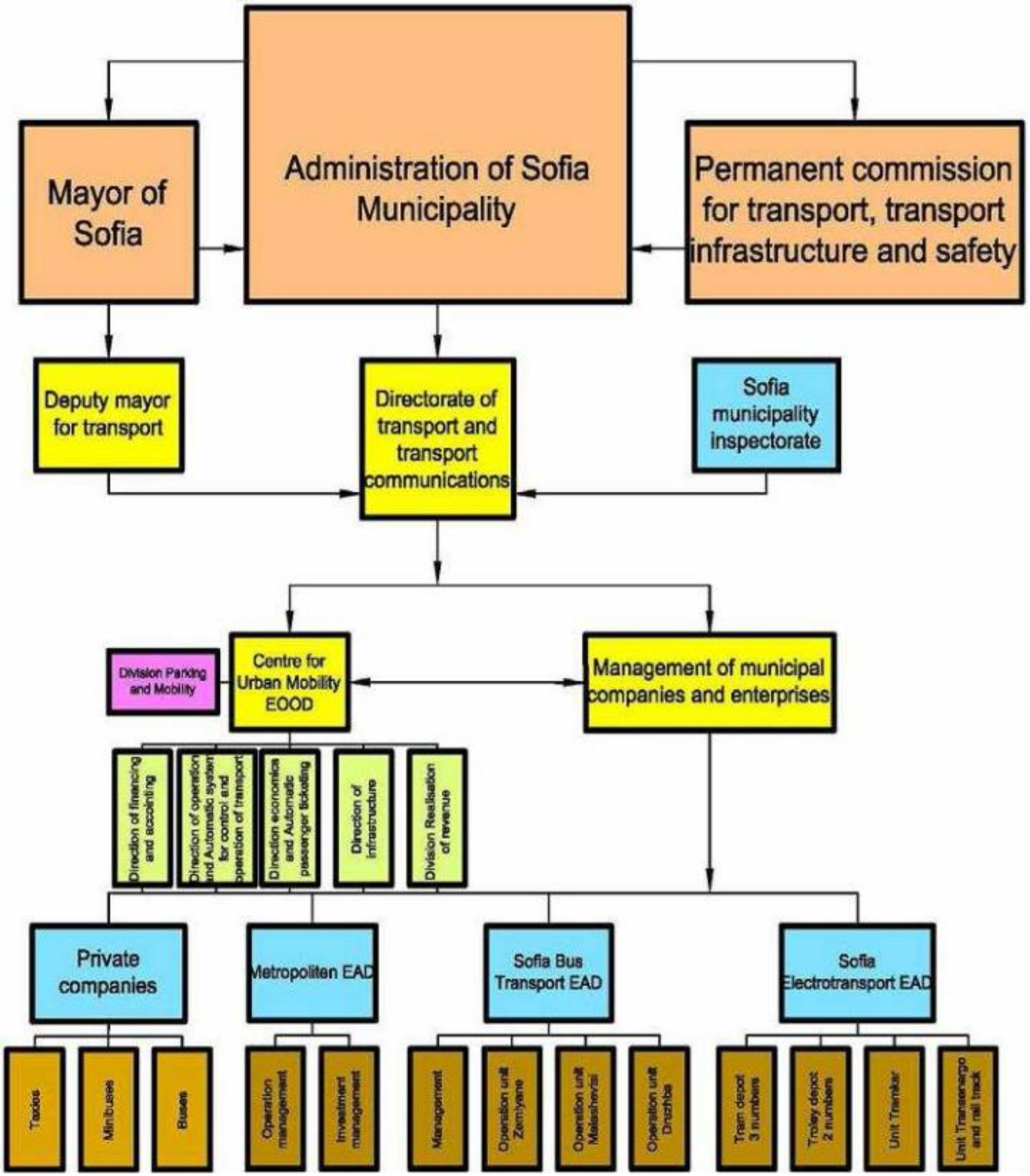
Annex VI: Answers to the Eurobarometer research.



Source: http://ec.europa.eu/public_opinion/archives/ebs/ebs_406_fact_bg_en.pdf)

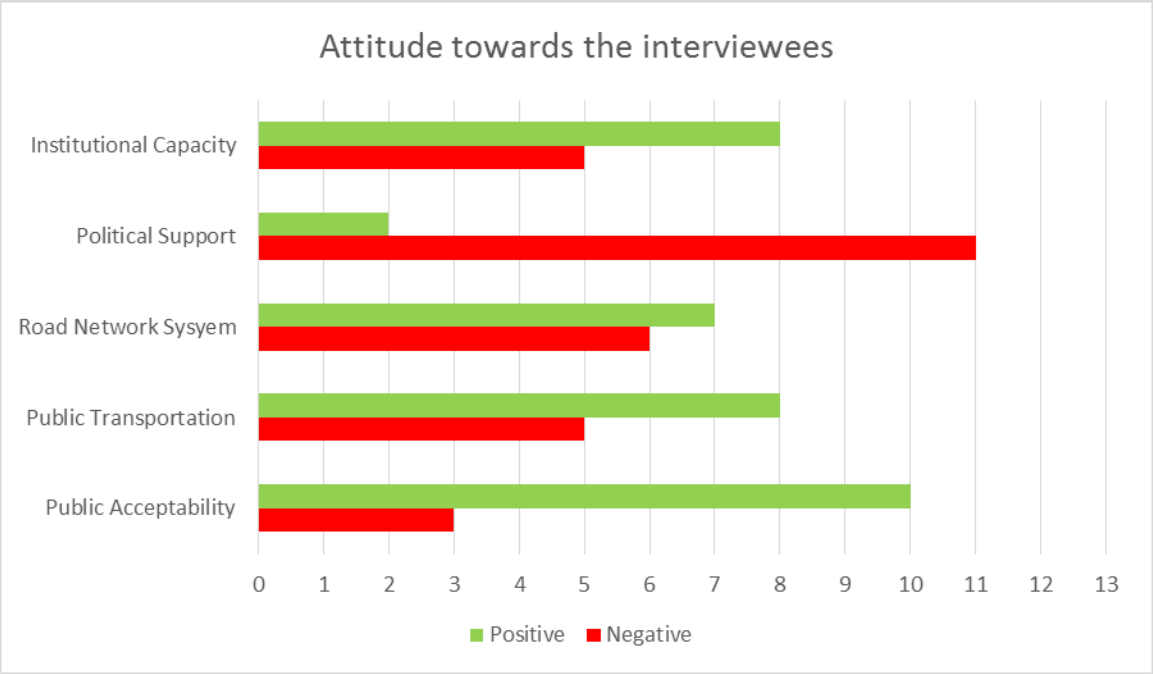
Annex VII: Sofia public transport organogram.

Source: Mott MacDonald, 2009.



Annex VIII:

General overview towards the respondents' attitudes on the congestion charging implementation in Sofia.



Annex IX: Basic regions and boundaries of generation of the transport flows.

Source: S. Stoev (2012)

Annex X:

Mott MacDonald Model of forecasted streets traffic intensity in 2020.

Source: Mott MacDonald (2009)

Annex XI:

List of Questions for the Interviews

This 'list of questions' is a research instrument of the study on *"Implementation of Congestion Charge in Sofia, Bulgaria*".

Purpose of the interview:

1. To understand the current policy transportation framework in Sofia that fits in with congestion charging system.

2. To determine the opportunities and challenges of implementing congestion charge in Sofia.

Congestion Charge Objectives:

• A fee that can vary depends on the condition of the traffic (higher prices under congested conditions and lower prices at less congested times and locations) or based on a fixed schedule.

• Can be implemented on existing road to avoid the need to expand capacity, or when road tolls are applied to raise revenue.

Date and time of interview:

Name:

Telephone:

E-mail address:

Name of organization where interviewee works for:

Position in the organization:

Location of the organization:

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia's urban mobility?

2. What kind of measurements and policy instruments has been applied to manage traffic congestion?

3. What is the experience with public acceptability when parking pricing was implemented?

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy/law/ regulation point of view?

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theories and practices, such as institutional capacity (legal framework, technology and enforcement), public acceptability, political support, existing road network and public transportation system.

5. What in your opinion are the opportunities of implementing congestion charge in Sofia?
   - Institutional Capacity
   - Public Transport System
   - Road Network System

6. What in your opinion are the challenges of implementing congestion charge in Sofia?
   - Political Support
   - Public Acceptability

Annex XII: List of Organizations/Representatives Interviewed

№	Organization	Name	Contact
1	Denkstatt Bulgaria *Sustainable Development Consultancy Agency*	Apostol Dyankov	+359 886 745 777 apostol.dyankov@denkstatt.bg
2	HaycadInfotech Ltd. *Engineering Strategies Enterprise*	Albena Sergisova	+359 879 530 807 albena.sergissova@haycad-infotech.bg
3	Florex ltd *Green Infrastructure Enterprise*	Anelya Yaneva	+359 888 415 238 aneliya.yaneva@abv.bg
4	IKEM Corp. *Sustainable Energy Development Corporation*	Gergana Avramova	+359 879 830 490 office@ikem-bg.com
5	New S Net Ltd. *Chamber of architects in Bulgaria*	Teodosi Kostov	+359 887324170 teo_kostov@new-s.net
6	Industrial Cluster “Electric vehicles”	Ivan Kostov	+359 888269128 kostov@new-s.net
7	Industrial Cluster “Electric vehicles”	Zornitsa Nedelcheva	+359 887859329 projects@emic-bg.org
8	“Transformators” Union *Urban planning and architecture*	Maria Marazova	+359 883 501 125 proekt@transformatori.net
9	Bulgarian Association of Municipal Environmentalists and Ecologists - BAMEE	Nikolay Sidjimov	+359 888 577973 sidjimov@bamee.org
10	Association of Education in Transport	Vidko Mitrovich	+359 887 868 776 trans@techno-link.com
11	Transportation sector	Anonymous	N/A
12	Transportation sector	Anonymous	N/A
12	Transportation sector	Anonymous	N/A

Annex XIII: Interviews' responds

No. 1.

Date and time of interview: 28/06/2013; 10:00h

Name: Apostol Dyankov

Telephone: +359 886 745 777

E-mail address: apostol.dyankov@denkstatt.bg

Name of organization where interviewee works for: Denkstatt Bulgaria

Position in the organization: Senior consultant

Location of the organization: Sofia, Bulgaria

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia's urban mobility?

Congestion and heavy pollution due to road traffic, incoherence and failure of cycling infrastructure

2. What kinds of measurements and policy instruments have been applied to manage traffic congestion?

Paid parking - blue and green zone, construction of park and ride facilities at stations outside the city center, building bike lanes, urban transport modernization and completion of the subway, information campaigns

3. What is the experience with public acceptability when parking pricing was implemented?

Negative, mainly due to the attitude that paid parking in the center is right and granted

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy/law/ regulation point of view?

Yes, with good reasoning, argumentation, planning and provision of choice (paidparking and high-quality public transport and cycling infrastructure). Also with different rules for light transport that loads stores and more.

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theories and practices, such as institutional capacity (legal framework, technology and enforcement), public acceptability, political support, existing road network and public transportation system.

5. What in your opinion are the opportunities of implementing congestion charge in Sofia?

- Institutional Capacity- Very high transparency in the organization of the UrbanMobilityCenter, clear and consensual solution to the spending of income tax

- Public Transport System- Combined ticket for 1) Parking 2) congestion charge, and 3) use of public transport. So with a card loaded with a certain credit can be used each option

- Road Network System- More parking spaces outside the center, good bypass connections, connections and optimal planning of newly constructed bike lanes

6. What in your opinion are the challenges of implementing congestion charge in Sofia?

- Political Support- Convincing the residents, daily drivers and companies of light transport

- Public Acceptability- convince the public of the appropriateness of the fee, the benefits of reduced traffic and meaningful their spending

No. 2.

Date and time of interview: 01/08/2013; 13:00 h

Name: Albena Sergisova

Telephone: +359 879 530 807

E-mail address: albena.sergissova@haycad-infotech.bg

Name of organization where interviewee works for: HaycadInfotech Ltd.

Position in the organization: Manager Business Development

Location of the organization: Plovdiv, Bulgaria

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia's urban mobility?

Shortage of parking space in residential and central areas of Sofia
Shortage of buffer and underground parking
Movement of a car with one driver / passenger
Congestion and difficulty to move within the city.
Unattractive conditions in vehicles from the network of public transport.

2. What kind of measurements and policy instruments have been applied to manage traffic congestion?

-Preparing the draft Master plan for the organization of traffic
-Preparation of Master Plan of Sofia, which contains a plan for the structure in the city until 2020, and the related development of transport, road infrastructure and hierarchical classification of streets.
-Development of a concept for parking (buffer and underground parking, definition of blue, green and yellow area)
-Stimulation of bicycling and pedestrian walking

-Construction of modern control traffic
-Implementation of measures to improve the quality of public transport - subway, bus lanes, parking in underground stations, elimination of parking along the routes of public transport, more comfortable public transport vehicles with electronic toll cards.

3. What is the experience with public acceptability when parking pricing was implemented?
The public accepted the new instrument because they understand the unconditional need of the park zoning.

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy/law/ regulation point of view?
Only in case of a reasoned proposal and if it involves the priority axis for the development of the city.

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theories and practices, such as institutional capacity (legal framework, technology and enforcement), public acceptability, political support, existing road network and public transportation system.

5. What in your opinion are the challenges of implementing congestion charge in Sofia?

- Political Support- The decision to implement this or other charges shall not be politically bound in order to be effectively applied and pure. It would have benefit from getting support from different political backgrounds, but only if that support ensure the effective management and implementation of such a project.

- Public Acceptability-There is a need to implement a bonus scheme in which the public can join and will receive a relief from charges set according to conditions, leading to alleviating traffic and avoiding congestion. Otherwise, burdening people with additional charge will cause public outrage and the initiative will not receive assistance from the citizens, which is actually crucial for achieving the desired result.

No. 3.

Date and time of interview: 01/08/2013; 9.45h

Name: Anelya Yaneva

Telephone: +359 888 415 238

E-mail address: aneliya.yaneva@abv.bg

Name of organization where interviewee works for: Private sector, Florex ltd

Position in the organization: Ecologist

Location of the organization: 1421 Sofia, Bulgaria

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia's urban mobility?

- Large amount of cheap old cars that are brought in from Western Europe

- Old roads / narrow / not designed and built to take the current traffic in Sofia

- Bad condition of roads / include those on the sidewalks /

- Lack of bike lanes

- Old, dirty and irregular buses, trolleys and trams

- Repair works carried out in the city lack of advance planning and proper organization

- It is extremely difficult for mothers with prams and people with disabilities who use wheelchairs to move; missing ramps

2. What kinds of measurements and policy instruments have been applied to manage traffic congestion?

-Regulator men

-BUS lane on the boulevards

3. What is the experience with public acceptability when parking pricing was implemented?

The "parking" fee does not solve the problem, but additionally collect money from people. As a result of the fee people park their cars in areas where there are no charging zones. Due to the large amount of cars that congregate in areas free of charge, drivers park their cars in the “green” areas, with leads to damaging of city gardens and turn them into muddy puddles. Another option to avoid the parking fee is to park on sidewalks which impedes the movement of pedestrians and lead to permanent damage to pavements.

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy/law/ regulation point of view?

From a legal and political point of view I am not competent. My personal opinion is that I am against the introduction of fees that "punish" people. If citizens have convenient public transportation the will not use cars. For example, the subway is a fast way to travel. It is regular, clean, safe, and people prefer it. I think that extending the subway capacity, abandoning old and unused cars (getting free lots of parking spots) and/or putting higher taxes on older vehicles will have a better final effect on the traffic in the city and a positive environmental added value. At this point there is a need the legal/policy makers to make a comprehensive analysis of the mobility situation and possible opportunities, and to create and adopt a program with sustainable measures and long-term planning that will take place.

No. 4.

Date and time of interview: 28/06/2013; 13:50h

Name: Gergana Avramova

Telephone: +359 879 830 490

E-mail address: office@ikem-bg.com

Name of organization where interviewee works for: IKEM Corp.

Position in the organization: Office manager

Location of the organization: Sofia

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia's urban mobility?

Heavy traffic, poor infrastructure, lack of parking spaces;

2. What kinds of measurements and policy instruments have been applied to manage traffic congestion?

Lanes for buses on some roadways; ban and sanctions for stopping, waiting and parking on sidewalks; bicycle lanes and more.

3. What is the experience with public acceptability when parking pricing was implemented?

Controversial - people who live in the center protested against paying an annual vignette for blue and green parking zone.

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy/law/ regulation point of view?

Benefits of implementing the congestion charge are numerous - surely this measure will reduce air pollution and emissions and will benefit the environment and the urban environment. The fee could be collected on an annual basis with the annual tax. Reasonable fee seems no more than 2 lev (1 euro) per month - 24 lev (12 euro) per year, as it can vary by vehicle type, year of manufacture and engine size of the car. Logically, the charges for heavy vehicles should be higher due to the produced air pollution, noise and caused congestion.

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theories and practices, such as institutional capacity (legal framework, technology and enforcement), public acceptability, political support, existing road network and public transportation system.

5. What in your opinion are the opportunities of implementing congestion charge in Sofia?

- Institutional Capacity- "Green" culture education among citizens; incentives and initiatives to use less personal cars, which will reduce traffic and pollution.
- Public Transport System- Accelerated development of urban electric transport, which is cleaner and more economical and makes Sofia "greener."
- Road Network System- Collection of the congestion charge would increase revenues for improving the road infrastructure

6. What in your opinion are the challenges of implementing congestion charge in Sofia?

- Political Support – N/A
- Public Acceptability- The charge will be more acceptable if it raises the revenue in the budget without increase in taxes.

No. 5.

Date and time of interview: 1/08/2013; 11:30h

Name: Teodosi Kostov

Telephone: +359 887324170

E-mail address: teo_kostov@new-s.net

Name of organization where interviewee works for: New S Net Ltd.

Position in the organization: Commercial Director

Location of the organization: Sofia, Bulgaria

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia's urban mobility?

- The lack of so-called "Green wave" of the busiest boulevards and gutters.

- Lack of incentives for the use of vehicles different than mainstream - electric bicycles, scooters and cars, standard bicycles and other vehicles on two wheels.

- Bad infrastructure and bad organization of the traffic

2. What kinds of measurements and policy instruments have been applied to manage traffic congestion?

- Implementation of parking zones in the city centre of Sofia
- Control of improperly parked vehicles obstructing the normal movement of traffic.

3. What is the experience with public acceptability when parking pricing was implemented?

- Positiveacceptancefromcitizensthatrarelyneedtoparktheirvehiclesinthecitycentre.
- Both positive and negative effects on the residents in the areas of paid parking. Positive - because of the continued presence of free parking places, negative - because the charges imposed for parking of residents in these areas, especially for second or subsequent car.

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy/law/ regulation point of view?

I think it is appropriate and this would lead to the normalization of the traffic in downtown. It would be better if such a charge will not be applied to residents in these areas. For companies that are engaged in the supply of various products or any similar activity is better to introduce a minimum charge for movement, accommodation and parking in downtown.

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theories and practices, such as institutional capacity (legal framework, technology and enforcement), public acceptability, political support, existing road network and public transportation system.

5. What in your opinion are the opportunities of implementing congestion charge in Sofia?

- Institutional Capacity – There is an available administrative capacity for implementation of the congestion charge. I also think that the administration would handle the controls associated with the charge.

- Public Transport System - The current state of urban transportation (the number and quality of the vehicles and their route and schedule) could not handle the increased load due to the introduction of such a charge.

- Road Network System - The poor condition of the road network of the city would cause problems due to the extra load.

6. What in your opinion are the challenges of implementing congestion charge in Sofia?

- Political Support - At this point I see no adequate political will and/or support.

- Public Acceptability – The public opinion would be positive for the introduction of such a charge. It is possible that the public opinion could change dramatically in case of implementing the charge in certain areas which could affect the residents. In that sense, the same effect will be achieved if there are no preferences for the businesses, restaurants and services in these areas.

No. 6.

Date and time of interview: 1/08/2013; 9:30h

Name: Ivan Kostov

Telephone: +359 888269128

E-mail address: kostov@new-s.net

Name of organization where interviewee works for: Industrial Cluster “Electric vehicles”

Position in the organization: General Secretary

Location of the organization: Denkoglu 1, Sofia, Bulgaria

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia’s urban mobility?

    - Lack of adequate public transport leading to the subway stations.
    - Use of buses with diesel fuel.
    - Outdated vehicles.
    - Absence of any innovation on introduction of a new kind of vehicles, in particular electric buses.
    - Busy traffic in downtown.
    - Not so strong policy of the municipality to promote environmental friendly vehicles.

2. What kinds of measurements and policy instruments have been applied to manage traffic congestion?

    - Implementation of “Blue" and "Green” parking zones
    - Introduction of differentiated payment through vignettes of cars to stay in an area according to the settlement.
    - Payment system to stay in areas using SMS (text message).
    - Traffic light systems with the ability to affect "Green Wave."

3. What is the experience with public acceptability when parking pricing was implemented?

- Very negative for those who have to park daily in the charging zones.
- Very negative by individual owners who live on the same address and so have each of them to pay twice as expensive for the vignette of the first register.

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy/law/ regulation point of view?

At this point, I think no. To introduce the chargeit is necessary to perform a number of other actions to reduce congestion, to allow such a charge to be logical and reasonable.

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theories and practices, such as institutional capacity (legal framework, technology and enforcement), public acceptability, political support, existing road network and public transportation system.

5. What in your opinion are the opportunities of implementing congestion charge in Sofia?

- Institutional Capacity – congestion charge could be introduced by a decision of the Sofia Municipal Council, and there is an available expert capacity. There is insufficient capacity of the supervisory bodies. There is insufficient capacity of engineering controls.
- Public Transport System – The public transportation is inadequate to take the load after the introduction of the measure. Environmental unfriendly public transport, which will minimize the positive environmental impact of the introduction of the charge.
- Road Network System - Inadequate and poorly maintained road network.

6. What in your opinion are the challenges of implementing congestion charge in Sofia?

- Political Support - not available political support.
- Public Acceptability - society will not approve the introduction of such a charge now, because of the complicated economic and political situation in the country and the unused number of other measures to reduce the congestion before the introduction of such a charge.

No. 7.

Date and time of interview: 30.07.2013, 14:00

Name: Zornitsa Nedelcheva

Telephone: +359 887859329

E-mail address: projects@emic-bg.org

Name of organization where interviewee works for: Industrial Cluster “Electric vehicles”

Position in the organization: Expert

Location of the organization: Denkoglu 1, Sofia, Bulgaria

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia's urban mobility?

Depreciated vehicles, not sufficiently well-developed public transport network with an uneven load, lack of bicycle lanes.

2. What kinds of measurements and policy instruments have been applied to manage traffic congestion?

Charging parking zones in the city center, subway network, promoting the use of alternative transport and combined trips

3. What is the experience with public acceptability when parking pricing was implemented?

Initially, people were against it, but then they started to realize the benefits of paid parking in terms of reducing the congestion

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy/law/ regulation point of view?

Legally it is applicable; in terms of the municipality's policy and whether it is in its own interest too. The problem will come from the relationship of citizens to such a charge, given the additional costs that they have to make.

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theories and practices, such as institutional capacity (legal framework, technology and enforcement), public acceptability, political support, existing road network and public transportation system.

5. What in your opinion are the opportunities of implementing congestion charge in Sofia?

- Institutional Capacity – according to the developed models of blue and green parking zones, it is possible to introduce the congestion charge, but the process requires expertise and careful study and implementation.
- Public Transport System – on some places it is needed to optimized the existing public transport network in order to prepare it to take the increased number of passengers.
- Road Network System – the implementation of congestion charge presupposes the existence of better road infrastructure. In some places in the city center lanes are destroyed and need repair.

6. What in your opinion are the challenges of implementing congestion charge in Sofia?

- Political Support – due to the destabilized situation in the country at this moment, the implementation of congestion charge is a sensitive issue.
- Public Acceptability - the introduction of such a charge will surely cause a public debate, which is why this step should be carefully considered and submitted with a campaign to promote the benefits.

No. 8.

Date and time of interview: 15.07.2013, 11:30

Name: Maria Marazova

Telephone: +359 883 501 125

E-mail address: proekt@transformatori.net

Name of organization where interviewee works for: “Transformators” Union

Position in the organization: Member

Location of the organization: Sofia, Bulgaria

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia’s urban mobility?

Lack of long-term planning and vision for the development of transport in Sofia. There is no policy and political will to promote alternative transportation.

2. What kinds of measurements and policy instruments have been applied to manage traffic congestion?

The only tool that is launched in the public domain for dealing with traffic is the construction of intersections on two levels that generate more traffic.

3. What is the experience with public acceptability when parking pricing was implemented?

I think society quickly get used to the introduced fees that had partial shared against and resolving.

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy/law/ regulation point of view?

Yes, it is applicable.

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theories and practices, such as institutional capacity (legal framework, technology and enforcement), public acceptability, political support, existing road network and public transportation system.

5. What in your opinion are the opportunities of implementing congestion charge in Sofia?
- Institutional capacity - Currently the municipality lacks the capacity to collect such a fee
- Public transport - There is a need to improve the image and quality of the public transport
- Road transport network - To focus on alternative methods of transport

6. What in your opinion are the challenges of implementing congestion charge in Sofia?
- Public Acceptability - You very well to communicate with the public. To outline the benefits, and alternatives to such measures.

No. 9.

Date and time of interview: 16.07.2013, 14:30

Name: Nikolay Sidjimov
Telephone: +359 888 577973

E-mail address: sidjimov@bamee.org

Name of organization where interviewee works for: Bulgarian Association of Municipal Environmentalists and Ecologists - BAMEE

Position in the organization: CEO

Location of the organization: Sofia and Sliven,Bulgaria

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia's urban mobility?

- Bad organization of the public transportation
- Not well planned transport schemes
- Poor coordination and lack of flexibility in the management of traffic light regulation.
- Lack of parking spaces

2. What kinds of measurements and policy instruments have been applied to manage traffic congestion?

The measures used are too cosmetic and do not address substantive problems of congestion and a momentary, local character. Policy instruments are not used properly and the measures are more populist and ineffective.

3. What is the experience with public acceptability when parking pricing was implemented?

Some of the resistance of the people living in the city center, but gradually adopted a positive in my opinion. There is a certain positive effect, but there are still areas where parking is almost impossible.

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy/law/ regulation point of view?

Yes.

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theories and practices, such as institutional capacity (legal framework, technology and enforcement), public acceptability, political support, existing road network and public transportation system.

5. What in your opinion are the opportunities of implementing congestion charge in Sofia?
- Institutional capacity - we need experts to manage transport schemes, conducting detailed studies of traffic and the introduction of high technological solutions
- Public transport - This is the fundamental way to solve the transportation problems of the big cities!
- Road transport network - Good infrastructure is very important, but it must be properly planned.

6. What in your opinion are the challenges of implementing congestion charge in Sofia?
- Political support - Required to be imposed discipline and implementation of new policies
- Public approval - you can always expect resistance, but it should be made and measures getting over resistance against implementation of tem. This is a normal element in all systems.

No. 10.

Date and time of interview: 20.07.2013, 15:00h.

Name: Vidko Mitrovich

Telephone: +359 887 868 776

E-mail address:trans@techno-link.com

Name of organization where interviewee works for: Association of Education for Transport

Position in the organization: CEO

Location of the organization: blvd. Hristo Botev 82, Plovdiv, Bulgaria

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia's urban mobility?

Outdated and poorly planned street infrastructure, the long delay in the construction of the metro, the concentration of relatively small size of many administrations combined with neglect of e-government.

2. What kinds of measurements and policy instruments have been applied to manage traffic congestion?

Inflated prices for parking fines, parking at the termini of the subway

3. What is the experience with public acceptability when parking pricing was implemented?

Discontentedly

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy/law/ regulation point of view?

No

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theories and practices, such as institutional capacity (legal framework, technology and enforcement), public acceptability, political support, existing road network and public transportation system.

5. What in your opinion are the opportunities of implementing congestion charge in Sofia?
- Institutional capacity - There will be none to spend some money
- Public transport - With the extension of the subway have reformulation tasks of other public transport
- Road transport network - To maintain and increase the pace of improvement in recent years

6. What in your opinion are the challenges of implementing congestion charge in Sofia?
- Political support - In the interest of specific individuals
- Public approval – hardly

No 11.

Requirements for confidentiality of personal and contact data (data will be presented only to the thesis supervisor in agreement of non-proliferation)

Date and time of interview:

Name:

Telephone:

E-mail address:

Name of organization the interviewee works for:

Position in the organization:

Location of the organization: Sofia

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia's urban mobility?

- Poor economic and technical conditions of the public transport, except the Subway,
- Lack of long term vision of different transport modes development
- Lack of awareness among citizens about the urban mobility's ideas and future projects
- Last but not least ignorance of the urban mobility ideas and projects among many of the "experts" working in this area

2. What kind of measurements and policy instruments have been applied to manage traffic congestion?

- Establishment and development of a modern road infrastructure
- Introduction of the "parking" fee

3. What is the experience with public acceptability when parking pricing was implemented?

Like any other measure leading to payment congestion charging will provoke resistance among the public but it seems more people are convinced in the good sides of the measure, and in my personal opinion the satisfied will be a majority.

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy /law/ regulation point of view?

I cannot give a concrete answer.

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theory and practice, such as institutional capacity (legal framework, technology and enforcement), public acceptance, political support, existing road network and public transportation system.

5. What in your opinion are the opportunities of implementing congestion charge in Sofia?

- Institutional Capacity – medium level
- Public Transport System – low level
- Road Network System – medium level

6. What in your opinion are the challenges of implementing congestion charge in Sofia?

- Political Support
- Public Acceptability

These are the two main components, without which it is impossible to implement any measure.
It is important that an insufficient public approval does not affect the political support.

Final Remarks and Advice

7. What are your final remarks and advice for implementation of congestion charge in Sofia?

I am not familiar enough with the idea to give an opinion, but I think a mandatory requirement is to do an awareness campaign in order to win the public approval and support.

No. 12.

Requirements for confidentiality of personal and contact data (data will be presented only to the thesis supervisor in agreement of non-proliferation)

Date and time of interview:

Name:

Telephone:

E-mail address:

Name of organization the interviewee works for:

Position in the organization:

Location of the organization: Sofia

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia's urban mobility?

- Lack of political will to implement a strategy for the development of different types of public transport and lack of traffic organization in the city;
- Poor economic and technical conditions of public transport, except of the Subway;
- Poor infrastructure;
- Underestimation of explanatory work among the public.

2. What kind of measurements and policy instruments have been applied to manage traffic congestion?

• Establishment and development of a modern road infrastructure
• Establishment of parking zones in the city and Introduction of the "parking" fee

3. What is the experience with public acceptability when parking pricing was implemented?

Generally it was accepted negatively, but it is observed in all countries implemented the fee. In my personal opinion, under certain conditions, the number of satisfied people grew gradually.

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy /law/ regulation point of view?

It is not feasible.

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theory and practice, such as institutional capacity (legal framework, technology and enforcement), public acceptance, political support, existing road network and public transportation system.

5. What in your opinion are the opportunities of implementing congestion charge in Sofia?

- Institutional Capacity – medium level
- Public Transport System – low level
- Road Network System – medium level

6. What in your opinion are the challenges of implementing congestion charge in Sofia?

- Political Support
- Public Acceptability

These are the two main components, without which it is impossible to implement any measure.
It is important that an insufficient public approval does not affect the political support.

Final Remarks and Advice

7. What are your final remarks and advice for implementation of congestion charge in Sofia?

- Under the existing conditions, the introduction of the "congestion charging" in Sofia is possible in a the long run, depending on the political will;

- Significant condition is to place a well thought-out awareness campaign to gain public support;

- Need of strategy for traffic organization, focusing on policies for parking and transport scheme of public transport.

No. 13.

Requirements for confidentiality of personal and contact data (data will be presented only to the thesis supervisor in agreement of non-proliferation)

Date and time of interview:

Name:

Telephone:

E-mail address:

Name of organization the interviewee works for:

Position in the organization:

Location of the organization: Sofia

Current Policy Transportation Framework and Experience

1. According to you what are the main problems of Sofia's urban mobility?

Insufficient capacity of the public transport and limited capacity of infrastructure (especially in downtown) with ever increasing population.

2. What kind of measurements and policy instruments have been applied to manage traffic congestion?

Reconstruction / improvement of road junctions and abandon of certain vehicles in downtown.

3. What is the experience with public acceptability when parking pricing was implemented?

According to my personal observation (I live in the affected area) – very negative.

4. Do you think that the implementation of congestion charging system in Sofia is feasible from a policy /law/ regulation point of view?
At the moment it is not feasible.

Opportunities and Challenges of Implementing Congestion Charge in Sofia

Based on the literature review of this research, there are opportunities and challenges identified in theory and practice, such as institutional capacity (legal framework, technology and enforcement), public acceptance, political support, existing road network and public transportation system.

5. What in your opinion are the opportunities of implementing congestion charge in Sofia?

- Institutional Capacity – N/A
- Public Transport System – medium level
- Road Network System – low level

6. What in your opinion are the challenges of implementing congestion charge in Sofia?

- Political Support
- Public Acceptability – the most important and difficult task

Final Remarks and Advice

7. What are your final remarks and advice for implementation of congestion charge in Sofia?

According to my personal opinion it is still too early to talk about implementation of 'congestion charging' in Sofia.
Medium and long term perspective depend on the future development of the Sofia's transport system.