



Lund University International Master's Programme in Environmental Science

Potentials of Introduction of Car Sharing Principles into the Transport Sector of Tbilisi as Important Aspect Towards Sustainable Transportation in the Capital of Georgia

Master's Thesis

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Abstract

Attributable to the political, social and economic transformations that occurred in Georgia during the last decade, the transport sector of Tbilisi undergoes significant changes. Subsequently, the city's environment is facing the problems of increasing air pollution, traffic congestion, noise, and limit of place, as well as an overall decline of the social security. Therefore, a commitment to new transport organization and policy framework is needed, in order to ensure the suitable and efficient transportation, along with maintenance of the environmental standards in the city. The aim of this thesis is to analyse the current transport sector of Tbilisi, determine the problems that occur and propose the possible solutions of improvement of existing situation. Furthermore, based on experience to deal with similar problems in western countries, this study investigates the possibilities of introduction of car sharing principles into the transport sector of Tbilisi in order to overcome the environmental side effects of transportation in the city. This study indicates that the major problems in transport sector of Tbilisi arise with increase of driving of private modes of transport. Consequently, this study suggests that the possible solutions of improvement of existing situation are connected to the consideration of the transport sector of Tbilisi under the sustainable transportation concept. Accordingly, this research implies that the measures towards sustainability in the city's transport sector should be based on direct policy measures that imply advanced organization, management and provision of urban transport system as well as on indirect measures and policies, addressed at the activities and services, which generate personal transport demand. Regarding the indirect measures and policies to deal with the increasing number of personal transportation in the city, this paper suggests that car sharing practices in Tbilisi could play an important role in achievement of sustainable transportation by influencing the decrease of excessive private car ownership trend. Furthermore, analysing the possibilities of implementation of car sharing practices in Tbilisi, this study found that car sharing practices could rationalize the travelling behaviour of participants, benefiting on the other hand whole society by decreasing the total amount of private car flow in the city. On the other hand, this research revealed that despite potential cost-saving attractiveness for participants, and positive environmental outcomes, there are several possible barriers to implementation. The most important barriers of implementation are connected to the issue of existing travel behavior of potential participants and low public and political accessibility.

Key Words: transport sector, environmental problems, sustainable transportation, car sharing, diffusions of innovations, public and political accessibility

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I. Table of Contents

1. Introduction	1
1.1 Objectives	1
1.2 Materials and methods	2
1.2 Scope and Limitations	3
2. Theoretical Framework	3
2.1 Transport and the Environment	3
2.1.1 Cities and Environmental Effects of Urban Travel	3
2.1.2 Sustainable Transportation	5
2.2 The Role of Car Sharing in Sustainable Transportation	7
2.2.1 Development of the Car Sharing Paradigm	7
2.2.2 History of Car Sharing Practices	10
2.2.3 Social and Environmental Aspects of Car Sharing	11
2.2.4 Car Sharing and Public Transportation	12
2.2.5 Theory of Car Sharing	12
3. Overview of Transport Sector of Tbilisi	14
3.1 Society, Economy and the Environment	14
3.2 Geography and Demography	15
3.3 Public Transport System	18
3.4 Transport Demand and Transport Behavior	21
3.5 Effects of Transport on the Environment of Tbilisi	21
4. The Analysis of the Problem	26
4.1 System Analysis Approach to the Study of Existing Situation	26
4.2 The Analysis of Possibilities of Improvement of Existing Situation in Transportation	28
5. Results	30
5.1 General Aspects of Implementation of Car Sharing Practices in Tbilisi Context	30
5.2 Introduction into the “SunFleet” Project	32
5.3 Car sharing in Tbilisi Through the Diffusion Theory Scope	34
6. Discussion	37
6.1 Possible Advantages of Implementation of Car Sharing Practices in Tbilisi	37
6.2 Possible Obstacles of Implementation of Car Sharing in Tbilisi	37
6.3 Methodological Aspects of Implementation of Car Sharing in Tbilisi	38

7. Conclusions	40
Appendix	41
References	43

List of Abbreviations

CLD	Casual Loop Diagram
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
CSO	Car Sharing organization
EFOA	The European Fuel Oxygenates Association
EU	European Union
FOE	“Friends of the Earth”
FSU	Former Soviet Union
GDP	Gross Domestic Product
GEL	Georgian Lari
GNP	Gross National Product
HC _s	Hydrocarbons
NO _x	Nitrogen Oxides
OECD	Organization for Economic Co-operation and Development
SO ₂	Sulphur Dioxide
UK	United Kingdom
VOC _s	Volatile Organic Compounds
WHO	World Health Organization

1. Introduction

The twentieth century has brought significant changes in mobility, which have influenced every aspect of the social, economic, political and physical environment within which human societies function. Realities of modern life have influenced the high demand in mobility within industrial, public and personal sectors. In the European Union, passenger and freight transport have more than doubled over the past decades, and private car ownership is approaching the figure of one car for every two inhabitants. These trends, closely linked to changing economies and the increasing number of households, are more than puzzling in a number of European countries with economies in transition, where transport sectors undergo significant changes along with expanding trade, cooperation and globalisation.

Political, social and economic transitions that Georgia undergoes during the last decade have imposed significant changes over the transport sector of Tbilisi. The present situation regarding the problems imposed by transport sector on the environment require urgent response. New approaches in the city transport provision and organization are needed, which would ensure the operational success of transport combined with maintenance and protection of the urban environment (State of the Environment of Tbilisi 2000).

The world practice shows that in order to overcome the environmental effects of personal transportation and the tendency towards a growth in such mobility, it is necessary to make structural changes that include direct measures related with the organization, management and provision of transport infrastructures as well as measures and policies addressed at the activities and services which generate personal transport demand (Gilbert R. 2000).

Car sharing is often promoted as an alternative to vehicle ownership by providing the convenience normally associated with owning a vehicle. Car sharing has been claimed to have significant implications on struggle towards sustainable transportation. A car sharing service makes vehicles available in a way that facilitates multiple users for each vehicle. Hence, as an alternative to vehicle ownership, car sharing can be environmentally beneficial from ecological, social and economical point of view.

1.1 Objectives

The objective of this study is to analyse the present situation regarding the transportation in Tbilisi from the societal, economic and ecological perspectives. According to that, it is implied in this research, to apply the fundamental principles of sustainable transportation to the consideration of transport sector of Tbilisi. Moreover, the objective of this thesis is to study the theoretical background of car sharing. In addition to the environmental implications, the intention is to investigate social and economical aspects behind car sharing, taking into the account the fundamental principles of sustainable transportation. Furthermore, the major objective of the paper is to address the theoretical framework and methodological context of implementation of car sharing principles to the analysis of the possibilities of introduction of

the car sharing principles into the transport sector of the capital of Georgia - Tbilisi. For that purpose, intention is to analyse the past and current situation with transport system of Tbilisi, and investigate problems that occur. Additionally, within the research theme of this study, this paper implies the case study of particular car sharing organization in Sweden, in order to examine practical aspects of car sharing and reveal certain features, which would be applicable for implementation of car sharing in Tbilisi. Furthermore, the main attention will be paid to the investigation of the practical economic, societal and environmental factors, which would be critical for introduction of the car sharing principles on the place. Finally this paper will propose methodological framework of potential implementation of car sharing practices in Tbilisi, and will discuss the potentials and constraints.

1.2 Materials and methods

The theoretical framework of this paper is based on literature review of theoretical and empirical works regarding the concepts of sustainable transportation and car sharing. Furthermore, written reports from existing car sharing organizations were important contribution to this research, as they provided certain practical features to theoretical frameworks.

Contacts with representatives of the Ministry of Environment of Georgia played important role, as they provided essential information regarding the environmental situation in Tbilisi. Additionally, meetings and interviews with persons, actually involved in car sharing practices were important contribution to this work. The case study of car sharing organization “SunFleet” was based on interview followed by specifically created questionnaire (material appended).

The principles of System Analysis were used in order to identify the systematic relationships among various factors from social, economic and ecological domains, which generate the present transport situation in the city. Furthermore, the system analysis was also used in consideration of possible resolutions of the existing transport situation in the city. Within the system analysis approach, in order to determine the dynamic interactions between elements of the system and identify the casual relationships between various elements, factors and variables, the casual Loop Diagrams (CLD) were created.

The elements of the theory of Diffusions of Innovations were applied in discussions of the potentials of introduction of car sharing practices in the transport sector of Tbilisi. In particular, the attempt was made to explain the general steps and elements of innovation process as well as to describe the perceived attributes of introduction of car sharing into the transport sector of Tbilisi as an innovative process.

1.2 Scope and Limitations

The issue of car sharing is a relatively new research theme. Due to the great potential outcomes and comparatively limited existing time of car sharing practices, no fundamental works yet exist. Consideration of car sharing through the scope of sustainability is especially motivating dilemma, as it requires composite consideration from the social, economic and ecological domains.

The main intention of this paper is to see the existing complex problem from the environmental perspective, and try to refer the innovative solution to the different strata of social units, who are involved or responsible for the problem. Therefore, the scope is limited by more or less qualitative analyses of causes and effects, possibilities and constrains.

Moreover it should be stated that if considering the actual implementation of innovative car sharing solution into the changing socio-political unit like Tbilisi, more scrupulous consideration of economical, social and political, factors are required before decision would be made.

2. Theoretical Framework

2.1 Transport and the Environment

In order to adequately examine the problems that occur in the transport sector of Tbilisi, and farther analyze factors, which would be critical for potential implementation of car sharing practices on the place, it is necessary to consider environmental implications of urban travel and to clarify the notion of sustainable transportation. Furthermore, for better understanding of potentials of car sharing, it is necessary to define the theoretical context of car sharing and investigate the role of car sharing in sustainable transportation.

2.1.1 Cities and Environmental Effects of Urban Travel

Cities are essential component of modern societies. One of the characteristic features of the twentieth century was the extraordinary urban growth. Greater demand for mobility, more possibilities to travel and different patterns of travel, has been rapidly rising over the few past decades, mainly driven by urban development. Urbanization generates economic and social development, however on the other hand leads to the side environmental problems.

The convenience of motorized transport hardly needs explanation. The private motor vehicles provide incomparable levels of mobility, flexibility and comfort. But their use unfortunately has side social and environmental impacts: loss of natural ecosystems; deteriorating air quality; noisy residential streets; deterioration of the public realm and dangerous road environments.

Environmental costs of personal transportation are to a large degree concentrated in urban areas. Urban traffic emissions have a greater impact on the environment and on human health as more people are exposed in cities and the traffic volume is higher, and the noise nuisance is generally larger than in rural areas. The contribution of urban transport to air pollution is one of the most important among others. Emissions from vehicles which cause concern are carbon dioxide (CO₂), carbon monoxide (CO), oxides of nitrogen (NO_x), sulphur dioxide (SO₂), the volatile organic compounds (VOC_s – mostly hydrocarbons HC_s), lead, particulates and smoke (OECD, 1995). For example, according to “Friends of the Earth” (FOE report 2002), the road transport is a major source of air pollution in UK. In London, traffic is responsible for 99 percent of carbon monoxide, 76 percent of nitrogen oxides and 90 percent of hydrocarbons. Analysis of government experts shows that when particulate levels exceed health standards, then road traffic’s contribution is in the range of 75-85 percent. In a recent report, UK Government experts concluded that between 12,000 and 24,000 people might die prematurely every year as a result of short-term exposure to air pollution. The report added that a further 14,000 to 24,000 hospital admissions and readmissions might also be caused by this air pollution (FOE report 2002). One of the most well known impacts of air pollution is an increase in asthma attacks. There are many more potential health effects of air pollution from road transport. For example, the reaction of pollutants with natural sensitizers may also possibly underlie an increase in the incidence of other allergies, such as hay fever. Some pollutants, such as ozone and nitrogen dioxide may also increase our susceptibility to infection. Carbon monoxide can aggravate angina. Diesel and petrol exhaust fumes are considered respectively to be ‘probably’ and ‘possibly’ cancer causing. Car exhausts certainly provide the bulk of most peoples exposure to numerous toxic substances including 1,3-butadiene, benzene, formaldehyde and polyaromatic hydrocarbons, all of which are known or probable cancer causing substances (FOE report 2002). According that issue, pollutant emissions related to passenger-km is, in general, considerably lower for public transport than for cars. However, as a result of significant technological improvements in car technology, in some cases the balance may have been reversed. Thus, the actual differences between car and public transport depend on the type of vehicle used, the fuel used and on vehicle occupancy. The potential of public transport depends furthermore on the local and regional land use and mobility patterns. The efficiency of public transport is linked with the density of land use, size of the population and the dispersion of trip origins and destinations. Public transport is also effective where congestion is a severe problem (Gilbert R. 2000).

Besides, pollutants from the road surface, such as lead, cadmium from tires and other chemicals from oil spills, could affect the quality of ambient environment by contaminating urban rainwater run-off (OECD 1995, p.63).

Congestion is counted to be a problem practically for all countries. This problem is especially keen for countries with generous transport system and poor road infrastructure. It is difficult to estimate the true costs of congestion because it depends very much on the definition chosen. However, the total cost of the time spent traveling in OECD countries is equivalent to roughly 7 percent of GDP. (OECD 1995, p.50)

Another side environmental effect of urban transport is considered as road casualties. For example, each year only in the European Union 55000 people are killed, 1,7 million are injured and 150000 permanently disable on the roads (OECD 1995, p.52). Apart from the human suffering, caused by road casualties, the consequent economic and social costs are high in all countries. Overall costs of road casualties and collisions in OECD countries are estimated to be equivalent to approximately 2 percent of GDP. (OECD 1995, p.52)

Analyses carried out during past decades showed that road traffic was the most common cause of disturbing noise in people's homes. On this basis, almost half of the urban population in EU is adversely affected by road traffic noise, ranging from 34 percent in Denmark to 74 percent in Spain. (OECD 1995, p.64)

Increasing urban traffic is the cause of congestion, noise, pollution and accidents in almost all cities all over the globe. People are becoming more dependent on cars and this has adverse effects on everyone, especially on those without a car. Solving the cities environmental problems is therefore the key to a sustainable transportation.

2.1.2 Sustainable Transportation

Today, the world is more aware that the Earth does not have limitless resources we can continuously draw on. Sustainable development becomes an important concept to understand and sustainable transport is one of the central themes to sustainable development.

There are many definitions of sustainable development, including this one which first appeared in 1987: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."(from the World Commission on Environment and Development's(the Brundtland Commission) report "Our Common Future" (Oxford: Oxford University Press, 1987)).

Sustainability means adjustment of different functions and structures of societies to the condition, at which rate of maintenance of ambient environment resources of societal structures would be combined, at the same success, with social and economical development. Transport is the core of this process because it defines the spatial and temporal boundaries of production and consumption and has the potential to accelerate resource depletion and environmental degradation, or support energy and resource conservation (Whiteleg 1993, pp.12-13).

Therefore, sustainable transportation is an issue that implies consideration of transport through the perspectives of environmental, economic, financial sustainability as well as social, and political sustainability.

Environmentally, current transport systems are non-sustainable due to its contribution to global warming and various negative environmental and ecological impacts, as it is discussed in section 2.1.1. Moreover, modern transports systems rely greatly on fossil-fuel resources,

which are finite. Many of the alternatives to this fuel are, unfortunately, also fossil fuel - based, for example natural gas or methane produced from that source. Such alternatives are also not totally without negative environmental impact. Alternative fuel or newly developed transport modes like electric cars etc are also currently economically and socially still not very feasible and popular for common people to use (Black, 2000).

In addition, motor vehicle accidents resulting in death or serious injuries also imply that current transport systems are not contributing to social sustainability. Congestion and other related traffic ills are also unfairly exerting social costs on people who may not be benefiting from the problem generating transport mode. Many researchers state that the physical environment, available technology as well as individual preferences and social conditioning are currently limiting sustainable transport (Black, 2000).

However, in order to approach the idea of sustainable transportation and overcome the side environmental effects of modern transportation activities, many authors state that it is necessary to make structural changes that include not only direct measures related with the organization, management and provision of transport infrastructures, but also other types of indirect measures and policies addressed at the activities and services which generate personal transport demand (Gilbert R. 2000).

One of the important tasks towards sustainable transportation is based in attainment of more efficiency in transportation patterns. Regarding that aspect, very important is the relation of total vehicle mileage covered, which is generated by a certain travel demand, to the occupancy of a vehicle. Generally, if a certain transport demand is met through other transport alternatives than one person in one car, the vehicle mileage would decrease, positively affecting environmental conditions. (Ekman, 1996)

Furthermore, one of the significant objectives for moving towards sustainable transportation is connected with improvements of energy efficiency of vehicles. Improvements in pollution control can have a significant effect. By making cars less harmful, such measures can improve air quality in ambient environments, thus encourage the decrease of environmental problems. (Ekman, 1996)

Another objective, which can be taken to achieve the sustainability of transport sector, is effective and appropriate use of regulation and economic instruments (taxes on fossil fuels and carbon emissions, tradable permits, etc). Many scholars assert that this kind of measure should be used when appropriate and should be adapted to the specific features of the various environmental problems (Gilbert R. 2000).

Regarding the urban transport, many researchers state that there is considerable potential to reduce personal transportation through adequate spatial organization of society and land-use planning policies. Planning for transport is an important element of spatial planning. More effective spatial organisation could decrease travel distances as well as transportations demand. So spatial planning policies for personal transport should be able to influence both the spatial structure and the transport mode and infrastructure (Workshop paper of British-German Environment Forum 2001).

Another important measure to reduce personal transportation in urban areas is related to the possibility of influencing travel and driving behavior by means of education and publicity

campaigns, which affect the attitudes and knowledge of travelers. With a growing recognition of the environmental problems, it could be expected that by providing information on the costs imposed by current travel behavior and the benefits to be achieved by changes to such behavior for the individual users and for whole society, behavioral change could help the improvement of the environment thought reduced or changed travel behavior (Gilbert R. 2000).

Modern western practice shows that some strategies for reduce private car ownership could also be very relevant. The necessary actions may include development of services that substitute not so much for regular uses of the automobile as for uncommon uses. One of the examples of this approach is introduction of car sharing services.

Personal transport depends on many factors that are virtually unconnected with the transport sector itself: lifestyles, economic conditions, location of facilities and services, residential trends, etc. Therefore, measures and policies to reduce environmental effects of personal transportation require broad and relevant consideration of social, economic and ecological aspect in order to provide more sustainable transportation.

2.2 The Role of Car Sharing in Sustainable Transportation

2.2.1 Development of the Car Sharing Paradigm

The essence of car sharing implies the common use of vehicles by various users in succession and independent of each other. The duration and goal of individual car trips is self-determined by the respect of a car user. In case of using the same car by various persons at the same time (e.g. several people going to the same workplace in the same car), one speaks of carpooling (Car Sharing 2000).

The difference between car sharing and car renting practices mainly consists in much flexible and convenient possibilities of possessing a car in case of car sharing. According to its functional structure, car sharing can generate advantages for users providing flexible short-term reservation possibilities (Car Sharing 2000)

Car sharing is a relatively recent phenomenon. Even decade ago it was unusual to speak about big car sharing projects anywhere in the world. Nowadays, there are hundreds of ongoing car share operations, thousands of vehicles being used, more than ten thousands of people involved in car sharing projects.

In the original car sharing projects back to the seventies and eighties, people decided to participate in car sharing because they knew each other and because it appeared to be convenient enough and could save them funds. Many of the early adopters of car sharing, in their decision to participate, have been followed by a personal commitment to a better environment. However towards expansion of car sharing practices, the reasons for participating have broadened. (Car Sharing 2000)

Considering present car sharing practices, most of all, it seems that people are deciding to participate in car sharing because of economic and convenience factors. Furthermore, car sharing becomes an especially attractive alternative of a car, for people who live in built-up areas, or who do not commute every day. Additionally, practices show that participants of car sharing use other ways of commuting, including public transport, walking, biking, ride sharing or even using modern telecommunication technology, such as teleworking and so on. Participation in car sharing involves the matter of its flexibility. The practice is that one can try to participate in car sharing for a while, and if it doesn't appear convenient enough-participant can stop use it. (Car sharing 2000)

Practice of car sharing show that, while sharing cars with others, an unplanned use of cars is more difficult, because the most important feature of car sharing is an uncoupling of the ownership and use of a car. "Organized car sharing" is the function of utilizing of a car, under which actions are directed somewhere between traditional forms of "private car sharing" and car rental. Under original car sharing conditions back to origins, "the private car" was often a resource, which was shared within a restricted circle of users, normally located in or around a specific household and encompassing relatives and friends. Organized forms of car sharing challenge this conception by creating a new car ownership paradigm for transportation. The concept of organized car sharing, merges the current division between "public" and "private" forms of transport and creates the possibility for integration and transformation of the existing transport regime (Car sharing 2000).

On the figure is shown how car sharing fits into the new transport configuration:

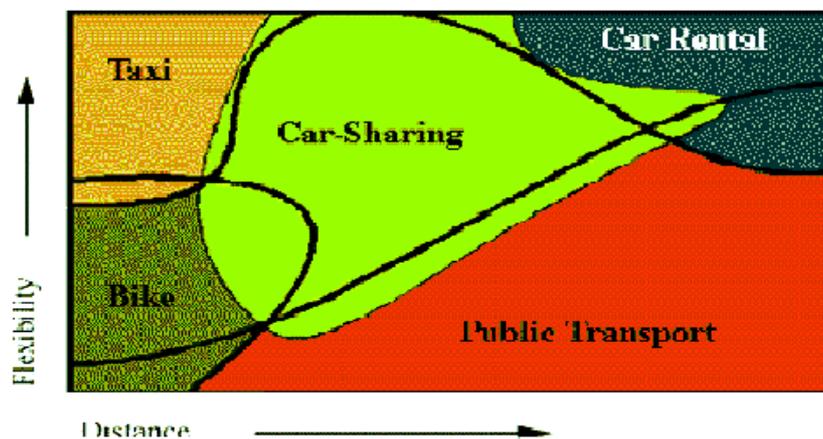


Fig.1. The place of Car Sharing in new transport configuration¹.

¹ Source: Car sharing 2000

Organized car sharing creates a new car possessing paradigm, by offering a new comfortable and flexible availability of a car, freeing a car user at the same time from all negative implications of actual car ownership (e.g. insurance expenses, maintenance and repairing costs). The development of such a system has only been possible in the last decade and is considered as a product innovation in the transport sector.

During the existence of car sharing practices, a number of organizational models have been established. Car sharing might take a variety of forms. It might be neighbourhood based, encompassing the residents who use the vehicles for short round trips; it might serve individuals commuting to work, it might provide business commuting purposes of organizations, or it might be a complex multi-modal transport system serving various users.

In general, it can be distinguished three types of organization of car sharing services (Klintman 1998).

Public sector based car sharing

This sort of car sharing practices represent an event when participants use vehicles owned and provided by authorities. In general it can be said that mostly public sector based practices of car sharing represent sort of pilot experiment projects, which aim at investigation of potentials revenues. For example, in Bellevue, Washington, the city government offered city-owned passenger vehicles for city employee commuters. This measure helped to solve the parking problem in the particular area.

Private company based car sharing

This form of organization of car sharing practices implies the practice of sharing a car under the provision and management of operations by a private company. This way of organization of car sharing activities seems to be more economically rigid and organizationally stable, because as shows practice, business approach to car sharing initiatives are the basis for organization's economical success. For example such companies as "Statoil" and "SunFleet"² in Sweden provide car sharing operation on a profit oriented basis, ensuring at the same time high level of operations and services.

Car sharing cooperatives and clubs

This form of organization implies that members or participants of car sharing activities establish cooperatives or clubs in order to share the cars with themselves. Generally, this form of car sharing practices implies that members of cooperatives or clubs provide themselves with car sharing practices on non-profit basis. The examples of this kind of organizational form could be found in initially small, local based car sharing projects (e.g. ATG in Switzerland). However, as members and consequently car sharing operation and start to increase, this organizational form tends to convert into the private company based organizational form.

² More detailed description of "SunFleet" project will be presented in farther chapters.

2.2.2 History of Car Sharing Practices

Many car sharing organizations were initiated couple decades ago, and a few even earlier, mostly in Europe, supported initially by government grants. Most involved shared usage of a few vehicles by a group of individuals. One of the earliest European experiences with car sharing can be traced to a cooperative, known as "Sefage," which was originated in Zurich, Switzerland in 1948. Membership in "Sefage" was primarily motivated by economics. It attracted individuals who could not afford to purchase a car but who found sharing one appealing. Elsewhere, a series of "public car" experiments were attempted, but failed, including a car sharing initiative known as "Procotip," begun in Montpellier, France in 1971, and another called "Witkar," deployed in Amsterdam in 1973. (Sperling, et al, 2000)

More successful experiences with car sharing began in Europe in the late 80s. In 1999, approximately 200 CSOs were active in 450 cities throughout Switzerland, Germany, Austria, the Netherlands, Denmark, Sweden, Norway, United Kingdom, France, and Italy, collectively claiming over 130,000 participants (Car Sharing 2000).

The two largest car sharing organizations are "Mobility Car sharing Switzerland", with 1,400 cars, and "Drive Stadtauto" (formerly StattAuto Berlin) with about 300 cars. The Swiss program, begun in 1987 and now operates in 700 locations in over 300 communities, with over 30,000 members. Drive Stadtauto, begun in 1988, now operates in 110 locations and has approximately 7,500 members. (Sperling, et al, 2000)

As of 1999, there were only nine car sharing organizations in North America. They all follow the operational model of most European car sharing practices: private individuals acquire cars from nearby neighbourhood lots and return them to the same lot. Four of them operated on profit basis, and the rest were run as non-profits cooperatives. In total, as of 1999, these nine CSOs had about 1600 members and operated about 115 vehicles. Portland, Oregon was the pioneer, starting car sharing in early 1998 by establishing the for-profit company 'Car Sharing Portland'. In Seattle, the city and surrounding King county offered funding (approximately \$600,000 for three years) to launch a for-profit private venture marketed as 'Flexcar' run by Mobility Inc. Starting in 2000, Flexcar already had 170 users within the first three weeks of operation. In Chicago, a project called "ShareCarGo!" began operation in 2000 with 12-14 vehicles, about 100 members, and 5-6 sites. (Sperling, et al, 2000)

Five of the nine North American CSOs are located in Canada. The oldest, Auto- Com in Quebec City began operations in August 1994 and had 450 members and 34 cars in 1999. This organization began as a non-profit cooperative, but changed to a for-profit business in 1997. In September 1995, it launched a second for-profit CSO in Montreal, CommunAuto, Inc., which had 550 members and 32 cars by 1999. (Sperling, et al, 2000)

Car sharing activities in Asia are more limited. Most prominent is the Car Co-op, launched in Singapore in 1997. It uses an electronic key box and on-board computers. Residents of two neighboring condominiums automatically become members and have access to a fleet of shared cars, including a Mercedes-Benz limousine and several multi-purpose vehicles, as well as sedans. As it expands, the intent is to provide one car for every 40 residents. (Car Sharing 2000)

2.2.3 Social and Environmental Aspects of Car Sharing

As it reveals analysis of modern car sharing practices, with the exception of a particular group of people who may be ideologically motivated, generally individuals decide to participate in car sharing, without consideration of environmental and social benefits. However, these environmental and social benefits may be large. If these effects are large, then it is important for the success of car sharing to quantify them so that government, employers, and others will be encouraged to support car sharing. Large environmental, economic, and social benefits can be generated with car sharing primarily through a reduction in vehicle usage, but also by reducing the demand for parking space. It should be mentioned here, that the price for making a trip/journey in a car sharing system is often more direct and obvious than in the case of owning a car, since all costs, direct and indirect, are included in the price of trip/journey. Therefore, vehicle travel will tend to be reduced because of participants' interest to reduce the vehicles per-usage cost of driving (Sperling, et al, 2000).

The impacts of non-market and indirect benefits from car sharing practices are large according to several car-sharing surveys. "Autodate" in Utrecht, Nederland reports of a 39 percent reduction in vehicles ownership of their participants. In Oslo, Norway, 68 percent of individuals reportedly gave up a vehicle after participating in car sharing (Klintman, 1998).

Reduced car ownership generally translates into reduced driving behavior. Mobility Car Sharing Switzerland study reported that car mileage for individuals who owned private vehicles was reduced by 33 to 50 percent after they joined the CSO. Most of these individuals increased public transportation usage to meet many of their other transportation needs. In the Netherlands, former car owners reduced car mileage by 37 percent—from 15,907 to 10,095 km (9,880 to 6,270 miles) annually. (Car sharing 2000)

As to environmental implications of car sharing, in order to fully understand the environmental potentials of car sharing, it is essential to consider the whole, complex influence of car sharing on a particular transport sector. As it shows practice, participants of car sharing, in their daily transportation demand, are more likely tend to use either public or non-motorized modes of transport. Therefore, by shifting some segments of their travel demands to more environmentally friendly modes of transportation, the side environmental outcomes of their mobility are proportionality reduced. This can lead immediately to lower aggregate fuel consumption, fewer air emissions, less noise and less transport accidents.

Car sharing practices are especially valuable for urban areas. If we take into account the significant economic and social value of prime urban real estate and space, the potential of car sharing has to be among its most important assets. Additionally, cities would benefit from potential environmental improvements. By decreasing the number of cars on the streets, there would be potential savings for the improvement and maintenance of transport infrastructure.

2.2.4 Car Sharing and Public Transportation

Public transport is essential component for car sharing practices, and is usually used to cover the main mobility requirements of the participants. On the other hand, public transport system gains from car sharing practices as it increases the number of public transport users. For example, in Switzerland, the 20000 existing car sharing customers spend 23.2 million Swiss francs a year on public transport season tickets – around 2.6 million francs more than before they joined the scheme. It is projected that with full exploitation of the user potential, public transport will be able to increase its revenue by over 300 million Swiss francs thanks to increased sales of season tickets (Car Sharing 2000).

As shows practice, the mobility behavior of car sharing customers is strongly oriented towards public transport and other more environmental friendly forms of mobility. This tendency is very important, for the meaning that the longer people use car sharing, the less they actually use the car sharing vehicle. Participant of car sharing learn to make better use of existing alternatives and to organise their car travel more efficiently. Additionally, with car sharing, customers no longer need to keep their own car, and are therefore able to save the associated fixed costs. Participation of car sharing makes it possible to lower fixed costs. The money thus saved is then at their disposal for other activities, and when they spend money for mobility purposes, they want the best possible price-to-performance ratio. Since public transport is both cheaper and more environmental friendly, it represents the right balance for participants of car sharing practices. (Car Sharing 2000)

However, introduction of car sharing practices and its integration into the public transport system is a complex matter. It should be understood as a sub-system and part of a much greater whole transport system. Cities can provide themselves with an integrated, full function, multi-modal transportation system that offers a real alternative to the private car. This is the real bottom line of car sharing from the overall public interest perspective.

2.2.5 Theory of Car Sharing

While considering the implementation of new transport innovations, it should be mentioned that it is difficult to estimate demand for new markets, new technologies and new attributes when customers have no experience with those products and attributes and when those attributes remain to some extent uncertain. Determining the demand for shared cars is especially difficult because it implies some reorganization of a travel patterns and lifestyle. People use and view their cars in many different ways and value them by different socio-economic categories. In that context, arise the questions about social economical and environmental factors, which are essential for acceptance of car sharing. (Car Sharing 2000)

Social acceptance of car sharing is a complex issue, which includes consideration of particular society, environmental values and actions toward environment. The relation between human

society and the automobile is studied from a number of perspectives within behavioural and social sciences. In the social sciences concentrated in study of environmental problems in society, initial attention is usually given to human actions, which are thought to be positively or negatively associated with certain environmental problems. The term “environmental action” implies human action believed to be associated with the particular environmental problem. Environmental action or environmentally related actions can include policy-making actions at the structural or systemic level. Different kinds of environmental actions can be distinguished based on three variables: 1) simple actions with less consequences to everyday life of every household. This action is closely related to the nature of the actions. 2) Actions that are less supported by social and physical structures. This measures are connected to the social context of involved variables 3) Actions, which consequences for other parts of everyday life vary from less to more depending on households characteristics. This kind of actions is connected to household lifestyles. In order to understand the degree of feasibility of an environmentally beneficial action, all three aspects need to be taken into account. Regarding the environmental actions connected to automobile use, the number of environmental factors such as: air pollution, traffic congestion, impact on ambient ecological systems, etc. are taken into account. Furthermore, specific types of actions have to be put in relation to their alternatives for environmental improvement. (Klintman 1998)

Besides, as state many researchers, the economical issue in car sharing acceptance process would play a major role, From a user's viewpoint, the success of a car sharing scheme is dependent on getting a car easily when they want to use one. Generally the cost savings for participants are one of the major advantages of Car Sharing compared to the private car. This relative advantage is the result of their differences in cost structure (Zegras, et al, Car sharing 2000). The costs of car usage are normally determined by six major different cost factors: depreciation, interests costs, taxes, insurance, fuel costs and repair and maintenance. Only the last two cost factors (fuel costs and maintenance and repair) are directly related to the extent of use and are therefore called variable costs. The other cost factors are fixed costs. The economic benefits of Car Sharing for the participants arise from the elimination of the fixed costs of possessing a car. By sharing these costs with car-sharing participants, a substantial financial benefit can be created for each of them. From the service providers viewpoint they wish to meet the users' needs with a minimum number of vehicles. This benefits the users as well as the service provider gains arises from balancing capital and operative costs of the vehicle fleet and users pool. These aspects come together as the **car / user** ratio. The actual user ratio of a scheme is dependent on many factors, such as the level of local services in walking distance and public transport service quality, cycling suitability and so on. But the user ratio is also dependent on the size of the scheme itself. As schemes become larger the percentage variation in demand is reduced and the supply of vehicles can be harmonized more closely to the average demand of the user pool. Under these circumstances, the needs of users can be supplied from a minimum number of cars. This is defined as the Scale Efficiency of car sharing (Car Sharing 2000) and gaining this efficiency can be seen as the core business of car sharing in extracting value from the use of fewer cars. Balancing the value of costs of operation for car sharing organizations, and users' pool is therefore the basis for its economical success

3. Overview of Transport Sector of Tbilisi

In order to properly investigate the factors behind potentials of introduction of car sharing practices into the transport sector of Tbilisi, a composite consideration of the social, economical and environmental factors, which have been influencing the present situation, is necessary. Hence, within this paragraph, we try to present background information on Tbilisi.

3.1 Society, Economy and the Environment

Georgia is one of the former Soviet republics, which regained its independence after the broke-up of the Soviet Union in 1991. With a population of 5,066,499 inhabitants (July 1999 est.) and an area of 69,700 sq. km, Georgia is considered a small country with a developing economy. While building a new democratic society, Georgia is currently undergoing a process of political reforms, structural and institutional changes and transition to a market economy. The country's GNP in 1993 was 66.4 percent of 1992 GNP, 37.8 percent of 1991 GNP, and only 30.3 percent of 1990 GNP (1991 World Bank estimations). One of the main reasons for this decline is industrial underproduction caused by disruptions in traditional economical ties with other former Soviet republics that were traditional suppliers of raw materials, energy and other industrial input items for Georgia. Other reasons include the inability to access traditional former Soviet Union markets to sell locally manufactured products and the remnants of central planning and bureaucracy (Republic of Georgia – Economic Trends and Outlook).



Fig.2. Map of Georgia

Tbilisi, as a capital of a country with the transitional economy, is undergoing considerable social-economic and political changes. Urbanisation of Tbilisi during the Soviet period had the significant scale. Currently Tbilisi is more populated than even any single province of Georgia. The tendency towards urbanisation has led to the emergence of Tbilisi as a single hypertrophic centre, with a concentration of more than 25% of the population of Georgia. Such an unbalance was further exacerbated by the fact that the third largest city- Rustavi, with a population of about 158 000 and a centre for heavy industry, is situated very close to the capital. As a result, the rising formation of the Tbilisi-Rustavi urban agglomeration, containing about one third of the total population of Georgia, has attracted the great majority of rural-urban migrants. Because of this, the progress of other urban centres has held back, and the development process remained unbalanced. (State of the Environment in Tbilisi, 2000)

Regarding the economic situation in Georgia and particularly in Tbilisi, it must be mentioned that at present, economic patterns undergo significant changes in Georgia. The most common trends are the depression of industry and increase in trade and communications. Disruption of traditional soviet market and sharp increase of the prices of raw materials, and, especially, instability of energy has made operation of many industrial enterprises in Tbilisi unprofitable. During the last years commercial activities in Tbilisi are characterised by the reduction of the state sector and the development of private sector. If in 1990 the state trade share constituted 95%, in 1993 95,5% of the overall volume of trade fell on the private sector. (State of the Environment in Tbilisi, 2000)

In Tbilisi, traffic related problems have been increasing primarily since the collapse of former Soviet Union and the decline of the economy. It should be mentioned that during the last decades, there was no integrated transport policy in the city. The majority of vehicles are old Soviet made models and imported obsolete 8-10 years vehicles with exhaust emissions exceeding permitted levels. Most of these vehicles have no catalytic converters. A general decline has also occurred in the provision of public transport. There has been a consequent increase in the use of private vehicles, which results in excess emissions per transport unit and other side effects. The low quality of roads and frequent traffic jams also tend to increase the impact of personal transport (National Environmental Action Plan 2000).

3.2 Geography and Demography

Tbilisi is located at 44⁰,80' longitude and 41⁰,69' latitude of the Eastern Hemisphere, in the eastern part of Georgia. The population of Tbilisi is 1,339,105 inhabitants, and total area of the city is approximately 200 km². The built-up area of the city is almost 65 km². The average population density is 3885 inhabitants per km². (State of the Environment in Tbilisi, 2000)

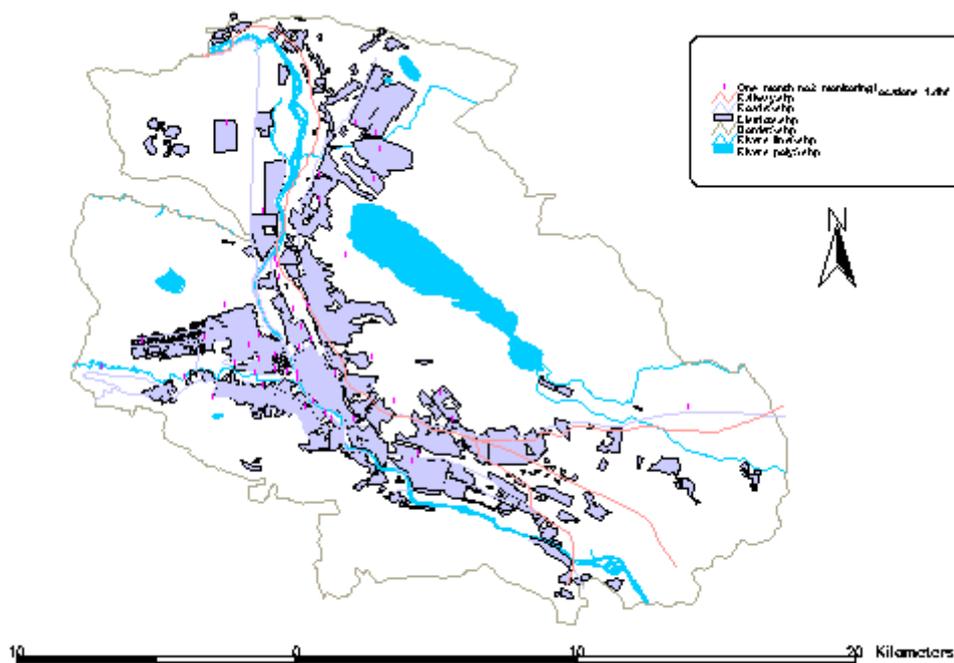


Fig.3. Map of Tbilisi

Tbilisi is split into 10 districts as shown in Figure 3.2.

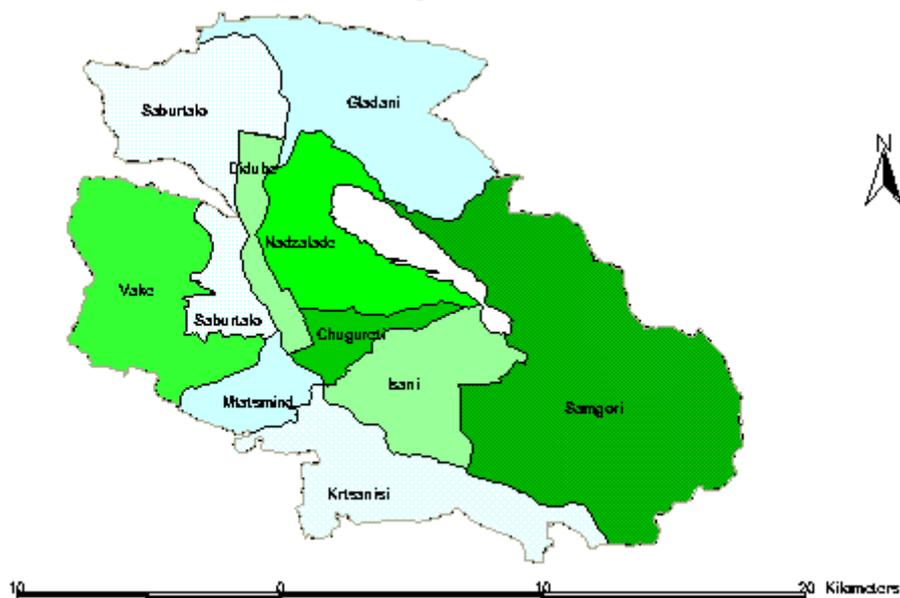


Figure 4. Location of the 10 Districts in Tbilisi

Table 1 shows the districts and the population in each district.³

³ Data source: Ministry of Environment of Georgia

Table 1. The population density in the 10 districts of Tbilisi

District name	Population	Area of district (km ²)	Population density per km ²
1. Nadzaladevi	204,556	22.5	9,091
2. Didube	101,421	10.8	9,390
3. Chugureti	96,032	15.0	6,402
4. Mtatsminda	62,638	11.9	5,263
5. Vake	126,050	36.2	3,482
6. Krtsanisi	50,022	34.9	1,433
7. Isani	208,121	57.0	3,651
8. Samgori	141,787	78.9	1,797
9. Gldani	201,867	47.0	4,295
10. Saburtalo	146,611	36.0	4,072
Total	1,339,105	350.2	3,824

The Following figure shows the split of stricture of population by age.

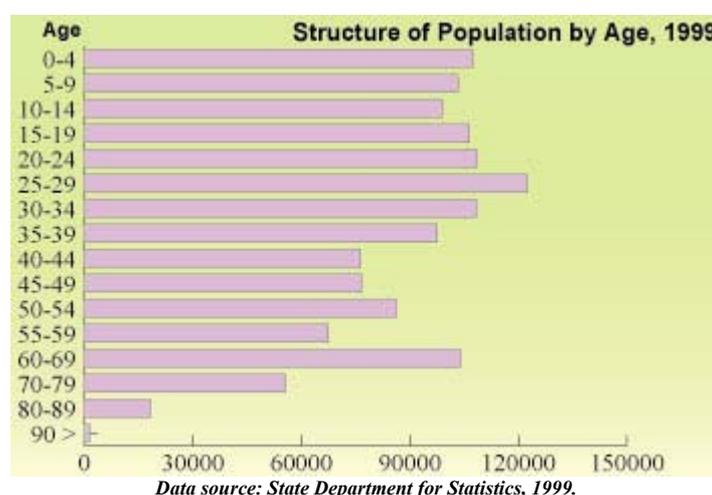


Fig.5. Structure of population by age

3.3 Public Transport System

Buses

Current economic and social processes in Georgia led to a transformation of transport services in Tbilisi. Because of the created situation the public transport has been facing many difficulties. Under the socialist system, responsibility for urban transport was very centralized under the control of a transport ministry of Georgia. Usually there was a division of the central agency at each regional level, which serviced and controlled the operations of the vehicle parks. In most cases these vehicle parks would have contained urban and inter-urban buses, and often freight vehicles as well (Gwilliam, 2000). Operations were very non-commercial. A large proportion of passengers would be carried free or at reduced rates. Accounting systems were also typical of the socialist system, being based on cash flow rather than accruals. Capital was obtained as a grant from the state (Gwilliam, 2000). In Tbilisi, the responsibility for the urban transport was held by transport organization “Tbiltrans”. Besides routine urban transportation operations, the Central Dispatching office of “Tbiltrans” was controlling the optimal transportation capacity and quality of the passenger transportation in Tbilisi. Nowadays, Central Dispatching Office of “Tbiltrans” has stopped functioning. Therefore, the control and management of optimal transportation of the city passenger transport are amorphous now (Esakia, 2002).

In Tbilisi government responded to the emerging financial crisis, followed by the collapse of the Soviet Union, by decentralizing financial responsibility for urban public transport sector. During that processes, almost all transport units and transport infrastructure of former traffic companies were privatized and sold out. As a result, towards more stabilization of socio-economic situation, the lack of passenger transport as well as organization and management of optimal passenger transport flow in the city has revealed to be. Regarding that, in order to substitute the lack of high capacity passenger transport, which was privatized and sold out, and obtain high level of the traffic frequency in the city, city administrators decided to include private trip minibuses on the passenger transportation routes. Nowadays in Tbilisi are 5000 minibuses on 270 traffic routes (Esakia, 2002). However, the decision of inclusion of minibuses on the transport routs was done without estimation of the potential optimal quantity. On the other hand, some scholars argue that, the provision of transportation on the traffic routes with appropriate traffic frequency of passenger transport units (quantity of passenger transport units per unit time) is very important for the optimal traffic flow in the city (Esakia, 2002). By means of inclusion of high number of minibuses on the transport routs, it happened in the city that traffic frequency of passenger transport flow increased. It might be true that when the traffic frequency increases, the traffic interval between transports unites decreases at the same time and accordingly, there decreases the passenger waiting time. However, irrational increase of the traffic frequency of passenger transport without consideration of the demands of the traffic flow in the city, contradicts with optimal transportation requirements. On the other hand, the use of transport with small passenger capacity at the time of big density of passenger traffic causes the increase of the probability of traffic jams and the decrease of the transportation speed. All that causes the decrease of the security level of transportation and provokes the lowering of environmental condition in Tbilisi.

Trams and Trolleybuses

During the soviet times, Tbilisi possessed adequate-functioning tram and trolleybuses systems. As in buses case, they management was centralized and operations were highly non-commercial. Following the collapse of former Soviet Union, the situation with trams and trolleybuses in Tbilisi became worse, in sense of deterioration of Vehicle Park and infrastructure. In year 2000, city administrators together with ministry of transport decided radically improve the existing situation by creating new, united commercial transport organization for trams and trolleybuses, which would be under the control and responsibility of the city council. In August 2001, as donation, this newly created organization received 70 units of used trolley buses from the city council of Athens (Greece). In October 2000, by initiative of city council it was opened new trolleybus route. It must be said that trolley buses lines cover almost all regions of the city. At present, construction of new trolleybus line to Gldani-Nazaladevi region is under the process⁴.

The information gathered at the Ministry of Transport of Georgia, is as following:

Table 2. Number of transport units by years.

Year	Trams	Trolleybuses
1990	111	209
1995	60	124
2000	39	74
2001	35	82
2002 (9 months)	32	135

Table3. Number of passengers carried by years.

Year	Trams	Trolleybuses
1990	3481,5 thousand	4698,9 thousand
1995	2948,9 thousand	53648,7 thousand
2000	5491,6 thousand	10374,0 thousand
2001	7535,5 thousand	11961,6 thousand
2002 (9 months)	3535,9 thousand	11009,3 thousand

The length of trolleybuses line is 207,0 km. As to trams, they only are functioning in Gldani-nadzaladevi and Isani-Samgori regions of the city. The length of trams lines is about 69,5 km.

⁴ Source: Ministry of transport of Georgia

Table 4. Number of transport routs by years.

Year	Tram	Trolleybus
2002	4	11
2001	4	13
2002	2	14

Generally it can be said that due to the lack of funds to renew the vehicle parks and modernize the infrastructures, these types of public transport cannot compete with other public transports types regarding the speed and quality of transportation. However, trams and trolleybuses are the cheapest way of transportation in the city. It should be mentioned additionally, that renovation of vehicle parks and improvement of infrastructures of trams and trolleybuses could positively influence the passengers' turnover volume in total public transport system.

Metro

It has been a norm under the socialist system that cities of more than 1 million population merited a metro system. Tbilisi was one of the first cities of the Soviet Union to have a subway system. The system consists of twenty-three kilometres of heavy rail lines, most of which are underground. Three lines with twenty stations radiate from downtown, with extensions either planned or under construction in 1994. The system is heavily used, and trains run at every four minutes throughout the day. In 1985, the last year of available statistics, 145 million passengers were carried⁵.



Fig.6. Map of Tbilisi metro.

⁵ Statistics of the Ministry of Transport of Georgia

The first line (Didube-Samgorskaya) opened in 1966 from Dibude to Rustaveli (6.3 km, 6 stations) via the city centre. A few years later it was extended towards the south to 300 Aragveli (1967) and Samgori (1971). During the 1980's it reached its current length of 21 km with 16 stations. In 1979, the second line (Saburtalinskaya) began operating between Vagzlis Moedani (railway station) and Victor Gotsiridze. In the year 2000 it was extended to its current terminus Vazha Pshavela. The line has a total length of 7.5 km with 6 stations.

3.4 Transport Demand and Transport Behavior

At present, there are no periodic research activities concerning the density of the personal transportation in Tbilisi. There is no study regarding an Origin-Destination survey. The typical origin-destination study consists of performing a survey of motorists as they travel through an area to study their travel habits. The origin-destination study is useful for obtaining information on existing travel patterns, so that the efficient transport movements can be planned by investigating: where vehicles begin and end their trips; what types of vehicles are used to make those trips; when these trips are generally made (time of day), and why the trip taken (work, shop, eat, school, etc.) (Abrahamsson, 1998).

Additionally, there is no research on the tendency of cycling and walking. There is not determined the average length of the passenger transportation, and the average time according to transportation modes of trips. This research is necessary for the correct organization and management of passenger transport system, and for relevant redistribution of personal car flow in the city (Esakia, 2002).

However, taking into account the tendency of increase of commercial activities in Tbilisi, mentioned in paragraph 3.1, it can be projected that the share of trips for business purposes within whole amount of the city's transportation would increase. Furthermore, towards more stabilization of socio-economic situation, the share of trips for purpose of cultural and welfare facilities would also increase.

3.5 Effects of Transport on the Environment of Tbilisi

Concentrated motorcar traffic poses different dangerous consequences on the Tbilisi environment. Air pollution, noise, conjunctions, car accidents have the significant influence because of side environmental and health effects.

Air pollution

The problem of air pollution is a key environmental problem for Tbilisi. Currently major sources air pollution in Tbilisi come from transportation (State of the Environment in Tbilisi, 2000). Total amount of motor vehicles driving in the city is estimated to be more than 113,000 (The State Traffic Police, 1999), 94,216 from which are in a private ownership. Most vehicles are obsolete and use extremely low quality fuel, which is imported mainly from Romania, Bulgaria and Russia (gasoline), and Azerbaijan (diesel). There has been conducted comparison of annual average concentration by different air pollutants during the last 15 years (1984-1998). The analysis show that situation with air pollution from major pollutants (CO, Particulate Matter, SO₂, NO₂) is serious. The concentration of pollutants in the air still remain very high concentration and many times exceed any permissible level: either former Soviet, and currently Georgian MPC (Maximum Permissible Concentration), or WHO Air Quality Guidelines (AQG). Additionally analysis revealed that the higher concentration of harmful substances exists in the central districts of the city, because of the excessive traffic activities and low dispersion of pollutants in the atmosphere. (State of the Environment in Tbilisi, 2000)

The following figures summarise the recent air quality data available and list annual average concentrations.

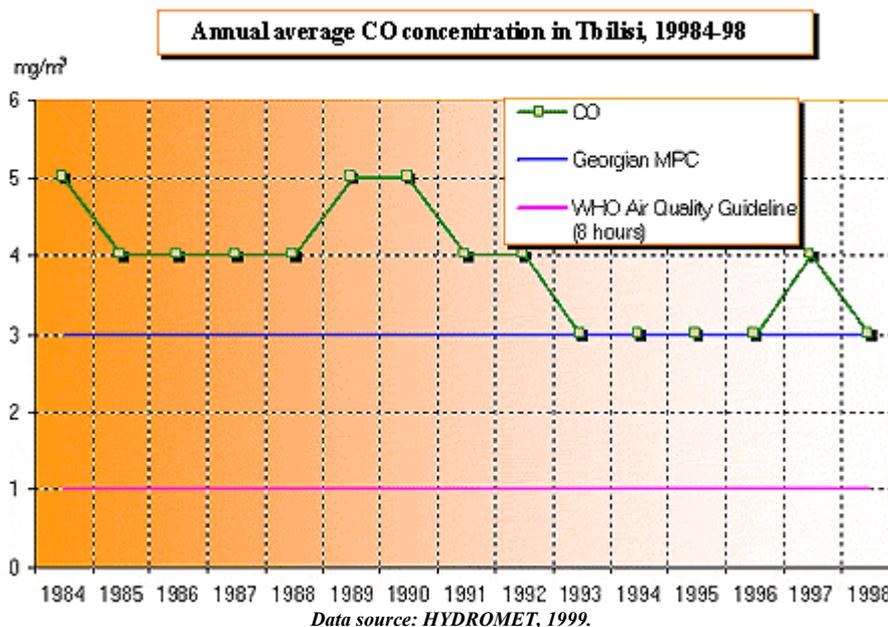


Fig.7. Annual average CO concentration in Tbilisi by years.

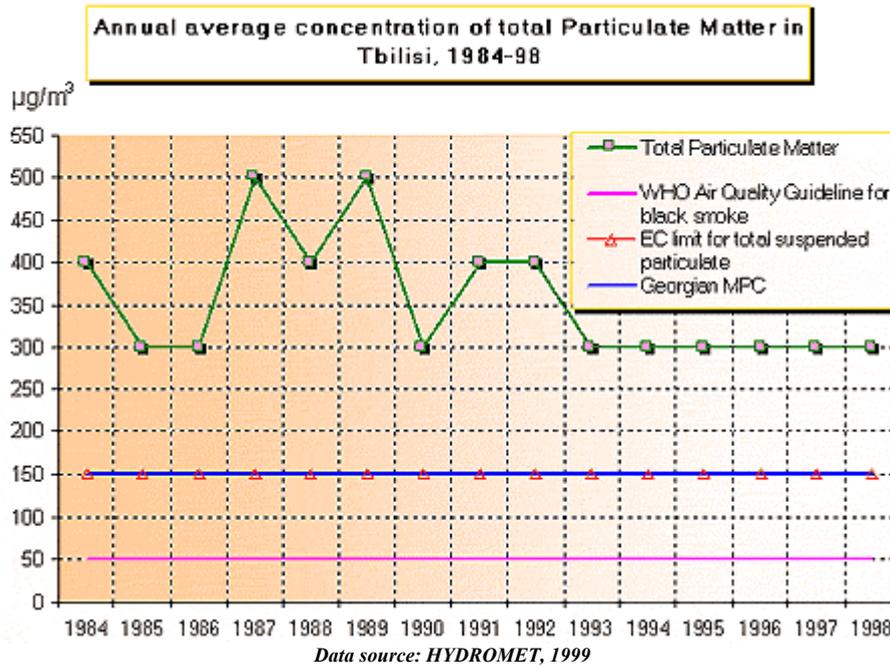


Fig.8. Annual average concentration of Particulate Matter in Tbilisi by years

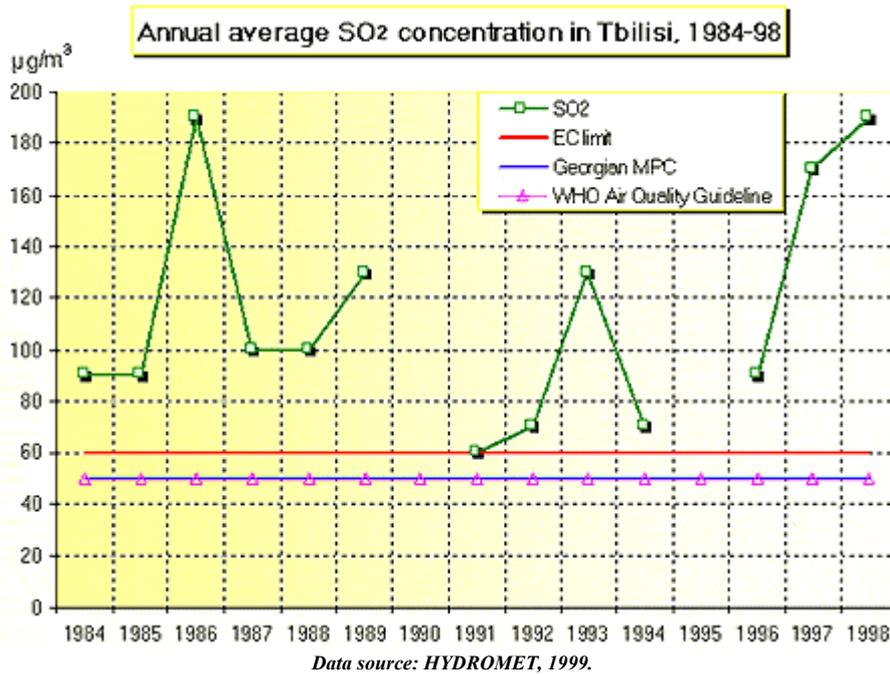


Fig.9. Annual average SO₂ concentration in Tbilisi by years

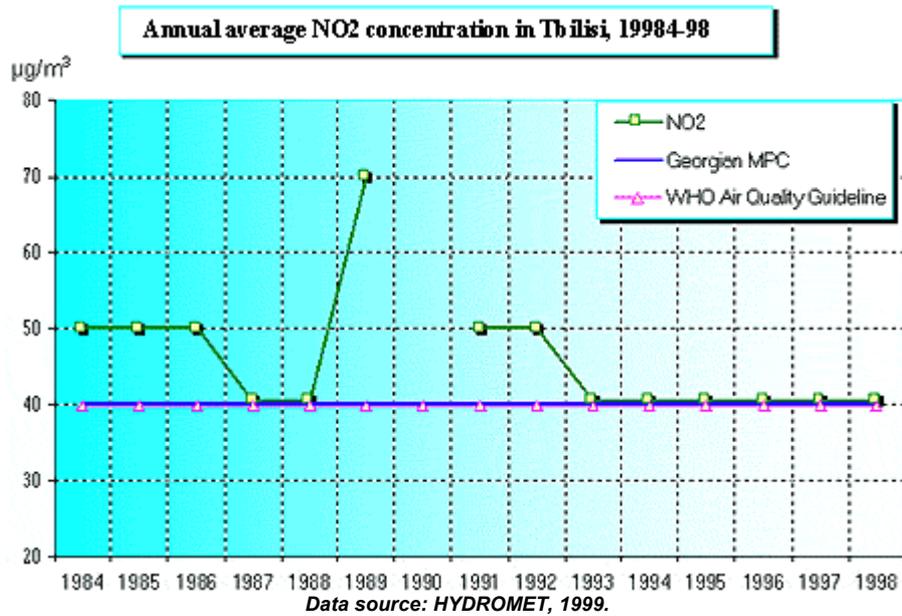


Fig.10. Annual average NO₂ concentration in Tbilisi by years

It should be mentioned that authorities understand that the air quality situation in Tbilisi needs the realization of urgent measures, and therefore as a basis of farther measures towards improvement of air conditions, it is necessary to harmonize its legislation to the requirements of the EU regarding the air quality standards.

The effects of air pollution on human health

A major impact of the severe air pollution in Tbilisi is related to increased level of respiratory and other illnesses. The situation is exacerbated during the summer time, when the temperatures' inversions are very low and as a result, harmful substances cannot disperse in the atmosphere. Hot sunny days and light winds, together with high traffic emissions, provokes photochemical activities in the lower part of Tbilisi (central districts). Thus, there are frequent cases of photochemical smog. These cause a reduction in visibility, eye irritation for humans and serious plant damage. Due to this fact, children and the elderly are encouraged to leave the city during the summer. (State of the Environment in Tbilisi, 2000)

Road accidents

Changes in economy, social conditions and changes in political state have had a significant impact on traffic conditions and safety. Conditions of transport infrastructures and quality of motor vehicles highly contribute to accidents in transport sector of Tbilisi. Regarding that, unsatisfactory state of the roads probably stipulates high rate of accidents. Besides, with the opening of the economy to international trade, many western models of automobiles have

been introduced into Georgia. Compare to soviet models, they can generate much faster speeds, competing therefore for road space at different speeds. Most of the vehicles, as they are old soviet models, are not equipped with air bags. No child safety seats are used because no laws requiring they use.

Additionally, the characteristics of travelling manner and driving culture also influence the accidents statistics. The percentage of accidents due to drunk driving probably remains to be high in Tbilisi. Unfortunately, statistics were not gathered as to the number of total people injured due to drunk drivers. In Tbilisi there are many underground crosswalks, especially in the central parts. However, because of the poor conditions, pedestrians do not use them much.

The statistics regarding the traffic accidents in Tbilisi, gathered from the State Traffic Police are as follows:

Table5. Statistics of accidents related with transport in Tbilisi

Year	Number of traffic Accidents	Injured	Death-roll
1988	2396	2801	668
1989	2621	3070	797
1990	2963	3484	1067
1991	3574	4391	1145
1992	2504	3253	883
1993	1522	1913	542
1994	1539	1977	494
1995	1567	1910	450
1997	1644	2076	449

Noise and Parking Space

It should be mentioned that, noise in Tbilisi is hardly monitored. However, it can be said that Tbilisi is a rather noisy city, especially the central parts of it due to the intensive traffic flow. Additionally, the roads in the central part of the city are narrow and the traffic is much heavier. Besides, the centre is the most densely settled area (average 25.5 thousand inhabitants per sq.km) for this reason the traffic in the centre is heavy even during the night hours. The intensity of automobiles is relatively lower in summer - from the middle of July until September. The city orography contributes to the spread of the noise: from the centre noise spreads to the city hillsides. (State of the Environment in Tbilisi, 2000)

Inadequate land-use planning processes also greatly contribute to environmental quality in the city. The arrangement of payable parking in the central streets of Tbilisi creates difficulties and inconvenience for citizens. Most of the parking places are mainly arranged directly along the main streets, and therefore they reduce the space for the movement of the traffic and slow down the speed, thus creating the possibilities for traffic jams. (State of the Environment in Tbilisi, 2000)

4. The Analysis of the Problem

4.1 System Analysis Approach to the Study of Existing Situation

The theory of systems and the system analysis, which have been developing for the last 50 years, have found a wide application in many branches of science. The reason of this fact consists, most likely, in dynamisms of processes in the field of human activity as well as in an opportunity to use the system approach practically in any problem solved by man. A system approach provides a multidimensional framework in which information from different disciplines and domains can be integrated without being forced into a one-dimensional mapping. A system approach to sustainability can be used to clarify points of disagreement between human and environmental factors, and hence facilitate a decision-making process in this field (Clayton et al, 1997. pp.12-14).

According to the task of investigation of possibilities of introduction of the car sharing principles into the transport sector of Tbilisi under the sustainable transportation framework, it must be stated that the consideration of sustainability of the transport sector of Tbilisi implies the complex consideration of the relevant social, environmental and economical factors. Therefore, we can apply the principles of system approach to sustainability problem, in order to analyse the interactions between the complex human system and all directly implicated environmental systems.

Applying the system approach method to our task, we may consider Tbilisi as a complex system, which consists of number of subsystems. Regarding that, in order to create the hypothetical model of the system, under which our problem could be unified, we must define the elements or subsystems of our main system. In other words we need to identify the “main actors” of our problem. Analysing this problem, it became clear that the “main actors” of our problem are: human society of Tbilisi, transport sector of Tbilisi and environment of the city. Furthermore, in order to understand the system properly, we need to define how system behaves and what its property are. According to this, we need to define the system level we are observing. In other words we must define the boundaries of the system. Analysing the problem, it become clear that the problem occurs within hypothetical boundaries of the certain urban unit and its surrounding environment. Following to the system approach principles, we can deem that the goal of sustainability of transport sector of Tbilisi is to maintain the balance between human society and surrounding environment.

In order to farther determine the systematic relationships between various elements, factors and variables, which are identified in an issue of this problem, lets create the casual Loop Diagram (CLD), by means of which we can determine the dynamic interactions between elements of the system and identify the main driving forces to obtain a balance within our system.

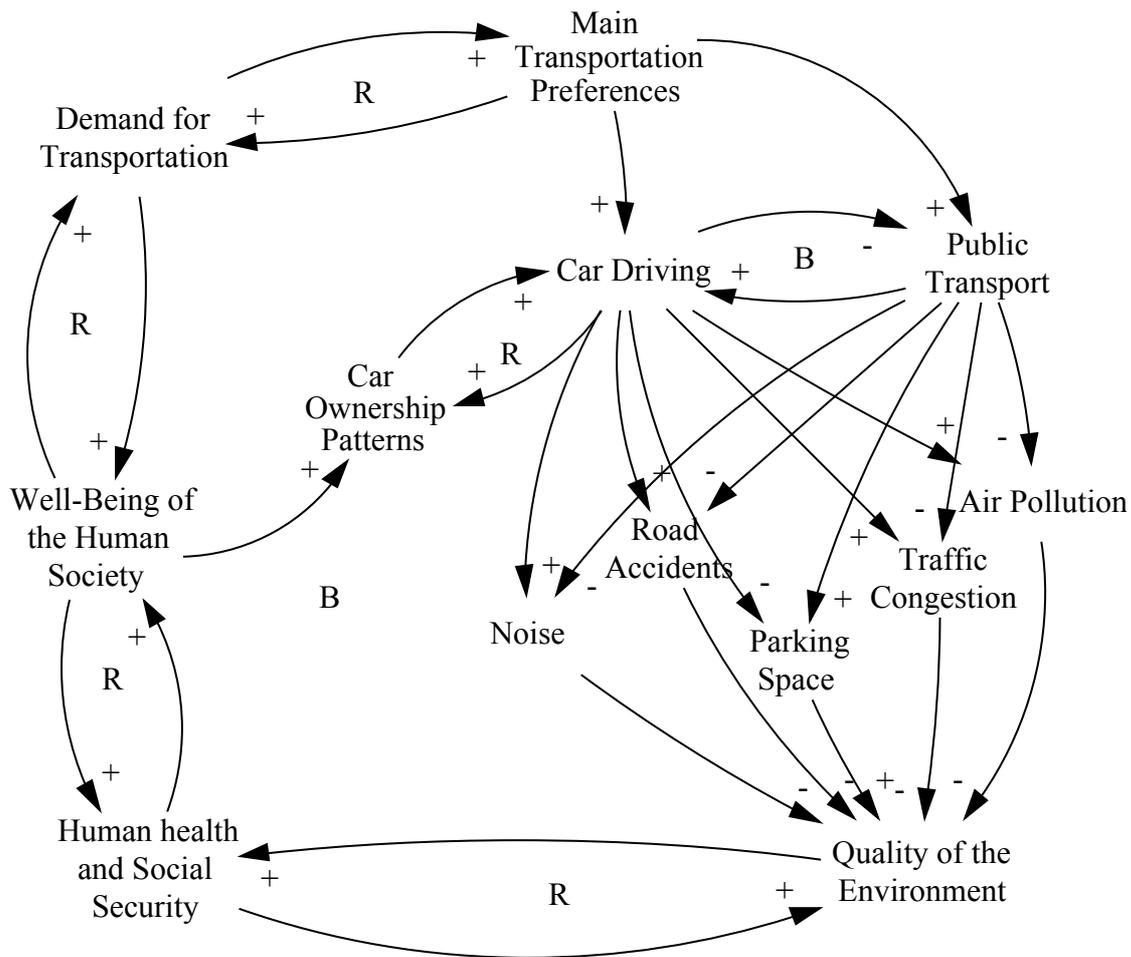


Figure.11. CLD of the transportation situation in Tbilisi

The causal loop diagram (CLD), shown above, consists of two balancing and five reinforcing loops, and represents a hypothetical model of interactions of factors behind the existing situation with transportation in Tbilisi.

According to CLD, the existence of human society of Tbilisi requires continuous and growing demand for transportation, which is defined by main transportation preferences of citizens. The preferences of transportation are determined by either of driving of private cars or use of public transport. On the other hand, a number of socio-cultural factors behind well being of certain strata of human society characterize the demanding car ownership patterns, which additionally lead to car driving. Following the logic of CLD, use of both cars and public transport has its own environmental and social side effects. They are: air pollution, road accidents, traffic conjunctions, noise, and growing requirement for parking space. However the contribution of car driving and use of public transport to above-mentioned side effects are different. Due to the fact that public transport system of the city, beside buses and minibuses includes ground and underground electric transports, which take major passenger turnovers,

the major environmental side effects arise from car driving. From CLD it follows that all side effects of transportation lead to worsening of quality of environment in Tbilisi. Furthermore, deterioration of environment of Tbilisi leads to decrease of human health and social security, which finally reflects on the decrease of well being of human society of Tbilisi.

As mentioned before, transport sector of Tbilisi is a complex system with lots of subsystems interacting with each other. The key problem appears with the decrease of public transport modes in overall transport sector of the city. The increase of number of private motor vehicles causes an increase in emissions, noise, social security, and thus a further deterioration of the environment.

4.2 The Analysis of Possibilities of Improvement of Existing Situation in Transportation

As we have seen from the examination of the environmental, social and economic conditions in Tbilisi, the current transport system doesn't meet the requirements of sustainability. The city's environment is facing the problems of air pollution, traffic congestion, noise, and limit of place, as well as an overall decline of the social security. The major problems arise with increase of driving of private modes of transport in the city. Taking into consideration the practice of dealing with the similar problems in European countries, the possibility to improve transport system in Tbilisi is connected with development of a sustainable transport system. Therefore, as it has been stated in paragraph 2.1.3, in order to fulfil the requirements for a sustainable transport system in Tbilisi, it is necessary to make structural changes by means of direct measures related with the organization, management and provision of the transport system, as well as implement other types of indirect measures and policies addressed at the activities and services which generate personal transport demand.

Regarding the organization and provision of urban transport system, it must be stated that the development of a relevant transport system, which will be able to meet the needs for efficient transport flow across the city and maintain the environmental standards, it is necessary to consider the measures towards the following directions:

1. A significant decrease of private transport flow in the city (especially in the central parts) by means of improvement and reorganization of traffic management.
2. The attainment of control and management of modern standards of noise and exhaust gases, which is normal for European countries.
3. The development and stabilization of adequate public transport system in association with municipal and private carriers.

Additionally, as it has been stated in paragraph 2.1.3, there are possibilities to reduce personal transportation through adequate spatial organization of society and land-use planning policies. At present, many of the central parts of Tbilisi are overfilled with redundant transit traffic flow of cars. The relevant redistribution of transit traffic flow of vehicles from central parts to outer ones would be efficient measure to optimise the personal transportation in the city. Regarding the city passenger transport, it would be advisable to redistribute the certain quantity of minibuses (which move on the overfilled routes) from the center to the periphery

The casual Loop above consists of two balancing and eight reinforcing loops, and represent hypothetical model of transition from present - to proposed sustainable mode of transportation in Tbilisi. As it was in CLD describing existing situation with transport sector of Tbilisi, well-being of human Society requires growing demand for transportation. However, in new CLD, demand for transportation is determined by sustainable transportation hypothesis. Taking into the account the possible steps towards sustainable transportation mentioned above in this paragraph, the transition to sustainable transportation implies fulfilment of changes towards two general directions: 1) Direct transport organizational and provision measures, which imply improvement in public transport system and relevant reorganization of transport infrastructures to limit the excessive personal car driving, especially in the centre of the city; 2) Indirect transport measures and policies aimed at the reduction of the personal transport demand, implied car sharing. According the logic of the CLD, the direct measures would improve and rationalize the transport infrastructures, where the indirect transport measures (car sharing) would influence the car ownership patterns that are generated within certain socio-economic strata of the society, in turn reducing the car driving in Tbilisi. Similarly to previous CLD, decrease of car driving in the city would reduce the environmental side effects of personal transportation. Decrease of the side effects would cause increase of environmental quality in the city, which would influence the human health and social security conditions, in turn enhancing the well being on the human society.

5. Results

5.1 General Aspects of Implementation of Car Sharing Practices in Tbilisi Context

During the last decade, many strategies aimed at reducing the impact of car use (e.g. legislative control of fuel quality and exhaust emissions) have been proposed. However, there has been a shortage of initiatives in transport planning and policy frameworks to deal with the increasing number of personal transport by means of development and implementation of services that substitute regular use of automobiles.

As it has been shown in theoretical part, car sharing practices can play an important role in achievement of sustainable transportation by influencing the decrease excessive private car ownership trend. However, regarding the implementation of car sharing practices on the place, the spectrum of actual social economic and political factors should be taken into account. Considering the existing car sharing practices, it should be mentioned that at present, the majority of CSO operate mostly in developed countries of Western Europe and America. The social-economical backgrounds of such innovation in transport sectors represent robust socio-economic systems, in contrast to the newly independent countries of Europe like Georgia, where societies undergo the transition from planned economies to market ones. Besides, some scholars assert that environmental concerns might play a certain role in the formation process and in individuals' predisposition to become participants of car sharing (Shaheen et al, Car sharing 2000).

Generally, it can be true that in Georgia and other countries of the Former Soviet Union, environmental concerns might sometimes be not comparable to those of western societies of this world. This situation is mainly caused by present transition conditions of the societies, and partly by socio-cultural remnants of the socialistic past. However, realities of modern life, which imply more integration of Georgia into the European community, would influence the society to accelerate the environmental conciseness. Even at present, environmental issues are growing in importance among a certain spectrum of social strata. However, even in the absence of serious environmental consciousness, the potential for CSO formation should not be discounted. For example, a 1994 survey in Germany on the motivations behind car share users identified the most important reasons for CSO use as: convenient location (71%); high probability of an available vehicle (45%); low tariffs (30%); and the availability of a safe/reliable vehicle (23%) (Shaheen et al, Car sharing 2000).

On the other hand, despite the differences in economies and social sectors, some scholars assert that it might be some predisposition to dismiss CSOs as a “luxury” mobility tool, appropriate only for the highly mobilized and wealthy markets of the western world (Zegras, et al, Car sharing 2000). In modern era of globalisation, where international integration and economical co-operation influence each branch of social and economic life, the potentials of car sharing would be noteworthy not only for one particular city, but also for whole geopolitical unit at whole. According to that issue, regardless present complex socio-economic situation in Georgia, which is mostly tailed by the disintegration of the Soviet Union, when traditional economic relations among the Member Republics were ruined, yielding a tremendous decline in economic activity, the current situation and the progress achieved in the industrial sector, if compared to the previous years, could be evaluated as potentially positive. The most important and positive aspect is the fact that practically all segments of the industrial sector are characterized with the relative stabilization. For example, the growth of total industrial production reached 8.8% in year 2000, compared to the same period of the previous years (Economic Growth Program of Georgia 2000). Another positive trend is the increased activity of small businesses, the total number of which reached 2,296 organizations, by October 2000 (Economic Growth Program of Georgia 2000). The volume of the goods produced by small businesses accounts to 94.3 million GEL, which is 14.5% of the total industrial production. This figure has grown by 11,1% in comparison to the same period of 1999, while the growth of total sector is 8%. (Economic Growth Program of Georgia 2000). Therefore, one can argue that towards more stabilization and socio-economic development of the society, potentially, car sharing practices can be truly considered by policy makers.

Additionally, car sharing activities can be considered actually by public transport providers in Tbilisi. According to government of Georgia, in contrast to other sectors, the development of the transport sector of Georgia is relatively stable. In recent years, the indicator of the number of passengers transported by the public transportation facilities has increased. For example, in the first 7 months of year 2000, this number has increased by 6.7% compared to the same period of the previous years. This is caused primarily by the improvement of service level in this sector. In the same period, the city electric transportation usage (which is the one of the main way of traveling in the city) has also increased (84.6 million people) by 16.5% compared to the previous year figures (Economic Growth Program of Georgia 2000). Public transport planners in Tbilisi should recognise that there are synergies to be drawn from car share programs to meet this new-age transport challenge. Regarding that aspect, it can be said that existed public transport infrastructure and modal split, in terms of use of electric transport, could be counted as potential for possible car sharing practices. However,

improvement of public transport sector, which is spine-bone for car sharing customers, is essential for practical consideration of implementation of car sharing.

Furthermore, it must be said that the important factors that determine potentials for implementation of car sharing practices on the place, lie on correct choice and use of target group of customers/users. Some scholars assert that there are many different potential markets that can be divided and subdivided profitably, using a suitable approach. For example, the market can be divided into individual and corporate customers (Muheim et al, carsharing 2000). Taking into account the characteristics of transport sector of Tbilisi and social and economic conditions in the city, in this regard, it would be worthwhile to include the business sector as a basis target group of customers at the initial stages of implementation of car sharing activities in the city. The inclusion of business sector would ensure the economical and socio-political stability of the possible car sharing organization. This approach to car sharing practices is new even in western car sharing practices; however, there are some successful examples that prove that this approach has much to offer due to its relevant customers-orientation features.

5.2 Introduction into the “SunFleet” Project

SunFleet is one of the most successful and environmentally sound car sharing organizations in Sweden. SunFleet is based in Gothenburg, Sweden and provides car sharing for business organizations and companies. Initially, SunFleet was launched as a pilot project “mobility.nu” by co-operation with international car rental company Hertz in 1998. At present company exists under a limited company status, and represent a modern service company offering a flexible mobility.

Sunfleet is oriented in its service towards business companies and different organizations. Moreover, the employees of the member companies can use the car sharing service privately if they have an agreement with SunFleet. As to the number of users within companies, it is difficult to estimate the exact number due to the fact that during the business trip, occupancy of the cars vary in each case. Potentially, SunFleet plans to expand its service area by attracting private persons as customers.

The following figure shows the application area of car sharing practices of SunFleet in terms of enhancement of transportation efficiency by reducing the number of vehicles that are required to meet total travel demand

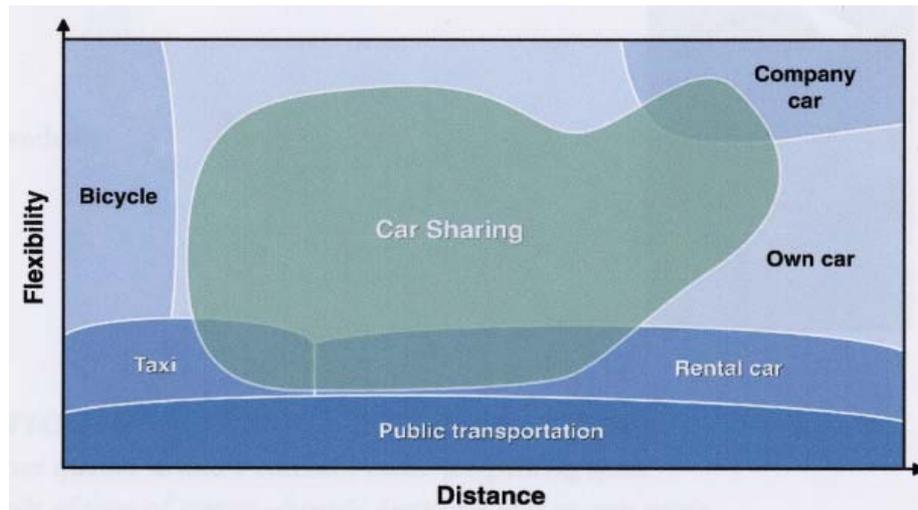


Fig 13. Application area of car sharing practices of SunFleet

Back to establishment, “mobility.nu” only had 3 cars. At present, SunFleet manages a fleet of 20 cars at 6 member companies. Potentially, the company aims at increase of its fleet to 50-70 cars by the end of this year. SunFleet provides environmentally vehicles, such as Volvo S70 Bi-fuel and Toyota “Prius”. SunFleet has a leasing agreement with Volvo, which ensures the permanent renovation of vehicle fleet. Furthermore, car rental company Hertz collaborates with SunFleet regarding the vehicle fleet maintenance and repairing.

The customers can book the cars 24 hours a day. The reservations can be made via Internet (www.Sunfleet.com), which is free of charge and which offers the following choices: registration and booking online, prolongation, shortening, or cancellation of the bookings. Regarding the use of car access and booking information and telecommunication systems, it should be mentioned that SunFleet utilises the original telematics system, developed by Pilotfish (Gbg) and the booking system Frontec. In opinion of the company, the booking system developed by Drive-IT could not be considered appropriate, as it could lead to dependency on the system, in terms of farther technological developments.

Beginning from this year, SunFleet adapted a new car access system allowing the customer to access the car via mobile phone, using SMS. The customer reserves his car by Internet, and the system sends him a SMS to the mobile phone with PIN code, by means of which the door opens. The car or locker only opens if there is a valid reservation registered for the corresponding customer and if the customer types in the right PIN. After the trip, the respective data (using hours, mileage) are transferred back to the local branch office where an automatic billing is carried out.

Regarding the administrative aspect of its business activities, SunFleet shows high flexibility and efficiency. At present, one employee ensures all daily operational and administrative aspects. The reason for this high effectiveness is determined by use of modern information and telecommunication technologies. Additionally, in its functioning company applies for external services to provide some necessary administrative services (e.g. accounting, insurance, legal aspects, etc.)

According to company's opinion, the public transportation and car sharing is complementary and both partners profit from the cooperation: public transportation becomes more attractive by offering car sharing and vice versa. Co-operation with public transport is under propriety of the company. At this moment, there are undergoing negotiations with railway and Bus companies to obtain discounts for SunFleet customers.

Regarding the market measures to attract customers, SunFleet arranged several meetings and presentations aimed at various organizations and companies. SunFleet also uses different media channels. Recently, SunFleet has started collaboration with Gothenburg Student Housing Organization, to promote car sharing among students.

In sum, it can be stated that existence and successful operation of SunFleet underlines that there is much to learn and foresee from business car sharing practices. The successful and relevant application of that type car sharing scheme is determined by correct choice of target customers and relevant market strategies.

5.3 Car sharing in Tbilisi Through the Diffusion Theory Scope

The introduction of car sharing practices into the transport sector of Tbilisi can be considered as an innovation in the transport sector, which involves farther social outcomes from the perspectives of general principles of social changes. If we consider the problem of this research theme through the Diffusion of Innovations paradigm posited by Everett M. Rogers, it would be possible to clarify many aspects of this innovation, and understand the main factors that the potential adopters may utilize in their decision on this innovation.

Everett Rogers first formulated the Theory of Diffusions of Innovations in 1960. According to this theory, the innovation-decision process is the process through which an individual (or other decision-making) unit passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision. The main elements in the diffusion of new ideas are: an innovation, communication channels, time and the social system. Innovation is communicated through certain channels, over time, among the members of a social system. Rogers defines innovation as an idea, practice, or object that is perceived as new by an individual or another unit of adoption. A communication channel is the means by which messages get from one unit of adoption to another. Time is defined as important element of diffusion process as it determines the innovation process. A social system is defined as a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal. A change agent is an individual, who influences clients' innovation-decision in a direction deemed desirable by a change agency. (Everett M. Rogers. 1995, pp.5-38)

Rogers suggests there are five main steps in the adoption process:

1. Knowledge,
2. Persuasion,
3. Decision,

4. Implementation

5. Confirmation

People go through these stages at different rates. By grouping people according to how quickly they adopt an idea, Roger came up with five categories: Innovators, Early adopters, Early majority, late majority, and Laggards. Adopter distribution tend to follow an S-shaped curve over time and to approach normality. Dominant attributes of each category are: Innovators-venturesome, Early adopters-respect, Early majority- deliberate, late majority-skeptical, and Laggards- traditional. (Everett M. Rogers. 1995, pp.252-280)

Rate of adoption of an innovation is defined as the relative speed, with which an innovation is adopted by members of a social system (Everett M. Rogers. 1995, p.206). The factors that impact the rate of adoption of an innovation include: 1) the perceived attributes of the innovation, 2) the type of innovation-decision, 3) the communication channels, 4) the nature of the social system, and 5) the extent of change agents' promotion efforts. Of all five of these factors, it is perceived attributes of the innovation that explains the major variance in the rate of adoption. This factor, perceived attributes of the innovation, is composed of five aspects: Relative advantage, compatibility, complexity, trialability, and observability. (Everett M. Rogers. 1995, pp.208-244)

Considering our research problem through the scope of Diffusion of Innovation Theory, it would be noteworthy to explain the perceived attributes of the potentials of introduction of car sharing practices in the transport sector of Tbilisi. Regarding that we should refer to the notion of Relative Advantage. Relative advantage is defined by Rogers as the degree to which an innovation is perceived as being better than the idea it supersedes (Everett M. Rogers. 1995, p.212). It is often expressed as economic profitability, social prestige, or other benefits. The nature of the innovation determines what specific type of relative advantage is important to the adopters, although the characteristics of the potential adopters also affect which sub dimensions of relative advantage are most important. Generally, it can be stated that the potentials of implementation of car sharing activities in Tbilisi would provide relative advantage of an economic type to potential participants by saving them fixed costs of possessing a car, ensuring the flexibility of traveling, and makes available much more environmental advantages for the city in terms of improvement of social and ecological conditions. Diffusion scholars have found relative advantage to be one of the best predictions of an innovation's rate of adoption. Relative advantage indicates the benefits and the costs resulting from adoption of the innovation.

The second predictor of adoption is compatibility. Compatibility is a degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters (Everett M. Rogers. 1995, p.224). An innovation can be compatible or incompatible: 1) with socio-cultural values and beliefs, 2) with previously introduced ideas, or 3) with clients needs for the innovation. Addressing this issue to potential adoption process, the problem of implementation of car sharing activities in Tbilisi should be compatible with: 1) the socio-cultural values and beliefs of potential participants of CSO, 2) previously introduced ideas, and 3) society's needs for improvement of existing transport and environmental situation. Consistency with current ideas and methods may have an unpredictable effect: it may speed up adoption, slow down adoption, or cause new methods to be inappropriately applied. Therefore, compatibility is only a moderate predictor of adoption.

The third factor of innovation adoption identified by Rogers is complexity. Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use (Everett M. Rogers. 1995, pp.242-243). If the innovation is perceived to be very complex, the rate of adoption is slowed. Research indicates that when potential adopters are required to develop many new skills in order to utilize the innovation, the rate of adoption is slowed. Therefore, for successful implementation of car sharing practices on the place, it should be ensured that the level of complexity of understanding and use of potential CSO should be relevant to the potential target groups' capabilities.

The fourth aspect of the attributes of the innovation that affect the rate of adoption is Trialability. Trialability is the degree to which an innovation may be experimented with on a limited basis (Everett M. Rogers. 1995, p.243). According to Rogers, an innovation will be more quickly adopted if adopters are able to experience the innovation on an "installment plan" (Everett M. Rogers. 1995, p.243). Therefore, the adopters should be able to sample the innovation for a while. If the innovation of car sharing is found to lack compatibility or to be too complex, the adopter must be free to quit the practice.

The last of the attributes of the innovation discussed by Rogers is Observability. Observability is the degree to which the results of an innovation are visible to others (Everett M. Rogers. 1995, p.244). The results of some ideas are easily observed and communicated to others. The car sharing activity is a type of innovation that implies approbation and farther implementation at different sectors and strata of societal activities; therefore it must have good level of observability.

Additionally, the innovation process in organization has been traced by Rogers in order to identify the main sequence of decisions, actions, and events in these processes. An organization is defined as a stable system of individuals working together to achieve common goals through a hierarchy of ranks and a division of labor (Everett M. Rogers. 1995, p.375). Individual behavior in an organization is relatively stable and predictable because organizational structure is characterized by predetermined goals, prescribed roles, an authority structure, rules and regulations. Rogers divides the innovation process in organizations into two sub-processes (Everett M. Rogers. 1995, p.391):

- 1) Initiation, where all the information gathering, conceptualizing, and planning for the adoption of an innovation, leading up to the decision to adopt;
- 2) Implementation, when all the event, actions, and decisions involved in putting an innovation into the use.

The two initiation stages are (Everett M. Rogers. 1995, pp.391-394):

- 1) Agenda setting
- 2) Matching

Implementation stages are (Everett M. Rogers. 1995, pp.394-400):

- 1) Redefining / restructuring
- 2) Clarifying
- 3) Routinizing

In sum it must be stated that understanding of the elements of Diffusion of Innovation Theory seems to be critical for successful implementation of car sharing practices into the transport sector of Tbilisi. The success is determined by correct and relevant placement of attributes of

the innovation, which should be viewed by the potential adopters and whole society as positive with respect to the adoption.

6. Discussion

6.1 Possible Advantages of Implementation of Car Sharing Practices in Tbilisi

While considering the implementation of car sharing practices in Tbilisi, it would be essential to stipulate the actual potential benefits, which future participants and whole society could gain from the car sharing practices. Taking into account the issues considered in the theoretical and analytical parts of this research, the following possible advantages could be summarized:

In address to the participants' benefits, the cost savings would be one of the major advantages of car sharing, compared to the matter of possessing a private car. By saving the fixed costs of possessing a car, a sizeable economic benefit can be created for potential participants⁶.

Additionally, the more flexible and relevant way of transportation, which would be proposed by car sharing practices could rationalize the traveling behavior of participants, benefiting on the other hand whole society by decreasing the total amount of private cars flow in the city. All this, in turn, would lead to decrease of environmental side effects (noise, traffic congestion, road accidents, shortage of parking space) caused by personal transportation in the city.

Furthermore, Car Sharing would stimulate the use of public transport system. However, as it has been stated in paragraph 6.3, the improvements in provision of public transport services, and tide collaboration with public transport providers is necessary for successful implementation of CSO activities on the place.

Additionally car sharing could help to renovate the vehicle park in the city. Car sharing vehicles could replace the older, obsolete vehicles that are so widespread in the city, and stimulate the introduction of environmentally sound vehicles. Moreover, due to the organizational structure of car sharing activities, the vehicles would be better maintained and energy efficient.

6.2 Possible Obstacles of Implementation of Car Sharing in Tbilisi

Despite the potential cost-saving attractiveness and positive environmental outcomes of implementation of CSO in the Tbilisi context, there are several possible barriers to implementation.

⁶ As it has been stated in paragraph 2.2.5, the fixed costs are one of the major factors that determine the automobile ownership trend.

One of the main barriers is related to the issue of public and political accessibility. This issue is crucial for successful implementation of car sharing in Tbilisi. Evidently, the implementation process will be strongly influenced by government and public policy. As it has been considered in paragraph 6.5, the penetration of public sector, among other factors, is determined by correct placement of attributes of this innovation during the introduction process. On the other hand, public accessibility is influenced by government's policy in the transport sector and general socio-political conditions in Tbilisi. Indeed, the government is already involved in the transport sector, as it provides many transportation services and facilities (road and transport infrastructure, legislative regulations, routes' licensing, etc.). However, taking into account the present policy in transport sector and general socio-economical stability factors, the more innovativeness and efficiency is required from the government in order to successfully implement the car sharing practices in Tbilisi. In this case, the role of government is to facilitate the process of introduction of car sharing practices by creating healthy and stable political and social backgrounds for successful introduction and farther development of this innovation in the transport sector.

Additionally, the travel behavior of potential participants would negatively influence the adoption of car sharing in Tbilisi. As it has been argued in paragraph 2.2, automobile ownership pattern in Tbilisi is determined by particular socio-economical and cultural factors. Therefore, during the initial stages of implementation of car sharing practices in Tbilisi the above-mentioned factors would have to be scrutinized in order to target the potentially relevant strata of participants.

An additional potential barrier of possible implementation of car sharing practices is the current unstable conditions of ground public transport modes (primarily buses) and apparent growing number of minibuses in Tbilisi. However, in this context, it should be mentioned that as a result of the considerable improvements of infrastructure over the few past years, underground transport-metro possess stable conditions of functioning, representing one of the major passengers carrier in the city.

Furthermore, as it shows practice, as car sharing programs start to expand, manually operated systems become expensive and inconvenient, subject to mistakes in reservations, access and billing, and vulnerable to vandalism and theft. New information and telecommunication technology based car access and car-booking technologies are a response to these problems (Shaheen et al, Car sharing 2000)⁷. Therefore the efficient and relevant operation of CSO requires installation and maintenance of modern communication and information technologies, which in turn requires improvements in local communication and information technology sector.

6.3 Methodological Aspects of Implementation of Car Sharing in Tbilisi

Potential benefits and obstacles in implementation of car sharing practices in Tbilisi, mentioned above are at some extend theoretical. Clearly, more analysis of particular social,

⁷ The examples of telematics systems used in car sharing practices are shown during the introduction into the "SunFleet" project.

economic and political aspects is required before a pilot project would be implemented. However, synthesizing the conducted analyses of potentials of introduction of car sharing practices in Tbilisi, it can be stated that the following general policy actions towards possible implementation of particular car sharing activity would be relevant to take into the account:

Business Research and Analysis of Potential Adopters' Market

Business research as well as analysis of potential adoption process is necessary for conception of the relevant business-plan and to reveal the appropriate potential adopter's market. Regarding that aspect, it would be significant to include the postulates of the Theory of Diffusions of Innovations in analysis of adoption process.

Targeting Appropriate Strata of Users

As it revealed the analysis within this research, the correct targeting of specific groups of users, like business sector, at the initial stages of implementation of car sharing practices in Tbilisi, would be worthwhile. Inclusion of Business sector would provide economical and socio-political stability of introduction and farther development of car sharing practices.

Public Communication

The communication of the Car Sharing concept to the society is an important condition for promotion of car sharing idea. This concept would include the relevant market positioning strategies by, means of different campaigns, media channels, etc.

Knowledge Transfer to Governmental Structures

The role of government in transport sector is essential as it provides different transport services, infrastructures and creates transport policies. Therefore, communication with appropriate governmental structures on positive environmental outcomes of car sharing would be important in obtaining the support and farther co-operation.

Co-operation with Public Transport Suppliers

The role of public transport in car sharing is important. Benefits gained from co-operation between car sharing organizations and public transport suppliers are mutual. Therefore, proper communication and co-operation with public service suppliers is basis for successful introduction and development of Car Sharing activity.

Implementation of ICT in Car Sharing Operations

Along with the development of car sharing practices, increases the demand for efficiency of operations. Therefore, information and communication technology can help to reduce to operation costs and improve the service quality to customers.

Further development of Car Sharing activities

In that regard it is significant to mention that long-live monitoring and analysis of efficiency and outcomes of operations is crucial for farther development of car sharing activities. Additionally, co-operation and experience exchange with other car sharing organizations not only at regional but international level is also important.

7. Conclusions

As a result of the changes imposed by recent political, social and economic transformations occurred, Tbilisi is in active search for innovative solutions in the transport sector. This study intended to investigate the present situation with transportation in Tbilisi, and tried to consider whether or not such concept as car sharing could be the answer to the environmental problems imposed by current transportation in the city.

As a result of the analysis conducted, this study revealed that the major problems in transport sector of Tbilisi regarding the air pollution, traffic congestion, noise, and limit of place, as well as an overall decline of the social security, arise with increase of driving of private modes of transport. In view of that, this study suggests that the possible solutions of improvement of existing situation are connected to the consideration of the transport sector of Tbilisi under the sustainable transportation concept. In that regard, this research implies that the measures towards sustainability in the city's transport sector should be directed towards two fundamental directions:

- 1) Direct policy measures that imply advanced organization, management and provision of urban transport system;
- 2) Indirect measures and policies addressed at the activities and services, which generate personal transport demand.

Accordingly, this research suggests that the regarding the indirect transport planning and policy frameworks to deal with the increasing number of personal transportation in the city, introduction of car sharing practices would be noteworthy. Car sharing practices in Tbilisi could play an important role in achievement of sustainable transportation by influencing the decrease of excessive private car ownership trend.

Analysing the possibilities of implementation of car sharing practices in Tbilisi, this study revealed that implementation of car sharing practices could be beneficial for participants by saving them fixed costs associated with a car possession. Additionally, car sharing practices could rationalize the traveling behavior of participants, benefiting on the other hand whole society by decreasing the total amount of private cars flow in the city. All this, in turn, would lead to decrease of environmental side effects (noise, traffic congestion, road accidents, shortage of parking space) caused by personal transportation in the city. Furthermore, Car Sharing would stimulate the use of public transport system in the city.

On the other hand, this research revealed that despite the potential cost-saving attractiveness and positive environmental outcomes of implementation of CSO in the Tbilisi context, there are several possible barriers to implementation. One on the main barriers to implementation is connected with the issue of low public and political accessibility.

In sum, it can be stated that potentials for implementation of car sharing practices in Tbilisi potentially exist, however more analysis of particular social, economic and political aspects is required before an actual car sharing project would be implemented.

Appendix

Questionnaire for “SunFleet”

Organizational and Structural Aspects

1. Legal aspects

- 1.1 What was the legal status of your organization at the beginning?
- 1.2 What is the legal status of your company at present?

2. Customers/Users

- 2.1. What was the number of customers/users from the beginning?
- 2.2. How many customers/users do you have at present?

3. Vehicles and infrastructure

- 3.1. How many and what kind of vehicles do you offer to your customers/users?
- 3.2. What are your plans regarding vehicle fleet growth?

Operations and Management

1. Administrative aspects

- 1.1 What is the number of your employees?
- 1.2 What is the percentage of managers among your employees?

2. Fleet management

- 2.1 What is the way of obtaining of your vehicles?
- 2.2 Do you provide any services for your vehicles by yourself, or do you use external companies for maintenance /repairing of your vehicles?
- 2.3. How is the insurance question solved in “Sunfleet”?

3. Business aspects

- 3.1 During the operation of your organization did you have any divergences from business-plan?
- 3.2 Which marketing measures do you use to obtain new customers?
- 3.3 Do you take into account the opinions/requests of your customers/users?

4. Reservation Service

- 4.1 Do you offer an own reservation service, or do you use external services?

- 4.2 What kind of reservation software do you use?
- 4.3. Do you offer Internet reservation to your customers?

5. Technological Innovations

- 5.1 What car access technology do you use?
- 5.2 In your opinion, are telematics based car access technologies helpful for you?

6. Integration in multi-modal services

- 6.1 Do you have cooperation with public transport companies?
- 6.2 Do you have cooperation with car rentals?
- 6.3. Do you have cooperation with railway sector?

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