PUBLIC TRANSPORTATION FOR MORE LIVABLE CITIES: A PROPOSAL FOR FAMAGUSTA

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ABSTRACT

Public transportation as a notion of accessibility is extremely affecting livability of cities, since accessibility is a dimension of livability. Providing appropriate modes of public transportation feed by suitable modes of private transportation would increase livability of cities by increasing their accessibility. A well organized transportation system would not only increase accessibility in a city, but also would cure many environmental, social and economical problems. As the city Famagusta, which is developing as car-oriented, is facing many problems related with accessibility like; urban sprawling, air pollution, congestion in traffic, car-parking, unhealthy communities, unsafe roads, unlivable streets etc., livability of the city has become questionable. Therefore, the city has been studied as a case in this research.

Livability dimensions are composed of different quality aspects. One of these aspects, which is functional place quality, is focusing on the accessibility issues like, pedestrian journeys, public transportation and vitality and viability of services. Studying these issues could help to derive indicators of accessibility. In a livability survey these indicators could be used for measuring accessibility of cities. Such a measurement could provide the basis for achieving the most appropriate solutions for increasing accessibility and consequently livability of cities. In order to be able to propose the most appropriate solutions for accessibility problems, it is needed to understand the most appropriate modes of transportation which have been searched and illustrated in this study by analyzing examples.

However, accessibility is not only a dimension of livability but also a notion of urban development, urban growth and urban structure. Thus, in addition to the accessibility measurement for proposing a new transportation system, urban development, growth and structure would also be analyzed and well comprehended.

After understanding the concepts of livability and accessibility, and the modes of transportation, it has been shown that livability of a city can be questioned by measuring accessibility of the city. Analyzing and measuring accessibility of a city would provide required information for providing a well organized transportation system for increasing its livability. In this context, accessibility of Famagusta has been analyzed and measured, and a new transportation system has been proposed for increasing its accessibility and livability.

Keywords: Livability, accessibility, public transportation

ÖZ

Yaşanılabilirliğin bir boyutu olan ulaşılabilirliğin konularından biri olan toplu taşım, kentlerin yaşanılabilirliğini yoğun ölçüde etkilemektedir. En uygun toplu taşım türlerinin, özel ulaşımın uygun türleriyle beslenerek uygulanması, kentlerin ulaşılabilirliğini ve dolayısiyle yaşanılabilirliğini artıracaktır. İyi düzenlenmiş bir ulaşım sistemi, bir kentin sadece ulaşılabilirliğini artırmakla kalmayacak, birçok çevresel, sosyal ve ekonomik sorunları da iyileştirecektir. Araç odaklı gelişen Mağusa kentinin, kentsel yayılma, hava kirliliği, trafik sıkışıklığı, araba parkı, sağlıksız topluluklar, güvensiz yollar, yaşanılamayan caddeler gibi ulaşılabilirlikle ilgili sorunlarla karşılaşması, kentin yaşanılabilirliğini tartışılabilecek duruma getirmiştir. Bu nedenle, Mağusa kenti bu araştırmada incelenmiş ve çalışılmıştır.

Yaşanılabilirliğin boyutları, farklı kalite yönlerinden oluşmaktadır. Bu yönlerden biri olan fonsiyonel mekan kalitesi, yaya seyahatleri, toplu taşım, servislerin yaşama gücü ve yaşayabilirliği gibi ulaşım konularına odaklanmaktadır. Bu konuların çalışılması, ulaşılabilirliğin göstergelerinin elde edilmesine yardımcı olacaktır. Bu göstergeler, bir yaşanılabilirlik araştırmasında kentlerin ulaşılabilirliğini ölçmek için kullanılabilecektir. Böyle bir ölçüm, kentlerin ulaşılabilirliğini ve neticesinde yaşanılabilirliğini artırmak için en iyi çözümlere ulaşacak temeli sağlayabilecektir. Ulaşılabilirlikle ilgili sorunlara en iyi çözümleri önerebilmek için, bu çalışmada da örneklerin incelenmesiyle araştırılan ve açıklanan, en uygun ulaşım türlerinin anlaşılması gerekmektedir.

Ancak, ulaşılabilirlik sadece yaşanılabilirliğin bir boyutu değil, aynı zamanda kentsel gelişimin, kentsel büyümenin ve kentsel stürüktürün de bir konusudur. Bu nedenle, yeni

bir ulaşım sistemi önerisi için yapılacak olan ulaşılabilirlik ölçümüne ek olarak, kensel gelişim, büyüme ve stürüktür de incelenecek ve iyi kavranacaktır.

Yaşanılabilirlik ve ulaşılabilirlik kavramları ile ulaşım türleri anlaşıldıktan sonra, bir kentin yaşanabilirliğinin o kentin ulaşılabilirliğini ölçerek sorgulanabileceği gösterilmiştir. Bir kentin ulaşılabilirliğinin incelenmesi ve ölçülmesi, yaşanılabilirliği artıracak iyi organize edilmiş bir ulaşım sistemi önermek için gerekli bilgiyi sağlayacaktır. Bu kapsamda, Mağusa kentinin ulaşılabilirliği incelenip, ölçülerek, ulaşılabilirlik ve yaşanılabilirliği artıracak bir ulaşım sistemi önerisi yapılmıştır.

Anahtar Kelimeler: Yaşanılabilirlik, ulaşılabilirlik, toplu taşım

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INTRODUCTION

Cities without public transportation in other words car-oriented cities are suffering from many problems such as, urban sprawl, air pollution, congestion in traffic, car-parking, unhealthy communities with limited physical actions in their daily life, unsafe roads, unlivable streets, high risk of traffic accidents, and limited accessibility for visitors without cars. As a result of all these problems, livability, which is recently a highly debated issue in the quality of life studies, is significantly affected. Preliminary research reveals that public transportation is one of the major indicators of the functional place quality which is one of the dimensions of livability. (Yeang, D. L., 2006)

Since, public transportation is an indicator of livability, providing public transportation in a city makes it to become more livable. According to Hahlweg (as cited in Timmer & Seymoar, 2006) "a livable city is a city where people can have a healthy life and where they have the chance for easy mobility – by foot, by bicycle, by public transportation, and even by car where there is no other choice…" In order to be qualified as 'A livable city for all', a city should be accessible for all: the children, the elderly, those living in the suburbs and in the surrounding communities (Hahlweg, 1997).

Thus, it can easily be claimed that, it is equally important to put emphasis on accessibility as to the importance of public transportation within the livability issues.

Appleyard and Lintell state that traffic conditions affect livability not only at city scale but also at street scale as well. According to them: “All aspects of perceived livability-absence of noise, stress, and pollution; levels of social interaction, territorial extent, and environmental awareness; and safety-were found to correlate inversely with traffic intensity” (Appleyard, D., Lintell M., 1972, p.84).

It is known that in Cyprus private car-ownership is extremely high and public transportation is not a preferred mode of transportation. A researcher has claimed that Cyprus is in the second rank in list of car-ownership ratio out of 143 countries after USA (Harun Uçar, 2011). Famagusta, which is the case of this research, is a small-sized island city in Northern Cyprus and it is a car-oriented city like all cities in Cyprus. The city is faced with many problems such as deserted and unsafe streets of walled city, traffic congestion on primary distributors like Salamis Road, car- invasion of sidewalks, no pedestrian priority, increasing air pollution with high level of CO_2 emission, invasion of lands with leap-frog development (sprawling), decentralization etc. Thus it is difficult to identify Famagusta as a ‘Livable City’, although it has important values.

1.1. Aims and Objectives

Based on what has been stated above, this research aims to search for the contributions of public transportation on livable cities and prove that provision of the most appropriate modes of public transportation would increase accessibility and consequently livability of the cities. First of all, it is needed to understand the concepts of livability, dimensions of livability, accessibility as dimension of livability, quality of life and place. The researches done, like quality of life surveys of Mercer and Monocle has been studied in

order to understand the indicators of livable cities. Then, methodology for accessibility assessment and measurement has been derived for questioning livability.

After highlighting the importance of public transportation for more livable cities, the transportation modes, strategies and policies has been examined. The most appropriate modes of transportation have been searched for increasing livability in cities. In this context, Famagusta has been studied as a case study. The accessibility of the city has been examined and measured for questioning its livability. According to the results of the assessment and measurement of accessibility of the city, proposals have been provided for improvements.

The research questions that would help to shape the study:

- What is the concept of livability?
    - How can a livable city be defined?
    - What are the dimensions of livability?
    - What is accessibility?
    - What are the indicators of accessibility?
    - How could accessibility be measured?
- How can public transportation contribute to the livability of cities?
    - How can public transportation make streets more livable?
    - What are the modes of transportation?
    - What are the problems of cities without public transportation?
    - What are the benefits of public transportation?
- What is the accessibility level of Famagusta from livability perspective?

- What are the urban problems of Famagusta?
- How can public transportation be solved for Famagusta?
- Which modes of transportation should be proposed to increase livability in Famagusta?

These questions would help to achieve the research objectives like:

- To understand the contributions of public transportation for more livable cities
- To derive a methodology for measuring accessibility
- To search for example cities having a well organized public transportation system
- To determine the most appropriates modes of public transportation for city of Famagusta
- To provide a transportation proposal for Famagusta in order to increase accessibility and livability in the city

1.2. Research Methods

The methodology of the study is a theoretical research. The research approaches are case study, documentary research and surveys. And the research techniques which have been utilized were a field study through observations, questionnaire survey and statistical information gathering. The study will start with a theoretical review, which will mainly be done through documentary research where all the concepts related with the aim of this study have been searched for and explained. All the information obtained and interpreted by documentary research, have been used for deriving a methodology for measuring

accessibility. The literature review also includes the sample cities which have well organized public transportation system and defined as Livable Cities.

Based on the observations, it has been realized that Famagusta is suffering from many urban problems related with accessibility. Therefore the city has been chosen as a case study for this research. After making a documentary survey for gathering information about the physical and historical development of the city, a field study has been done for gathering statistical information like, population and street hierarchy. Furthermore, in order to reflect expectations of citizens, a questionnaire survey has been conducted to be able to produce proposals for increasing livability of Famagusta with an appropriate public transportation system. The literature review has been taken as a basis for determination of the most suitable mode of transportation in a small-sized city like Famagusta.

1.3. Limitation

Preliminary research reveals that there are several dimensions of livability such as, environmental quality, functional and physical place quality and safer places (Llewelyn Davies Yeang, 2006). Among these dimensions of livability, this research is focusing on accessibility and public transportation which are subjects of functional place quality. In this context, accessibility has been assessed and measured through livability perspective. Public transportation modes have been examined as they are classified according to their usages and engine system, since usages and engine systems are related to the social and environmental aspects of sustainability which is an important issue of livable cities. The aspects of sustainability have been associated with key principles of livability in the research. The most appropriate modes of transportation have been evaluated through a

couple of selected cities with good public transportation systems, which are similar in size to the city of Famagusta and some cities that are in the list of most livable cities determined by Mercer's and Monocle' quality of life survey.

The level of accessibility in Famagusta city has been examined at the city-scale. All parts of the city within municipal border have been considered and analyzed. At the end of the assessment and measurement, a transportation system proposal which is composed of transit oriented system has been provided also considering the possible future developments of the city.

Chapter 2

LIVABLE CITIES

In order to achieve one of the main aims of this study, which is to provide the most appropriate public transportation to increase accessibility for increasing livability of cities, the first step should be the understanding of what a livable city is. There are many different approaches for defining a livable city. For example according to Hahlweg (as cited in Timmer & Seymoar, 2006), "a livable city is a city where people can have a healthy life and where they have the chance for easy mobility – on foot, by bicycle, by public transportation, and even by car where there is no other choice…" He says and explains it as "the livable city should be attractive, worthwhile, safe for our children, for our older people, not only for the people who earn money there and then go and live outside in the suburbs and in the surrounding communities. For the children and elderly people it is especially important to have easy access to areas with green, where they have a place to play and meet each other, and talk with each other" (Timmer & Seymoar, 2006, p.2). And he concludes his approach with a sentence: "The livable city is a city for all" (D. Hahlweg, 1997). As it can be seen in Hahlweg's words, accessibility plays an important role in the livability concept. In order to be "City is for all", every citizen and visitor should have equity in accessing urban facilities and meeting their needs.

Many approaches derived after the recognizing of the urban problems, which were trying to create solutions for increasing livability of cities. The supporters of these movements (garden city movement, city beautiful movement, new urbanism), which had emerged to solve the urban problems, had proposed many visions for livable cities. Jane Jacobs (1961) in her book 'The Death and Life of Great American Cities' emphasized the notion of low-rise, mixed-use and high density neighborhoods. She was talking about vibrant traditional neighborhoods and says that these neighborhoods should be preserved (Mellon, 2009). And Lewis Mumford the author of the books 'The Culture of Cities' (1938) and 'The City in History' (1961), also has emphasized that the cities should be more ecologically sensitive, healthier, safer and more vibrant (Mellon, 2009).

Today, there are some researches which are done to measure and compare livability in cities. For example there is Mercer's quality of life survey (2010). In this survey criteria are determined for measurement and the criteria are valued to reach a result through ranking the values of cities. The survey has 39 criteria but the most important ones are; "*safety, education, hygiene, health care, culture, environment, recreation, political-economic stability and public transportation"* (http://www.mercer.com/press-releases/quality-of-living-report-2010). According to this survey the most livable city is Vienna-Austria; the second is Zurich-Switzerland and the third one is Geneva-Switzerland.

The other survey on livability of cities is Monocle's Most Livable Cities (2010). Its most important criteria are; "*safety/crime, international connectivity, climate/sunshine, quality of architecture, public transportation, tolerance, environmental issues& access*

to nature, urban design, business conditions, proactive policy developments and medical care" (http://en.wikipedia.org/wiki/World%27s_most_livable_cities). According to this survey the most livable city is Munich-Germany; the second is Copenhagen-Denmark and the third one is Zurich-Switzerland.

Table 2.1 Livability Survey's

	MERCER'S SURVEY	MONOCLE'S SURVEY
The Most Important Criteria	Safety Education Hygiene Health Care Culture Environment Recreation Political-economic Stability Public Transportation	Safety/Crime International Connectivity Climate/Sunshine Quality Of Architecture Public Transportation Tolerance, Environmental Issues Access To Nature Urban Design Business Conditions Proactive Policy Developments Medical Care
First 3 Most Livable Cities	1. Vienna-Austria 2. Zurich-Switzerland 3. Geneva-Switzerland	1. Munich-Germany 2. Copenhagen-Denmark 3. Zurich-Switzerland

The importance of accessibility, public transportation, safe and vibrant streets is highlighted in almost all researches on livability. Public transportation is extremely important as long as it prevents many problems in cities. Deficiency of public transportation causes cities to develop as car-oriented. In such cities problems like, urban sprawl, air pollution, congestion in traffic and car-parking, unhealthy communities with limited physical actions in their daily life, unsafe roads, unlivable streets, high risk of traffic accidents and limited accessibility for visitors without car can be observed. These problems significantly affect the livability of cities. Being aware of this

importance, this study mainly aims to address the importance of public transportation in achieving livable cities.

2.1. Livability

With the emergence of the urban problems like; "the loss of local small businesses and the formation of retail deserts, sedentary lifestyles and the growing incidence of obesity, loss of neighborhood institutions, shops and services, lack of neighborliness and severance between neighborhoods, loss of play space or opportunity around home and intolerance or fear of children in the public realm, alienation of the elderly and people who are disabled from their local environments, higher casualty rates or the reduction in street activity as a result of their poor use by pedestrians, degradation of historic environments and along distributing routes as a result of traffic and its infrastructure or more general environmental pollution and its global implications" (Biddulph, 2008, p.58); questioning the livability of cities became inevitable.

The concept of livability refers to "an urban system that contributes to the physical, social and mental well being and personal development of all its inhabitants. It is about delightful and desirable urban spaces that offer and reflect cultural and sacred enrichment (citiesPLUS, 2003). Key principles that give substance to this theme are *equity, dignity, accessibility, conviviality, participation and empowerment*" (Timmer & Seymoar, 2006, p.2). These key principles could be solutions for reducing/eliminating the negative impacts of increasing urban traffic and congestion which are mentioned by a survey done by EU commission. For instance 30% of households in Europe don't have private car, so they have to afford the traffic cost without enjoying mobility benefits provided by car ownership. So this situation creates inequality in society. Side parking

caused by car-parking problems and some other infrastructure make visual intrusion which results in losing dignity for a city. Also dignity decreases by noise and air pollution caused by increasing motorized vehicle dominance and congestion. On the other hand crowded urban roads create difficulties in accessibility. The survey on negative impacts of increasing urban traffic and congestion reveals that "motorized transport infrastructure- such as roads and car-parking- takes up highly valuable city center land, and spoils and threatens existing open spaces" (European Communities, 2004, p.9). High percentage of urban living space is spent for vehicles rather than social and recreational activities which negatively affect conviviality and participation aspects in cities. Congestion also causes cities to decentralize and most of the retails moves to less congested peripheries of the urban area. By this way traditional centers face competition with these new retail areas. Competitiveness and energy consumption result in losing empowerment of cities. (European Communities, 2004)

Considering the findings of EU commission on negative impacts of motorized transportation infrastructure, it can be claimed that the key principles of livability are also highly related with the aspects of sustainable development which is defined as "development that meets the need of the present without compromising the ability of future generations to meet their own needs" (http://www.un-documents.net/ocf-02.htm#I). The determined aspects of sustainable development are social, environmental and economic. These aspects, as general and wide subjects, comprise the key principles of livability concept as such: Equity is a social and economical issue, dignity is an environmental issue since it is related with pollution, accessibility is the matter of all

three aspects, conviviality and participation are social and environmental issues, and empowerment is related with economical and environmental aspects.

The relationships between sustainability aspects and key principles of livability and the findings of EU commission about the negative impacts of increasing urban traffic are shown in the table below.

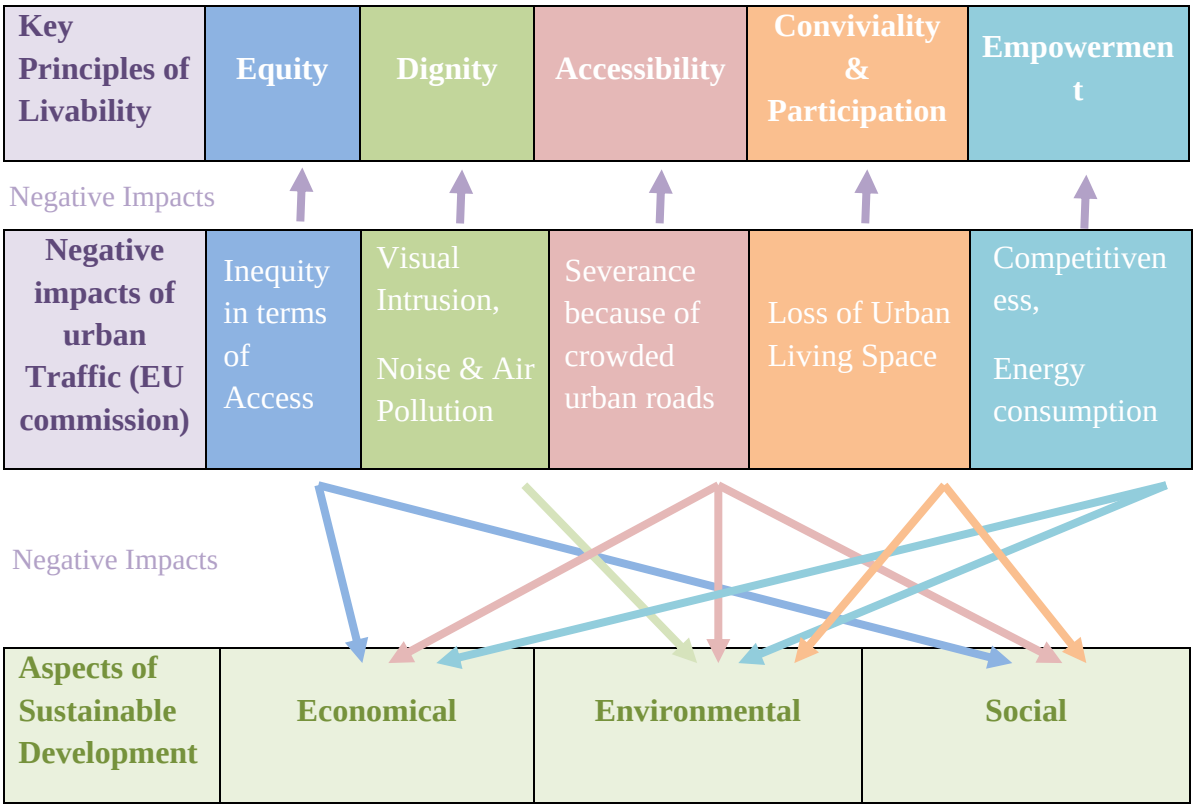


Figure 2.1 Relationship between sustainability aspects and key principles of livability and the findings of EU commission negative impacts of increasing urban traffic

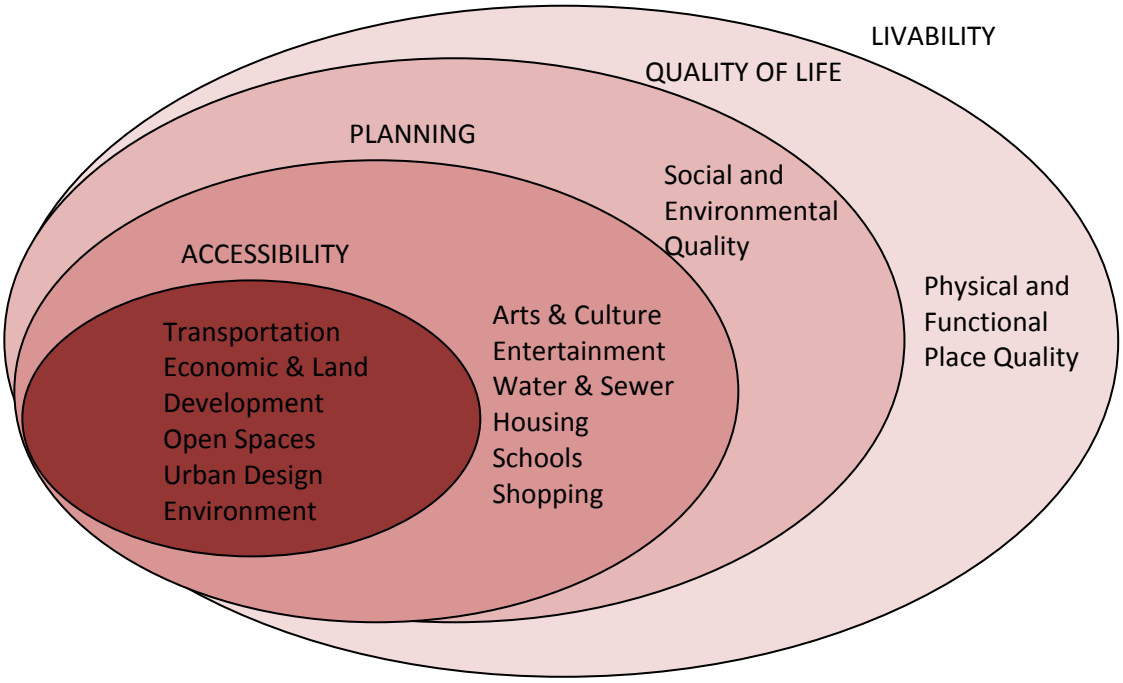


Figure 2.2 Relationships between Transportation and Livability

Literature survey reveals that the concept of livability is strongly related with the concepts of quality of life. Quality of life which is a part of livability dimensions (as social and environmental quality) is supported by planning. Since planning includes accessibility issues such as transportation, development, open spaces, urban design etc. it can be said that accessibility supports quality of life as well. The relations between livability, quality of life and transportation has been shown in the figure above.

2.2. Livable Streets

Considering the key principles of livability (equity, dignity, accessibility, conviviality, participation, and empowerment) which are somehow related to the characteristics of quality of the streets, it is not surprising that subject of livable streets is one of these issues which is frequently considered by architects, urban designers and planners. Appleyard and Lintell state that traffic conditions affect livability not only at city scale

but also at street scale as well. According to them: “All aspects of perceived livability-absence of noise, stress, and pollution; levels of social interaction, territorial extent, and environmental awareness; and safety-were found to correlate inversely with traffic intensity” (Appleyard & Lintell, 1972, p.84).

Urban streets should be the places where people walk, make shopping, meet and etc where the social, economical and recreational activities take place. Features of streetscape such as aesthetic, transportation safety and roadside elements like street trees, lights or benches as fixed-objects influence the usage of these places. If these spaces can be used effectively and can be pedestrian friendly, it will provide “economic growth and innovation (Florida, 2002), improvements in air quality (Frank et al., 2000), and increased physical fitness and health (Frank et al., 2003)” (Dumbaugh, Eric and Gattis, J. L., 2005, p.283).

With an emphasis on the significance of the livability of streets, it is worth to analyze characteristics of livable streets. First of all since they “seek to enhance pedestrian character of the street they should provide a continuous sidewalk network and incorporate design features that minimize the negative impacts of motor vehicle use on pedestrians”. On the other hand roadside elements “such as street trees and on-street parking, should serve as a buffer for the pedestrian realm from potentially hazardous oncoming traffic, and provide spatial definition to the public right-of-way” (Dumbaugh, Eric and Gattis, J. L., 2005). In fact roadside trees are accepted by many livability advocates that they are providing positive effect on streetscape aesthetically but providing safety issue is a subject of debates.

2.3. Dimensions of Livability with an emphasis of Accessibility

Literature survey reveals that the concept of livability has been studied focusing on different dimensions of quality aspects. These quality aspects are the dimensions of livability which include criteria for measuring livability according to the quality aspects. Llewelyn Davies Yeang in exploring livability for the State of the Cities Report (ODPM, 2006), derived four main aspects as dimensions of livability (Table 2.5).

Table 2.2 Dimensions of Livability

A. Environmental Quality
1. Noisier-Quieter? 2. Dirtier-Cleaner? 3. More or less congested? 4. Building quality, Better or Worse?
B. Place Quality (Physical)
5. Quality of the built environment 'product' 6. Levels of derelict land 7. Quality of parks and green spaces 8. Public realm quality
C. Place Quality (Functional)
9. Pedestrian journeys: easier-or harder? 10. Public transport quality 11. Vitality and viability of services
D. Safer Places
12. Crime levels 13. Anti-social behavior

Resource: Llewelyn Davies Yeang, 2006

According to Yeang, the dimensions of livability are classified as; environmental quality, place quality (functional and physical) and safer places. Evaluation of this classification in line with the main concern of this research, which is accessibility and public transportation, it can easily be claimed that functional place quality is strongly related to these issues. Thus, analyzing accessibility in a city will help to examine its livability. For this aim Yeang asks some questions like;

- "Does the building layout take priority over the roads and car parking, so that highways do not dominate?

- Are the streets pedestrian, cycle and vehicle friendly? Is car parking well integrated so it supports the street scene?
- Does the scheme integrate with existing roads, paths and surrounding development?
- Are public spaces and pedestrian routes overlooked and do they feel safe?" (Llewelyn Davies Yeang, 2006).

Answering these questions will provide the basis for determination of the criteria for increasing livability of a city. Criteria derived from answers of the questions can be generalized as;

- right of way of the roads,
- non-vehicular accessibility,
- streetscape (visual intrusion by car parking),
- integration of modes of transport and safety of the roads.

Considering Yeang's argument, accessibility which is one dimension of livability would be regarded within functional place quality. The indicators of functional place quality which are pedestrian circulation, public transport quality and vitality and viability of services, would serve and be utilized in the analysis and for understanding the accessibility dimension and public transportation which is the subject matter of this research.

2.3.1. Accessibility Dimension of Livability

Accessibility is not only a dimension of livability but also a factor in a city which has impact on the location decisions of different uses like; business, commercial, recreational etc. thus accessibility has impact on the urban development. For example a light rail transit system's station can become a commercial activity area of the district, or a firm will chose its location according to availability of any public transportation system and etc.

According to Bruinsma and Rietveld, accessibility itself depends on the transportation infrastructure, in other words it is determined by the quality of transport infrastructure.

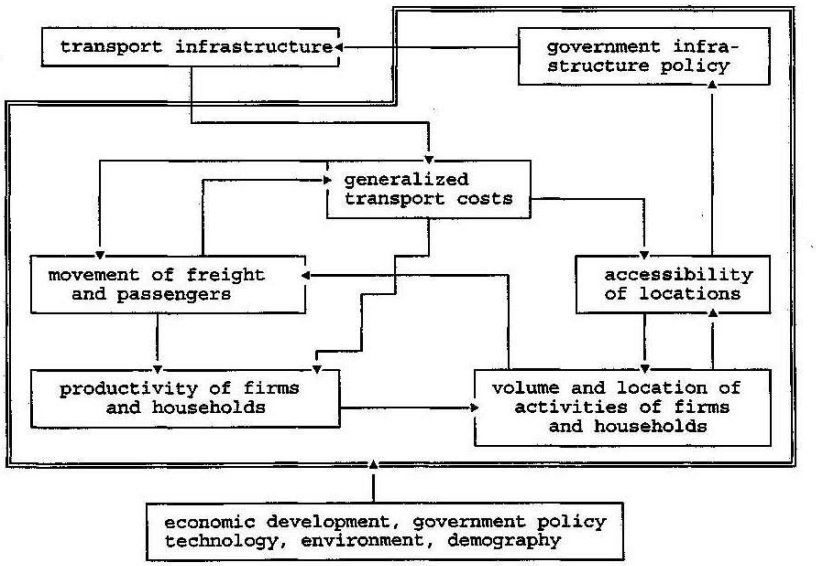


Figure 2.3 Transport infrastructure and urban development

Resource: Bruinsma, F., Rietveld,P., 1993

Accessibility is not only affected by transportation infrastructure but also by government policy, technology, environment and demography as it is shown in the figure. Thus in any proposal for accessibility and transportation, these issues should be considered.

Livability of a city is greatly affected by accessibility and transportation conditions. As it has been stated in the previous section, in a research by EU commission responsible for environment the main problems associated with increasing urban traffic and congestion were described. In that research it has been stated that, increasing motorized vehicle dominance and congestion, which has negative impact on urban quality of life, resulted in many problems generally about; visual intrusion -by parked cars and other infrastructure-, noise and vibration, energy consumption, severance -because of congested urban roads-, competitiveness, equity, economic efficiency, loss of urban 'living space', air pollution and accidents.

Unfortunately it is impossible to create car-free cities in the high technologic era, but it is possible to provide different modes of transportation like, public transportation, cycling and walking, to support accessibility rather than encouraging private car usage. Also creating attractive car-free spaces in cities (some parts of cities) will provide a cleaner, quieter and safer environment for pedestrians and cyclists. In other words it will increase livability in that city.

Public transportation always needs a walking trip, because it starts with a walking trip and ends with again that kind of trip. Creating car-free spaces which will be supported by public transportation would encourage the usage of urban street spaces more

effectively and to recognize the importance of streets. Streets are not only ‘movement space’ but also ‘exchange space’, which has high social importance.

As it is mentioned above, providing the most appropriate public transportation modes to improve accessibility in a city will increase its livability. Before questioning the most appropriate public transportation modes to improve accessibility, the current conditions of accessibility in the city should be understood. That’s why accessibility should be measured and assessed in order to reach an effective result. Thus in the next section, measuring accessibility through livability perspective will be explained.

2.3.2. Measuring Accessibility In A City

As accessibility is a dimension of livability, any problem that occurs related with accessibility such as, “rising traffic volumes, decreasing open space, increasing air pollution and reduced funding” (Bhat, C., Handy, S., 2002, p.1) would greatly affect livability. However, it should be noted that accessibility is not only a dimension of livability but also it is a notion of urban development, urban growth and urban structure (Darroch, G., Winsborough, H., 1972). It can also affect land use decisions, in other words functional distributions in a city. It is claimed that accessibility is an important link between transportation and land use (Zhu, X., Liu S., 2003)

Pasaogullari and Doratli quoted in their article that accessibility for Lau and Chiu (2003) is defined as “the freedom or ability of people to achieve their basic needs in order to sustain their quality of life” (Paşaoğulları, N., Doratlı, N., 2004, p.227). Easy access, in a city, would provide equity in society, participation to activities, utilization from facilities and in more general terms functional place quality. Considering all these

highlighted significances of accessibility, it is important to measure accessibility of the city in order to increase its livability.

Since urban macroform includes accessibility as a notion (Darroch, G., Winsborough, H., 1972), it should also be considered in such a measurement/assessment. In the book 'Urban Geography', it is mentioned that urban transportation and the form of the cities have an important connection. The movement of people in cities is designating the internal form. Furthermore it is claimed that the railways in cities had played a significant role in developing morphology of urban areas in nineteenth century (Johnson, J., H., 1971). Thus, in order to be able to assess accessibility with regard to urban form, it is worth to make a brief overview of urban macroform.

URBAN MACROFORM

Based on the policy goals set by Dutch governments such as sustainability and reduction of car mobility, Snellen, Borgers and Timmermans say that the term urban form is composed of basic urban shape, distribution of different functions over the area, and the connections between them (Snellen, D., Borgers, A., Timmermans, H., 1999). They have identified six different basic urban shapes:

(1) The concentric city

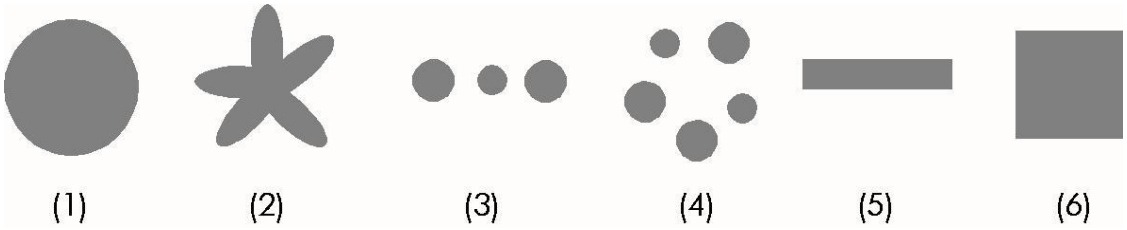
(2) The lobe city

(3) The linear poly-nuclear city

(4) The concentric poly-nuclear city

(5) The linear city

(6) The grid city



Then they have derived five main networks for motorized transport, which is the second basic element of urban form:

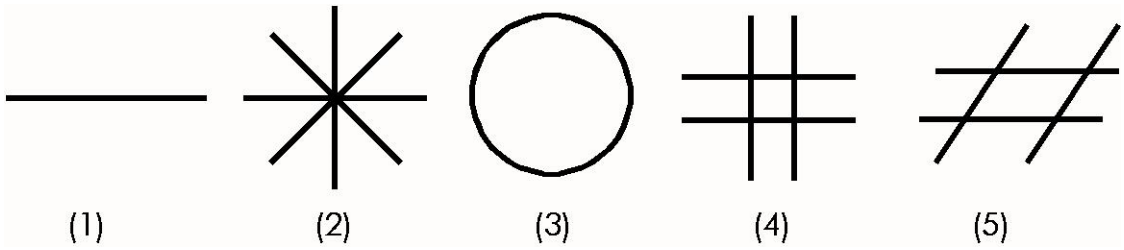
(1) The linear network

(2) The radial network

(3) The ring

(4) The grid

(5) The shifted grid



With this argument and illustrations in mind, it can be said that, a city can be shaped by its functional distribution- the type and location of city center, and with effect of the street network form of the city is developed. That means for suggesting new transportation proposals to increase accessibility; it is needed to read the urban form in order to understand functional distribution and the existing street network.

Similar to the Snellen, Borgers and Timmermans arguments, Bertaud (2001) claims that the type and location of city center affect urban movement patterns. He says that

structurally cities can be classified as polycentric or monocentric and their flows can be organized or disorganized. According to Bertaud, if a city is transit oriented (having well developed public transportation), then it tends to be monocentric and have a higher level of organized flows. On the other hand, if a city is car oriented, then it tends to be polycentric and have a more disorganized structure of flows (Bertaud, A., 2001).

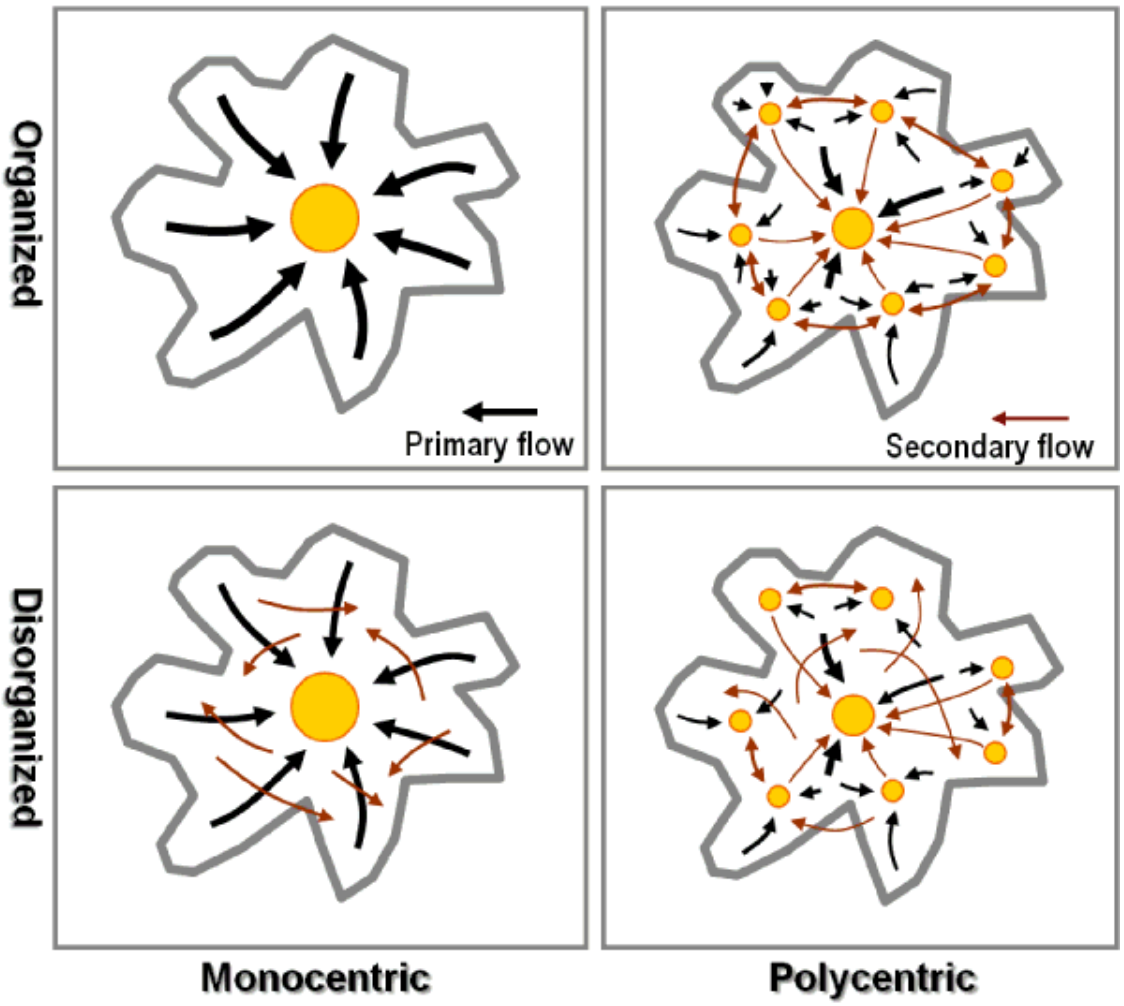


Figure 2.4 Possible Urban Movement Patterns

Resource: http://alain-bertaud.com/images/AB_Metropolis_Spatial_Organization.pdf

STREET NETWORK

Examining urban macroform and street network, which shows street hierarchy, intersections, “the extremes of dead-end roads (cul-de-sacs) and the edges, the street fragments connecting the intersections” (Masucci, Smith, Crooks, Batty, 2009, p.1), would provide information about the accessibility of the city. As it is defined in the book ‘Responsive Environments’, streets can be classified as; Primary distributors (long distance through traffic, serves town as a whole), district distributors (through traffic linking main districts within town), local distributors (links traffic within local ‘environmental areas’) and access road (provides direct access to buildings and land within ‘environmental areas’) (Bentley, Alcock, Murrain, McGlynn, Smith, 1987). This information is essential for proposing public transportation for increasing accessibility and consequently livability of the city.

When considering the street network of any urban settlement, the main arteries are used for providing public transportation and secondary streets designed for private transportation as supporter for public transportation. Based on the arguments of Swenson and Dock, it can be claimed that if the existing urban structure has gridiron street pattern than public transportation adjustment and transit oriented development can easily be applied. However if the urban pattern is developed randomly, hence has an organic pattern, main arteries should be determined and used for public transportation and the secondary streets or dead end streets should be connected to the public transportation by feeder modes such as walking, cycling, also policies should be applied

like park and ride, kiss and ride or bike and ride around the transit stops. (Swenson, C., Dock, F., 2003)

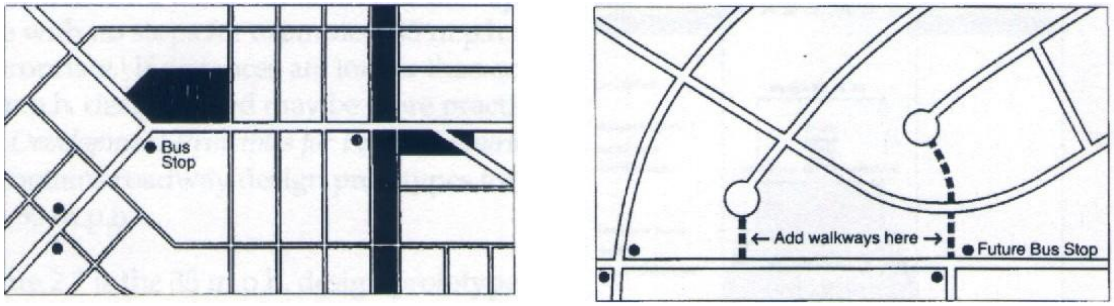


Figure 2.5 Grid-iron pattern (on the left) Organic Pattern (on the right) pathways connecting cul-de-sacs to transportation networks

Resource: Swenson, C., Frederick, D., 2003

Examining urban macroform and street network would provide relevant grounds for understanding the street hierarchy, which can be considered as an important feature for understanding accessibility. However, this understanding needs to be supported by certain measurable criteria.

Therefore in the following section, criteria of measuring accessibility will be determined, and then a methodology will be proposed that will be applied to the case study.

2.3.2.1. Criteria of Measuring Accessibility

Many different methodologies in different perspectives have been derived for measuring accessibility. The first step in any attempt to measure accessibility should be the determination of "what to measure". It can be accessibility of any activity or facility in the city or an urban, a rural or suburban area. For example Center for Transportation

Research (The University of Texas at Austin) developed a system which was represented by the interaction between land use patterns and transportation facilities to measure urban accessibility. The land use part of the system would involve opportunities for activity participation and the transportation part would involve the ease of participating in activities at specific locations (Bhat, C., Handy, S., 2002). They have used a computer program for applying their 5 determined measurement types, and every type has different criteria and variables related to them: (Bhat, C., Handy, S., 2002)

1. Spatial separation/graph theory measure: related to transportation system
2. Cumulative opportunities measure: a counting of opportunities available within a certain distance or travel time
3. Gravity measure: the value of an opportunity decreases with increasing distance
4. Maximum utility/logsum measure: considering models of travel choice
5. Time-space measure: considering hours of operation of activity opportunities

Another example is a research done for measuring accessibility and utilization of public spaces in Famagusta. First of all the research identifies the variables affecting the accessibility of public spaces and other factors affecting the use of public spaces. For the measurement, the study indicates a classification of theories such as dispersion, proximity and ways and means of accessibility. Every theory has elements to measure and a method how to measure. After the measurement of these elements, the results are evaluated to see final assessment of the measurement. (Pasaogullari, N., Doratli, N., 2004)

Since the aim of this study is to increasing livability of cities by providing most appropriate type of public transportation, the accessibility analysis should be done from the livability perspective. When considering accessibility from livability perspective, it can easily be seen that, as it has been proposed by Yeang, accessibility is one of the functional place quality dimension of livability aspects (Yeang, 2006). This dimension is composed of *pedestrian accessibility, public transportation quality,* and *vitality and viability of services*. Considering the table of livability dimensions (see Table 2.5 p.20) derived by Yeang, an indicator list for accessibility can be proposed as shown in the table below.

Table 2.3 Relationship between functional place quality aspects and accessibility indicators

Functional Place Quality	**Indicators of Accessibility**
Pedestrian Journeys	Non-Vehicular Accessibility
	Safety of Roads
Public Transportation Quality	Vehicular Accessibility
	Integration of Modes
Vitality and Viability of Services	Streetscape

Every indicator should include its own criteria for evaluating accessibility which would be checked one by one to reach a result. (Table 2.7)

Table 2.4 Indicators of Accessibility and their criteria

Indicators of Accessibility	**Criteria of the Indicators**
Vehicular Accessibility	Public transportation Road type/ Transport Infrastructure
Non-vehicular Accessibility	Street type sidewalks Pedestrian ways Cycling ways
Streetscape	Street furniture/Landscape elements Cleanliness Car parking (visual intrusion by side parking)
Integration of modes	Integration of different public transportation modes Integration of private transportation & public transportation modes
Safety of Roads	Traffic calming Segregated bike lanes Safe sidewalks

Two tables (Table 2.3&2.4) are integrated and shown in one table (Table 2.5).

Table 2.5 Relationship between functional place quality aspects, accessibility indicators and their criteria

Functional Place Quality	**Indicators of Accessibility**	**Criteria of the Indicators**
Pedestrian Journeys	Non-Vehicular Accessibility	Street type sidewalks Pedestrian ways Cycling ways
	Safety of Roads	Traffic calming Segregated bike lanes Safe sidewalks
Public Transportation Quality	Vehicular Accessibility	Public transportation Road type/ Transport Infrastructure
	Integration of Modes	Integration of different public transportation modes Integration of private transportation & public transportation modes
Vitality and Viability of Services	Streetscape	Street furniture/Landscape elements Cleanliness Car parking (visual intrusion by side parking)

Following the determination of criteria, the next important step should be to develop/identify a sort of method to measure them. Thus, in the next section a methodology for this purpose is suggested.

2.3.2.2. Methodology of Measuring Accessibility in a City

The criteria which are determined to measure accessibility are related to "what to measure", whereas the methodology would be related to "how to measure". Since, examination of the determined criteria reveals that they are to the most part of the accessibility perception of the citizens; the most appropriate approach for the measurement would be a questionnaire survey.

The sample data from this survey would be evaluated through utilization of a "Likert Scale" like tool. According to McCall, to make a decision on a problem, Likert Scale can be used for considering opinions and attitudes of relevant people towards the subject. In this tool (likert scale), through assumption, numerical values can be assigned to the individual item responses. These values can be summed or averaged to reach at an overall or average score. By this way, validity and reliability analysis can be done for the items that have been summed or averaged. (McCall, C., 2001)

Usually likert scales include five possible options. These options are the items that would be used to give scores to indicators and then calculated to reach a result. However, in this study, it is necessary to include an additional option as some of the indicators have possibility of being 'not available'. The research reveals that, the most appropriate options for this study are not available, very poor, poor, average, good or very good. These six options will be scored between 0-5 as shown in the table 2.9.

Table 2.6 Evaluation of Accessibility

Indicators of Accessibility	**Criteria of the Indicators**	**Evaluation**					
		Not Available	**Very Poor**	**Poor**	**Average**	**Good**	**Very Good**
Vehicular Accessibility	Public transportation	0	1	2	3	4	5
	Transport Infrastructure	0	1	2	3	4	5
Non-vehicular Accessibility	Street type sidewalks	0	1	2	3	4	5
	Pedestrian ways	0	1	2	3	4	5
	Cycling ways	0	1	2	3	4	5
Streetscape	Street furniture/Landscape elements	0	1	2	3	4	5
	Cleanliness	0	1	2	3	4	5
	Car parking	0	1	2	3	4	5
Integration of modes	Integration of different public transportation modes	0	1	2	3	4	5
	Integration of private & public transportation modes	0	1	2	3	4	5
Safety of Roads	Traffic calming	0	1	2	3	4	5
	Segregated bike lanes	0	1	2	3	4	5
	Safe sidewalks	0	1	2	3	4	5
Total Score							

There are five indicators with thirteen criteria in the measurement. Based on assumption, for each criterion the ‘average’ score is three, therefore the total ‘average’ score is thirteen times three - thirty nine. That means, if the evaluation result is a score between zero and thirty eight, the accessibility of the city is below average and it needs to have a new transportation system proposal to improve its accessibility. For proposing a system,

the existing situation for each criterion should be considered, and determined what to be newly established and what to be improved. Also such a new system needs to include strategies and related policies for transportation to be applied. On the other hand, for each criterion the ‘very good’ score is five, so total ‘very good’ sore is thirteen times five - sixty five. And that means, if the result is sixty five then the accessibility of the city is very good, however if the result is between thirty nine and sixty four, then the accessibility of the city is above average. This time the criteria which are under average should be checked and improvement or rehabilitation should be applied to increase accessibility consequently livability of the city. Again first of all the existing conditions should be analyzed and type of intervention should be determined. Then the strategies and related policies should be detected for improvement.

Table 2.7 Accessibility Evaluation Results Interval

Accessibility Evaluation	**Below Average**	**Above Average**
Total Score of the Evaluation	0-38	39-64
Necessary Contributions	New Transportation System Improvements Strategies Policies	Improvements Rehabilitation Strategies Policies

In this chapter, the relation between livability, accessibility and public transportation has been expressed through examining livable cities. The research reveals that accessibility as a dimension of livability has great impact on livability of cities. Furthermore, it can be claimed that public transportation has great contributions for increasing accessibility of cities. That means, public transportation provides increase in livability level of cities.

Through all these obtained information, an accessibility assessment and measurement methodology has also been derived in this chapter. It has been claimed that, after assessment and measurement of accessibility, new proposals could be done for the city, to increase and improve its accessibility. In order to be successful in making such contributions, it is necessary to explain public transportation deeply; its different modes, strategies and to analyze examples of cities which have good public transportation systems. Thus public transportation is the subject of next chapter.

Chapter 3

PUBLIC TRANSPORATION

As George M. Smerk mentioned, transportation is one of the major factors affecting growth, development and shaping of cities. From early settlements onwards, the importance of transportation had shown itself. In ancient times settlements were mostly situated nearby a lake, river or sea, because of agriculture and water transportation opportunities. Goods were transported by simple types of transportation like animal forces and water, and people were walking. But after industrial revolution cities had started to grow rapidly. Since work places and homes had been separated, transportation for people had become a problem. People needed to access their work places, service areas and other facilities in growing cities. As a result private car usage had initialized by upper-class in that time, and increased day by day up until today, which also has increasing negative impacts, like the effects mentioned before; air pollution, congestion in traffic, car-parking, unhealthy communities with limited physical actions in their daily life, unsafe roads, unlivable streets, high risk of traffic accidents. Considering the benefits of public transportation, which will be explained in this study, it seems to be a solution for the many other problems cities suffer today such as environmental pollution, loss of urban living spaces and agricultural lands, congestion, traffic accidents and etc.

Public transportation provides shorter travel time comparing to car. For example rail systems do not face with congestion or parking problems and since they have separate

lanes they can arrive to destination faster than a car. Actually travel time depends on the mode of public transportation and their routes. Although sometimes cars provide shorter travel time, still public transportation's travel time is more reliable than a car, because it will provide approximately same time for the trip. (Van Vugt, M., Van Lange, P., Meertens, R.,1996)

Another benefit of public transportation is that it is less hazardous for environment, because one vehicle carries 30 people instead of 5 people at most. Just as an example if it is compared like that, private car usage is polluting air 6 times more than a motorized public transportation mode. Also same example can be given for energy consumption issue. One vehicle carrying at most 5 people needs same fuel with a bus carrying 30 people. That means using public transportation would decrease one person's travel cost.

The research reveals that the benefits of using public transportation in a city are varying depending on the modes of transportation systems. In order to analyze and learn which public transportation system is more feasible for which kind of cities, these modes should be explained in details.

3.1. Modes of Transportation

Transport modes express different choices of transportation. There are two main modes, which are private transportation modes and public transportation modes. Private transportation modes includes walking, cycling (motorized and non-motorized) and private cars, and public transportation includes buses and coaches, taxis and private hire vehicles, tramways and light rail and heavy urban rail. This mode can be classified as environmental friendly and petrol driven according to their engine types. Although the

main focus of this study is public transportation, it is necessary to explain private transportation modes as well, because private transportation either supports public transportation or competes with it. (The Demand for Public Transport: a practical guide, TRL report, 2004)

Table 3.1 Classification of Transportation Modes

Public Transportation Modes		***Private Transportation Modes***	
Environmentally Friendly Modes	*Petrol Driven Modes*	*Supportive Modes*	*Competitive Modes*
- Tramway & Light Rail - Heavy Urban Rail	- Bus & Coaches - Taxi & Private Hire Vehicles	- Walking - Cycling (non-motorized)	- Cycling (motorized) - Private Car

As it is mentioned before most of the public transportation trips start and end with walking or cycling, in that sense walking and cycling can be considered as invisible supporters of public transportation. Driving to a station, parking there (park and ride) or dropping off a passenger (kiss and ride) are other supportive ways. However, door-to-door transportation, which is a type of private transportation done by cars, is a competing more with public transportation. Thus all these modes should be searched and explained to understand their integrations and the way they compete, in order to be able to encourage public transportation.

3.1.1. Private Transportation Modes

Private transportation modes provide door-to-door transportation which is its major difference from the public transportation. Reliability is the most important statement for encouraging private transportation. It can be walking, cycling (motorized and non-motorized) and driving private cars. These modes are explained briefly below.

WALKING

This mode is a significant supportive type of private transportation with its own right. Providing safe pedestrian ways and standard walking distance to bus stops and railway stations which is a basis of accounting equality will make this mode to work as a feeder mode. Walking is an equal right for everybody even disabled people with wheel chairs who can use pedestrian access (if it is suitable) to arrive their destinations. It is important for shopping, personal business and home-to-school trips for young children. (TRL report, 2004) This mode is also necessary for a healthy life, social interactions and also it is economic. (see "Livable Streets")

Quality of streets highly affects this mode. The streets should be safe-segregated from vehicle traffic by barriers, attractive and provide continuous sidewalk networks- with street furniture like benches, street lights, landscaping etc. The design of "livable" streets or streets aiming at integrating the needs of pedestrians is encouraged since pedestrian friendly streets have many social outcomes, like economic growth and innovation (Florida, 2002), improvements in air quality (Frank et al., 2000), increased physical fitness and health (Frank et al., 2003) etc. beside quality of life benefits (for a healthy life, social interactions, recreational activities etc.) (as cited in Dumbaugh, Eric and Gattis, J. L.2005).

Figure 3.1 A wide, segregated sidewalk in Napoli, Italy
Resource: Elda Istillozlu, 2010

Figure 3.2 Walking as a supportive mode of public transportation in Roma, Italy
Resource: Elda Istillozlu, 2010

CYCLING (NON-MOTORIZED)

Cycling is another healthy and economic way of private transportation. Most of the characteristics of this mode are same with walking. The bicycle lanes should be safe and well designed in order to be encouraged. Also it can be feeder for public transportation if buses provide space (or would be handled) or rail stations have reliable parking places (secure racks) for bicycles. It is a good supportive mode for public transportation and should be encouraged.

Figure 3.3 A separated bike lane with sidewalk in Berlin, Germany

Resource: http://journal.davidbyrne.com/2007/06/62007-berlin-st.html

CYCLING (MOTORIZED)

This mode involves two wheelers motorized like motorcycles, scooters, motorized bicycle, motorbike and etc. This type is competing with public transportation. According to TRL report (2004) motorized cycling is mostly used in low-income countries, because

it is more economic and practical when compared with cars. However they are causing air pollution since they are using fuel. Additionally they create noise pollution. This mode of transportation is not safe and it is risky.

PRIVATE CAR

This is another competing mode of private transportation with public transportation. Although it is not economic and not energy efficient, it is used greatly in most of the cities. Car ownership is increasing rapidly in all over the world, because of availability of a car would mean that the owner have a wider choice of employment, shopping and leisure facilities in a short time (Mackett, R., Edward, M., 1997). However the high usage of this mode causes environmental problems like air pollution, energy consumption etc., traffic congestion and decreases safety of streets since it increases accident risk and has many other negative impacts.

As it is mentioned in TRL report, depending on the usage type this mode can be classified as passenger and driver use. However, through utilization of different policies, this mode can be transformed from a competing to a supportive mode to the public transportation. Kiss and ride and park and ride can be good examples to these policies. Every public transport station and stop should have parking area and a pocket for drop off passengers. These policies, which will be explained in the 'Strategies for Transportation' section of the research, will support public transportation. Additionally, some other discouraging strategies should be considered such as: decreasing road capacities; congestion charging; pedestrianisation and etc.

3.1.2. Public Transportation Modes

As has been mentioned before, buses and coaches, taxis and private hire vehicles, tramways and light rail and heavy urban rail are the public transportation modes. According to George Gray and Lester Hoel, public transportation modes can also be classified according to their capacity and speed such as, street transit (bus, trolleybus, street car), semirapid transit (semirapid bus, light rail transit), rapid transit (rail, rubber-tired, regional rail) and paratransit (minibus) (Gray, G., Hoel, L., 1992). However, in this research these modes will be examined as they are classified according to their usages and engine system, since usages and engine systems are related to the social and environmental aspects of sustainability which is an important issue of livable cities.

Table 3.2 Classification of Public Transportation Modes

Classification of Public Transportation (PT)	MODES of PT	VEHICLE TYPES
According to Capacity and Speed	Street Transit	Bus, Trolley bus, Street car
	Semirapid Transit	Semirapid bus, Light rail transit (LRT)
	Rapid Transit	Rail, Rubber-tired, Regional rail
	Paratransit	Minibus
According to Usages and Engine System	Buses and Coaches	Local bus, paratransit, contract school service, Intercity express coaches, Hybrid bus
	Taxis and Private Hire Vehicles	Cars
	Tramways and Light Rail	Street trams, Modern trams, LRT
	Heavy Urban Rail	Underground, Metro

BUSES AND COACHES

The Demand for Public Transportation guide (TRL report, 2004) team claims that buses and coaches are the most common type of public transportation. This type of mode can be in different usages with different vehicles, such as local buses, paratransits, contract school services and intercity express coaches. Local buses are for general public, they have a determined route and fixed stops. Paratransits are usually minibuses, they are for general public as well but they don't have fixed stops and route, they are flexible and give stop depending on demand. Contract school services are not for general public, they are only for the students of the school they contracted with. And intercity express coaches are for general public, they are for longer distances and have scheduled travel times. There are also buses and coaches for hire by organizations or individuals, for example tourist travel purposes.

Table 3.3 Examples for Buses and Coaches

A Local Bus- Salerno City, Italy	A Paratransit
	
Resource: http://www.flickr.com/photos/semmytrailer/2764952262/	Resource: http://www.seyvet.com/foto/8004

Table 3.3 (Continued) Examples for Buses and Coaches

A Contract School Bus	An Intercity Express Coach
	
Resource: http://green.autoblog.com/2007/03/27/what-to-do-with-old-non-hybrid-buses-that-are-replaced-how-abo/	Resource: http://englandtwitter.blogspot.com/2011/01/buses-in-london.html

Hybrid system, which includes an electric drive and a clean diesel engine, has been produced by some bus companies recently. In this system, regular bus transmission is changed to an electric transmission which performs as a transmission, generator and electric motor. These hybrid busses have batteries on the roof and they work during acceleration and use the braking process to generate power. They are greatly reducing fuel consumption and greenhouse gas emission about 90 percent compared to conventional buses (American Public Transportation Association, 2008). Therefore this type of public transportation mode is count to be an environmentally friendly mode.

Figure 3.4 Hybrid Bus

Resource: American Public Transportation Association, 2008

TAXIS AND PRIVATE HIRE VEHICLES

Although this is a mode which is used for private purposes and provides door-to-door transportation; it is still a type of public transportation mode since it is serving general public. Private hire vehicles generally have fixed daily fares and taxis charges a fixed fare per km. This mode is more luxury and expensive comparing to other modes of public transportation but they are an alternative type in cities.

TRAMWAYS AND LIGHT RAIL

This type of public transportation is the most effective mode in cities. Most of the modern types are using an environmentally friendly electric system. The tramways, also called as street cars, can be traditional street trams or modern tramways. On the other hand light rails are the other type of surface systems, which have higher capacity than

tramways. The funiculars are also type of light rail systems; they are used in the sloppy topographies. Tramways and light rail transits have fixed speed and stations and taking trips depending on a time schedule, so they are reliable in terms of time. Although they play the same role in cities, this mode is more attractive than buses because of time reliability.

Table 3.4 Examples for Tramways and Light Rail

A Street Tram- South Island, New Zealand  Resource: http://www.tour-smart.co.uk/destinations/new-zealand/new-zealand%20%20-%20tour-smart/	A Modern Tram- Geneva, Switzerland  Resource: http://switzerland-geneva.com/transportation/trams.html
A LRT- Houston, Texas  Resource: http://www.beyondrobson.com/city/2009/11/alternatives_to_broadway_corridor_skytrain/	A Funicular- Lisbon, Portugal  Resource: http://www.travel-earth.com/portugal/

HEAVY URBAN RAIL

This mode contains underground and metro systems. They are fully separated from surface traffic and have high speed and capacity. The stations are greater than tramways' and LRT's stations and the trip time and distance are longer. They provide service both in city and between cities-settlements. In this mode, travels are according to a time schedule and since it is segregated from surface traffic, it provides time reliability. Heavy urban rails are also generally using environmental friendly systems, and they are very effective type of public transportation modes.

Table 3.5 Examples for Heavy Urban Rail

An Urban Rail/Metro- Australian City of Perth	An Underground /Subway- Tokyo, Japan
 Resource: www.flickr.com/photos/_autumn_leaf/262622781/	 Resource: bartman905.wordpress.com/2008/10/26/tokyo-subway/

3.2. Strategies for Transportation

Before directly discussing "Intermodality", it is worth to highlight strategies for transportation very briefly, simply because intermodality can be considered as an indispensable part of strategies and relevant policies which serve sustainability issues with respect to transportation.

Following the increasing awareness about sustainability and sustainable development, in the field of urban planning there has been a considerable shift towards sustainable planning systems. This has been followed by a considerable interest and studies on sustainable cities.

Peter Newman and Jeffrey Kenworthy explain some indicators for sustainable cities derived from an Extended Metabolism Model (scaled-down version of the 150 indicators defined by the World Bank and UN Center for Human Settlements-World Bank, 1994) in their book. The main subjects of these indicators are; "energy and air quality, water, minerals and waste, land, green spaces and biodiversity, transportation, livability, human amenities and health". A set of strategies are suggested under these subjects.

Transportation is one of the main subjects in these indicators. Its strategies are; (Newman, P., Kenworthy, J., 1999)

- "reducing car use per capita
- increase transit, walk/bike, and carpooling (ride sharing) and decrease sole (private) car use
- reduce average commute to and from work
- increase average speed of transit relative to cars
- increase service kilometers/miles of transit relative to road provisions
- increase cost recovery on transit from fares
- decrease parking spaces per 1,000 workers in central business district

- increase kilometers/miles of separated cycle ways" (Newman, P., Kenworthy, J., 1999, p.5)

These strategies are all related with each other, for example providing safe or segregated pedestrian and cycle ways, increasing transit services and quality and reducing capacity of car parks will lead to reduce private car use per capita. One strategy is the result or supporter of the other one and they are all reaching to the same point; discouraging private car use and encouraging public transportation.

The research reveals that there should be some supportive policies for the application of these strategies. Integration of modes or in other words intermodal transportation and congestion charging are supportive policies. Congestion charging is a policy, which effectively discourages private car usage only some parts the city. However, intermodal transportation directly encourages and increases usage of public transportation in whole city and also between cities-settlements. Considering the importance of intermodal transportation for public transportation, will be explained in this research with some examples. The definition of the policy is; "the transportation of a person or a load from its origin to its destination by a sequence of at least two transportation modes, the transfer from one mode to the next being performed at an intermodal terminal" (Crainic, 2007, p.2).

Integration of modes is a very important transportation policy that increases feasibility and utilization of public transportation. If intermodal system is established properly in a city and connects urban transport systems with interurban transportation, the facilities

and usability of public transportation would be increased. Transportation directors from different world cities (Intermodal Freight Transport between Belgium and Bulgaria, intermodal public transportation in Sacramento city and Wareham) stated strategies for intermodal transportation in cities and between cities/settlements. For example, the strategies, which are directly aiming at increasing public transportation, defined by the city of Sacramento transportation directors are:

- "Provide better connectivity between passenger rail and transit services to meet user needs at a convenient focal point
- Improve capacity and reliability for both freight and passenger rail service
- Reduce conflicts and widely dispersed operations among transportation modes
- Accommodate future growth for current rail, transit and bus service providers and provide opportunities for potential new operators
- Remove traffic from interstate and highway systems, as well as from City streets" (http://www.cityofsacramento.org/transportation/director/sitf/)

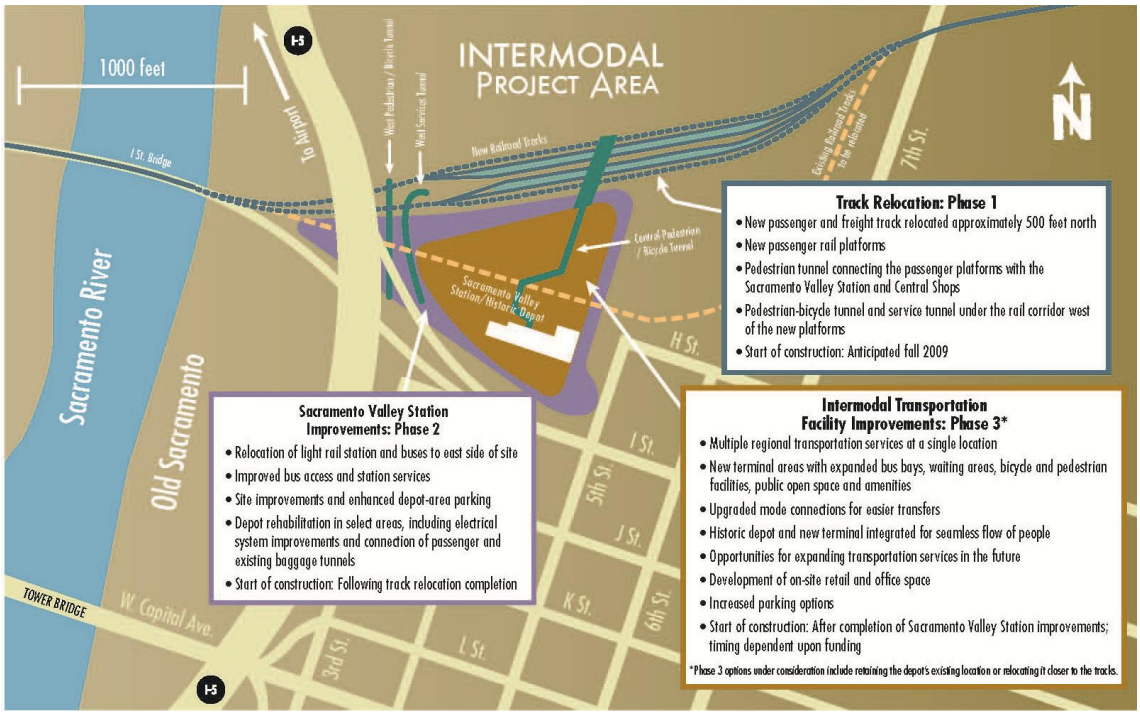


Figure 3.5 Intermodal Project Area, Sacramento

Resource: http://www.cityofsacramento.org/transportation/director/sitf/index.html, April 2011

These strategies, for the city of Sacramento, are determined for inner city transportation. Another example for inner city transportation can be Wareham (a small market town in United Kingdom) Intermodal Transportation Center's strategies; which has been defined as: (Southern Regional Planning & Economic Development District, 2005)

- "Serve the current need and anticipate future needs;
- Minimize traffic impacts;
- Be accessible without requiring travel through the center of town;
- Be easily accessible from both ends of town;
- Contribute to the viability of Main Street;
- Provide space for bus connections and for intercity bus passengers;

- Provide a connection to the rail line;
- Have access for emergency vehicles; and,
- Help to promote the Town as a destination"

  (http://srpedd.org/WarehamITC.pdf).

Intermodal transport system includes integration of one public transportation mode with another (rail-bus, bus-bus, rail-rail, rail-minibus etc), park and ride (integration of private vehicles with public transportation-long term parking), kiss and ride (integration of private vehicles with public transportation-short term parking), bike and ride (integration of a private vehicle with public transportation) and integration of pedestrian access and cyclers with a public transportation mode. All these policies will be explained in the following.

3.2.1. Integration of Public Transportation Modes

This kind of integration can between buses, minibuses, urban and interurban rail systems. These modes of public transportation can also be feed by private transportation modes such as, walking, cycling or private cars. The main stations, tram stations or bus stops can be located in a pedestrian square, or they can have their own car parks. Some of these modes provide fully closed linkages for example a bus stop and a LRT station, for providing protection in the heavy seasons.

Table 3.6 Examples of Integration of Public Transportation Modes

INTEGRATED MODES	LOCATION	PHOTOGRAPH
Street tram Main railway station Pedestrian way	Düsseldorf, Germany	 Resource: iguide.travel/Düsseldorf/Getting_There/By_train
Bus Metro	Saarbrücken, Germany	 Resource: transitmy.org/2011/06/14/prasarana-showcases-new-fare-collection-system/
LRT Bus Car parks A high level walkway	Brentwood station, Calgary, Canada	 Resource: http://www.railwaybob.com/Calgary/CTrain01.html

Table 3.6 (Continued) Examples of Integration of Public Transportation Modes

Tram Bus	Croydon, England	 Resource: http://wn.com/Harrow_Road_Shell

3.2.2. Park and Ride

Public transportation can be supported by park and ride system in which people can drive to any station, park there their private cars and continue with the public transport mode. This is time saving integration mostly for crowded parts of the city like city centers or central business districts: parking to the periphery of the congested area and riding into that part with a running system instead of hanging out to the heavy traffic. Also it can be economical solution for the congestion charging areas.

Figure 3.6 Park and Ride Signs, United Kingdom

Resource:http://commons.wikimedia.org/wiki/Category:Park_and_ride_signs_in_the_United_Kingdom

Figure 3.7 A bus stop, which is feed by car parking space and bicycle racks for park and ride, and bike and ride

Resource: http://www.celsias.com/article/park-and-ride-confusion-learning-europe/

3.2.3. Kiss and Ride

This system is a practical way to drop off or embark passengers from stations in a short time. There can be pockets on the roads for this purpose, just before a bus stop or a railway station, or even it can be provided in front or at the back of the station. Also a short-lasting parking lot can be provided for kiss and ride facility.

Figure 3.8 Examples of Kiss and Ride

Resource: http://en.wikipedia.org/wiki/File:Marta_kiss_ride.jpg

3.2.4. Bike and Ride

Bike and ride is a practical, environmentally friendly and healthy public transportation supporter system. The combination of cycling as a feeder private transportation mode with any of the public transportation mode would help to reduce traffic congestion, energy consumption, pollution and etc. In order to apply this system, providing safe bike lanes and providing bike rails, cages or lockers at the public transportation stops will be required. (Australian Government- Department of Regional Development & Local Government)

Table 3.7 Examples of Bike and Ride

Bike Cages 	Bike Lockers 
Bike Rails 	Bike Racks on Buses 

Resource: http://transport.act.gov.au/bike_and_ride.html

3.2.5. Integration of Pedestrian Access into Motorized Travel

This type of integration is provided between a public transportation mode and a supporter private transportation mode (walking, non-motorized cycling). Walking or riding bicycles should provide safe, convenient, and comfortable access to every destination within a community, so it is important to provide a linkage between these modes and a public transportation mode.

Table 3.8 Examples of Integration of Pedestrian Access and Motorized Travel

INTEGRATED MODES	LOCATION	PHOTOGRAPH
Light Rail Pedestrian Zone	Karlsruhe, Germany.	 
	Grenoble, France	

Resource: http://citytransport.info/Framezon.htm

Table 3.8 (continued) Examples of Integration of Pedestrian Access and Motorized Travel

	Amsterdam, Holland	 

Chapter 4

THE MOST APPROPRIATE MODES OF TRANSPORTATION FOR LIVABLE CITIES

The research reveals that a way of increasing livability of cities is to provide appropriate public transportation feed by private transportation. By analyzing the modes of public and private transportation, it is derived that some modes are more compatible for increasing quality of life in cities according to their environmentally friendly characteristics. And these appropriate transportation modes will not only improve environmental conditions but also improve social and economical conditions of the city.

Providing environmentally friendly modes of public and private transportation with intermodal system would create equity in terms of access; prevent loss of urban living spaces, visual intrusion, air and noise pollution; and reduce congestion and energy consumption. Accordingly livability of cities would increase, as it has been explained in the chapter 2 of this research.

4.1. The Most Appropriate Public and Private Transportation Modes

Based on the literature survey on different transportation modes, which also been presented in the previous chapter, among the public transportation modes, the rail systems and hybrid buses are the most environmentally friendly systems. In order to provide feasibility for the usage of public transportation, it should be feed by private transportation such as walking, non-motorized cycling and private cars. Although

private cars are not environmentally friendly and they are counted as a competitive mode against public transportation, they could be used as feeder mode by applying transportation policies like park and ride, kiss and ride or bike and ride. These environmentally friendly modes of public and private transportation should be planned and designed in order to improve environmental, social and economical conditions in cities. In other words such kind of transportation planning would contribute to the sustainability of cities, by decreasing CO_2 emission, fossil fuel dependency, traffic accidents and congestion, obesity and so on.

Public transportation is one of the criteria in the Mercer's and Monocle's quality of life survey. Examining the first three cities from the most livable cities list, prepared with the results of these surveys, it can be seen that rail systems, hybrid buses, non-motorized cycling and walking are the most appropriate modes of transportation in these cities.

4.2. Accessibility of The First Three Most Livable Cities From Mercer's & Monocle's List

All of the livability studies include accessibility and emphasize the importance of public transportation. Thus the approach of increasing livability in cities by providing integrated appropriate public and private transportation modes (rail systems, hybrid buses, walking, non-motorized cycling), could be illustrated with accessibility of the first three most livable cities determined by Mercer's and Monocle's survey on most livable cities explained in Chapter 2. According to the Mercer's survey the first three most livable cities are Vienna, Zurich and Geneva and in Monocle's list they are Munich, Copenhagen and Zurich. Hence these five cities' (Vienna, Zurich, Geneva,

Munich and Copenhagen) accessibility from livability perspective will be illustrated in this section.

VIENNA- AUSTRIA

Vienna, with a 1.7 million population, is the capital city of Austria. The city has a modern underground system known as U-bahn of 5 lines with a total length of 74.5 km and 101 stations. Vienna is counted as the city of having the world's largest tram network as well (Schwandl, R., 2010). There are 28 tram lines with a total network of 165 km. The Badner Bahn (Local Rail) is another light rail system operating in the city and the Schnellbahn (metropolitan railway), which is a rapid rail transit, is the complementary rail service within the city.

In the city, underground rail system (U-Bahn), tram network, local rail, metropolitan railways are well integrated public transportation systems.

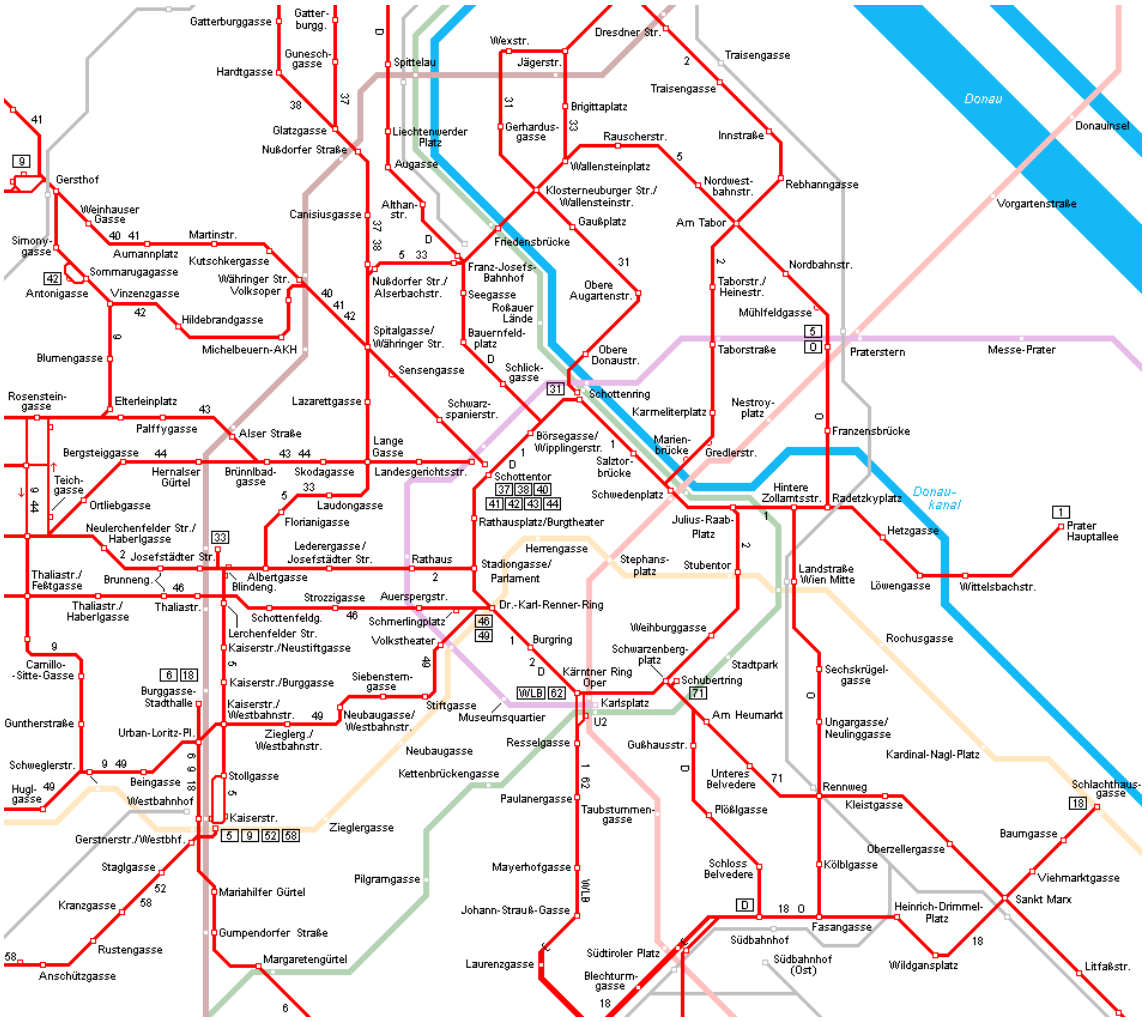


Figure 4.1 Tramways in Vienna

Resource: www.urbanrail.net/eu/vie/tram/wien-tram.htm, April 2011

The figure above shows the railway network of Vienna (Figure 4.1). Red lines are indicating streetcars (tramways) and the light colored lines are showing underground rail network which are shown in the Figure 4.2 in more detail.

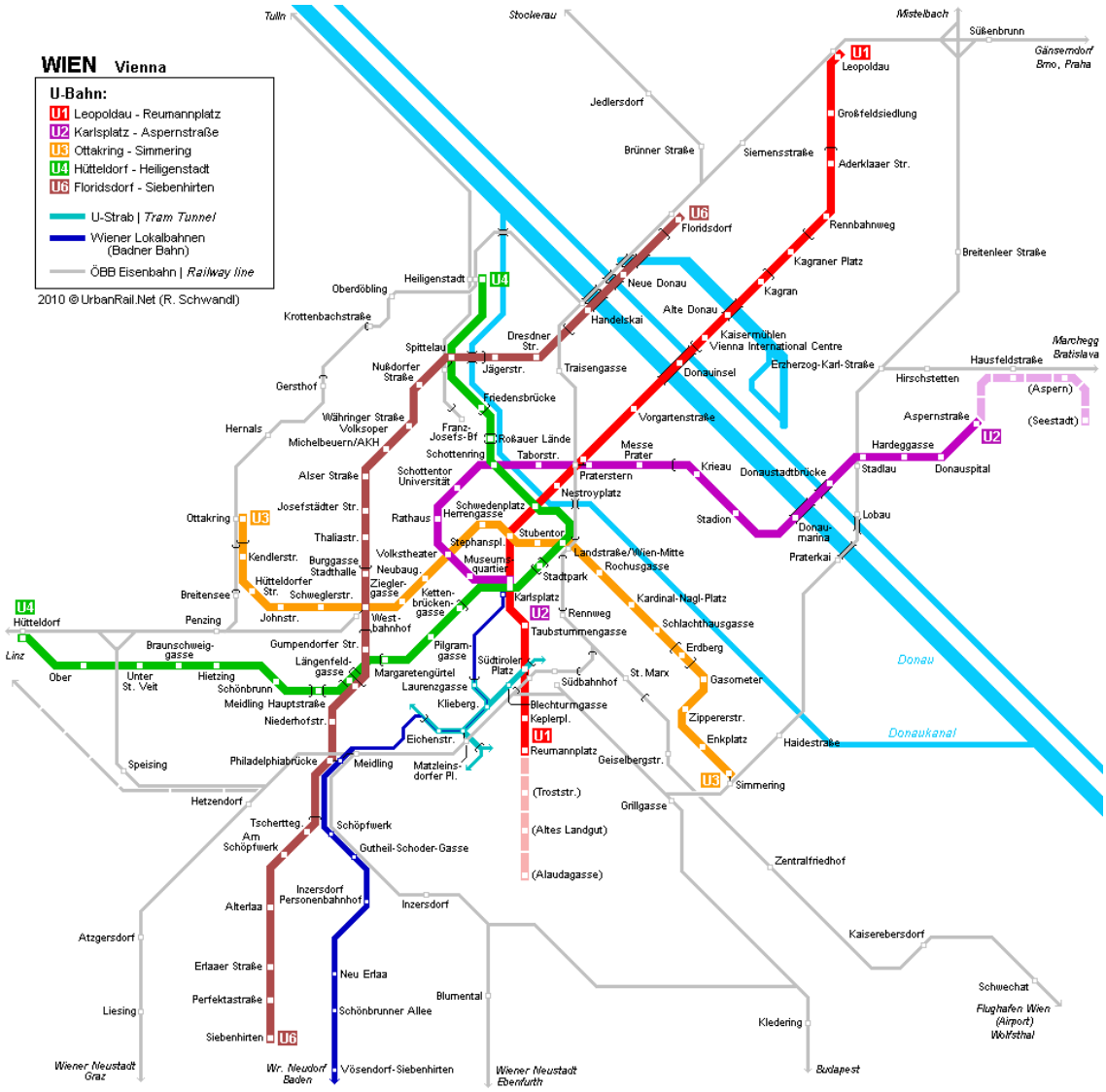


Figure 4.2 Vienna Rail Transportation System Map

Resource: www.urbanrail.net/eu/vie/wien.htm, April 2011

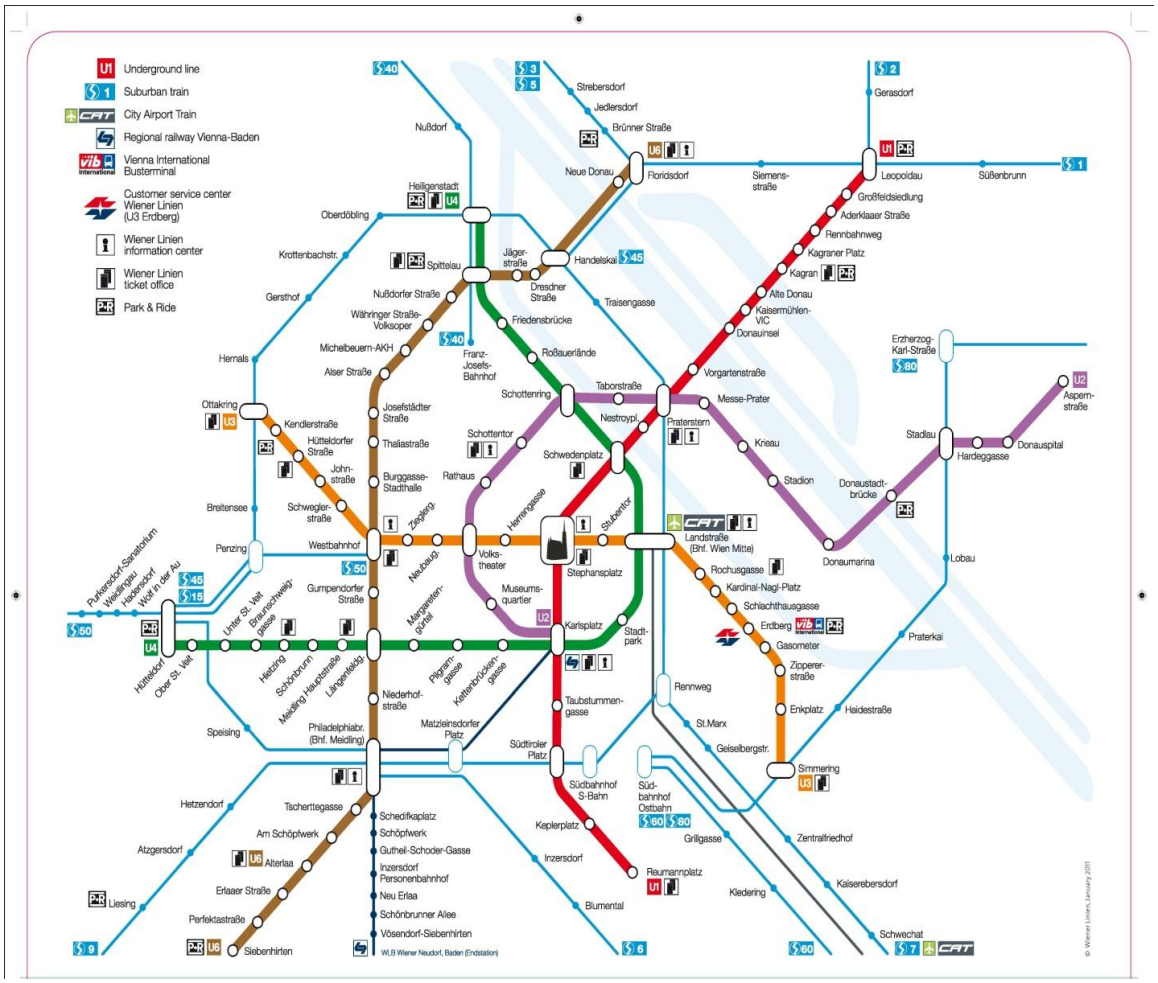


Figure 4.3 Rapid Accessibility Map in Vienna

Resource:
www.wienerlinien.at/media/files/2008/Schnellverbindungsplan_englisch_3104.pdf,
April 2011

The Figure 4.3 is showing the rapid rail system network in the city. The map also indicates the intermodal stops and park and ride stations. The integration in the city is between one underground line with another and between underground line and suburban rail lines.

ZURICH- SWITZERLAND

Zurich has 375.000 inhabitants in the city boundaries. The city provides an intermodal transportation for its citizens by tram, suburban rail, funicular, bus and also lake and river boats. The city has got 14 lines approximately 79 km long tramways and 380 km long suburban rail known as S-bahn. Also the rail system of the city includes a funicular system (cable cars) for sloppy areas (Figure 4.4).

The vehicles are mostly low-floor type, so they are providing easy travel with prams. Some doors have symbols for prams and if people want to use that facility, the vehicle driver can keep doors open longer to get on or off. Also bicycles can be taken to a bus or a tram by their owners.

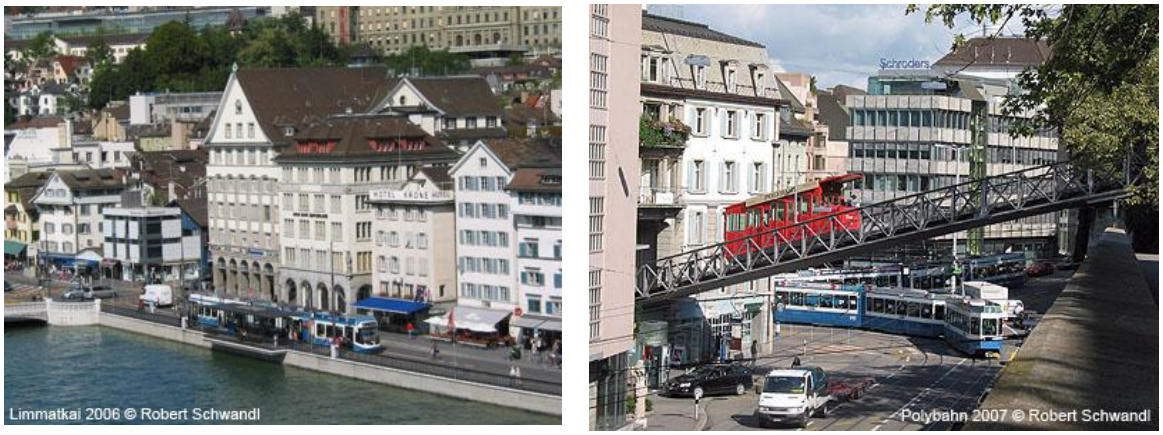


Figure 4.4 Tramway and Polybahn (Funicular)

Resource: http://www.urbanrail.net/eu/ch/zh/zuerich.htm

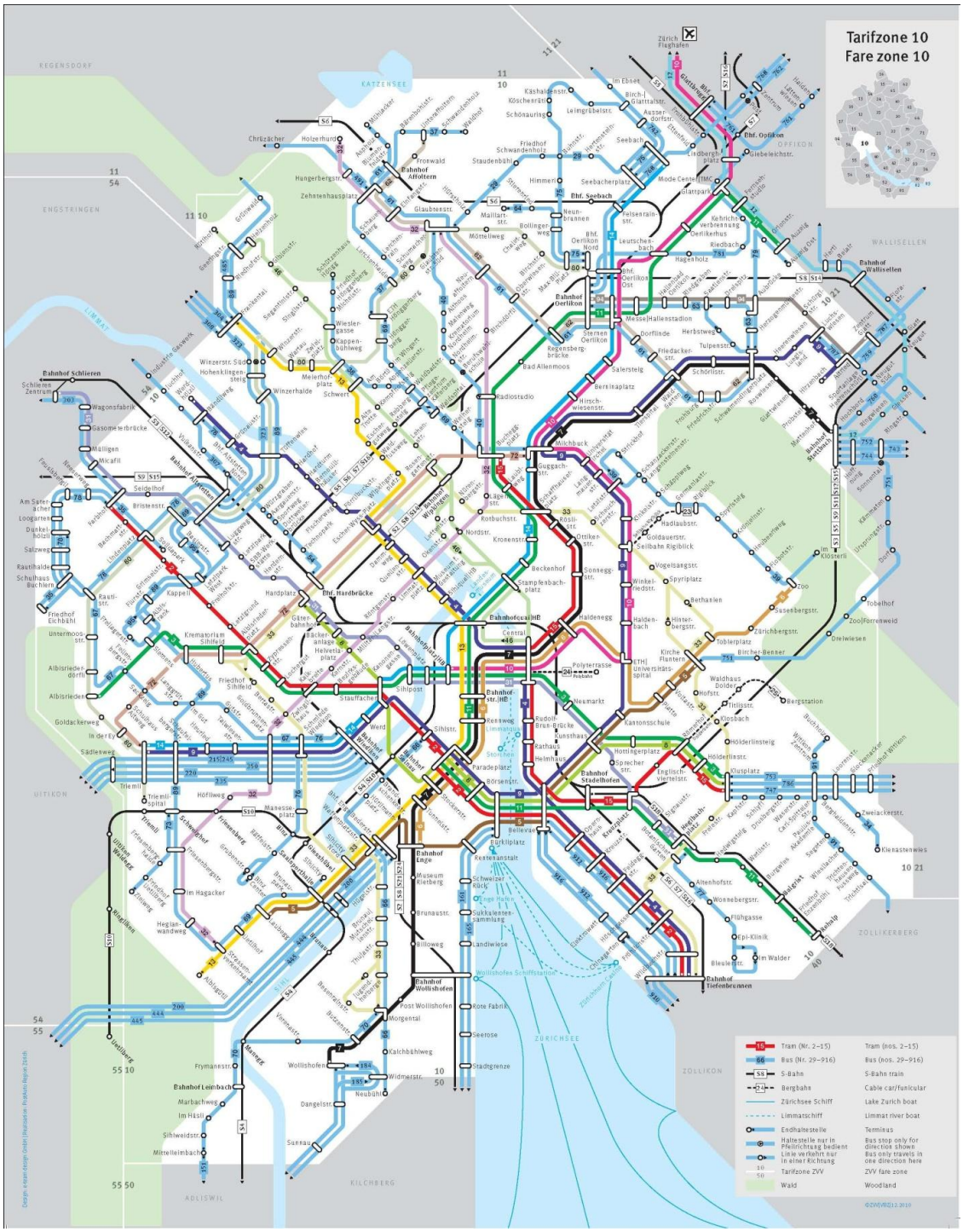


Figure 4.5 Accessibility Map of Zurich

Resource: http://www.stadt-zuerich.ch/content/dam/stzh/vbz/Deutsch/

The accessibility map of Zurich is showing whole transportation network of the city. The blue lines are indicating bus routes, black lines are S-bahn rails, and dashed black

lines are funicular routes. And all other colored lines are showing the tram network in the city.

GENEVA- SWITZERLAND

Geneva has a population of 186.000 people within its city boundaries. The city provides tramways and trolleybuses for public transportation. It has 7 tramway lines with a length of 33.5 km and 6 trolleybus lines with a length of 37.5 km. the tramway lines are shown with blue lines in the Figure 4.6.

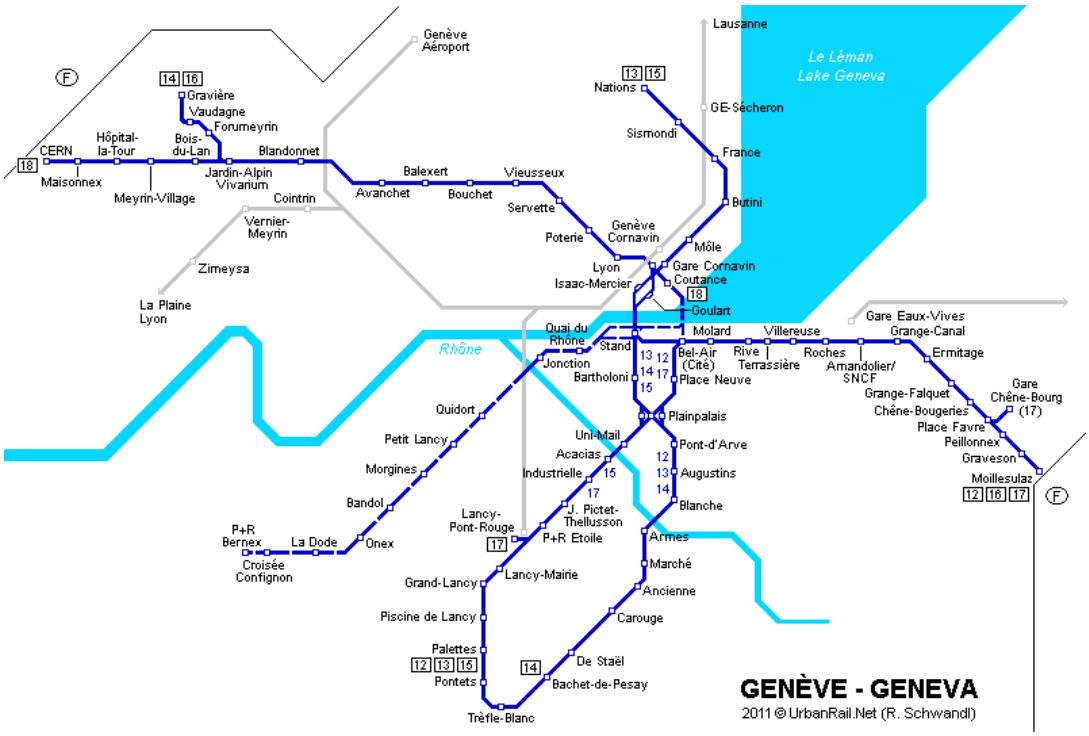


Figure 4.6 Tramway Line Map of Geneva

Resource: http://www.urbanrail.net/eu/ch/ge/geneve.htm

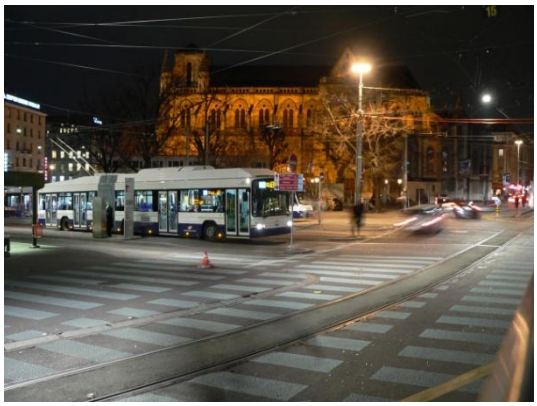


Figure 4.7 Tramway and Trolleybus

Resources: http://www.urbanrail.net/eu/ch/ge/geneve.htm,
http://upload.wikimedia.org/wikipedia/commons/1/16/Place-Cornavin

MUNICH- GERMANY

Munich is a crowded city with its 1.3 million inhabitants. The city provides tramways, underground and suburban rails for public transportation. The tramways and underground rails (U-bahn) are light rail systems and suburban rails (S-bahn) are the rapid rail systems. There are 11 lines for tramways with totally 71 km length. The underground rail network, known as U-bahn, has actually 3 lines with 2 branches in each and the total length is approximately 95 km.

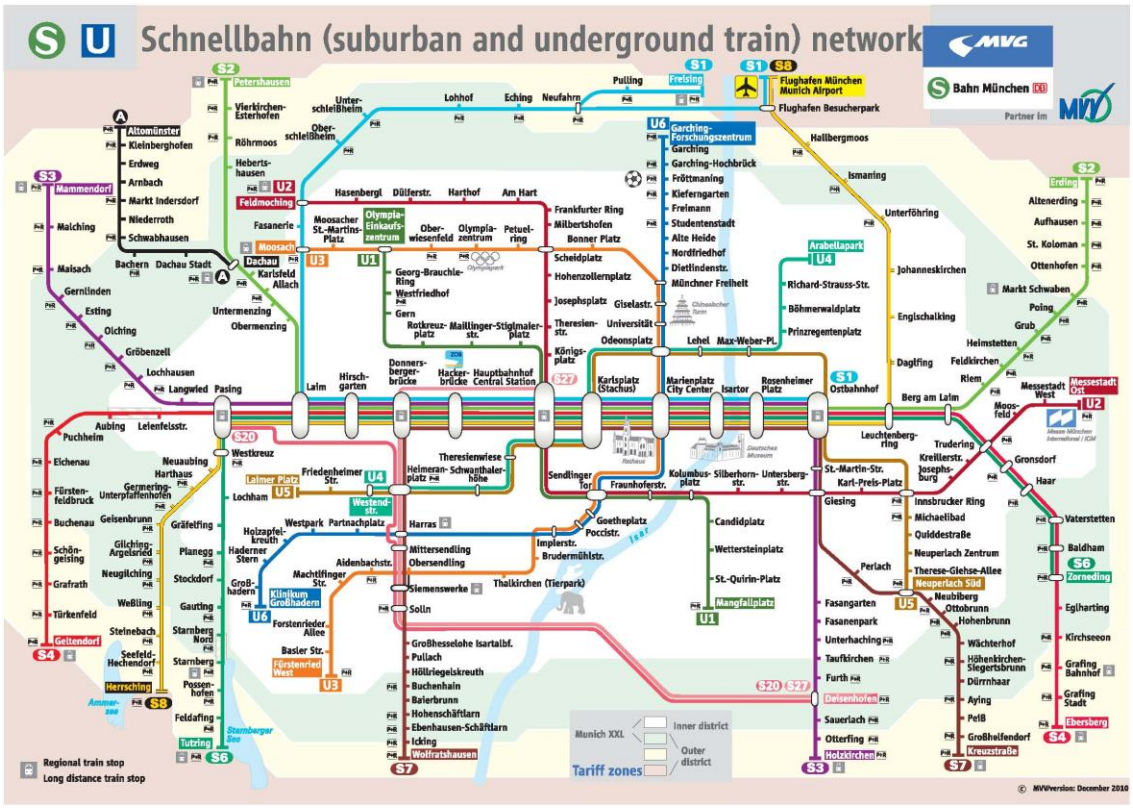


Figure 4.8 U-Bahn & S-Bahn Map

Resource:http://www.mvvmuenchen.de/en/home/mvv_network/transportnetworkmaps/urbanrailnetwork/index.html

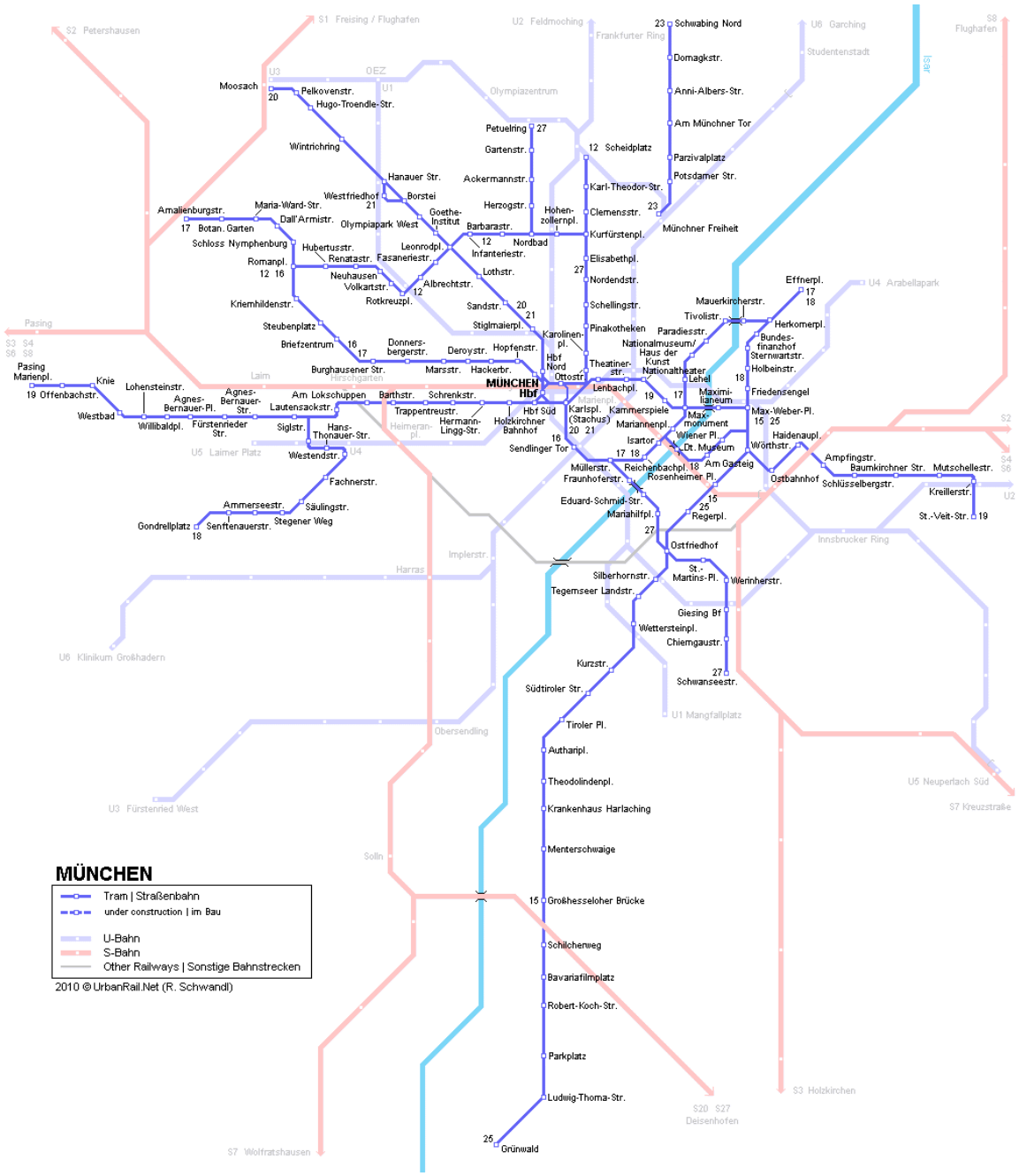


Figure 4.9 Tramway Lines of Munich

Resource: http://www.urbanrail.net/eu/de/m/tram/muenchen-tram.htm

The city transportation network also offers, park and ride and bike and ride facilities in rail stops. Number of spaces for cars or bikes has been shown in park and ride (Figure 4.10) and bike and ride maps (Figure 4.12).

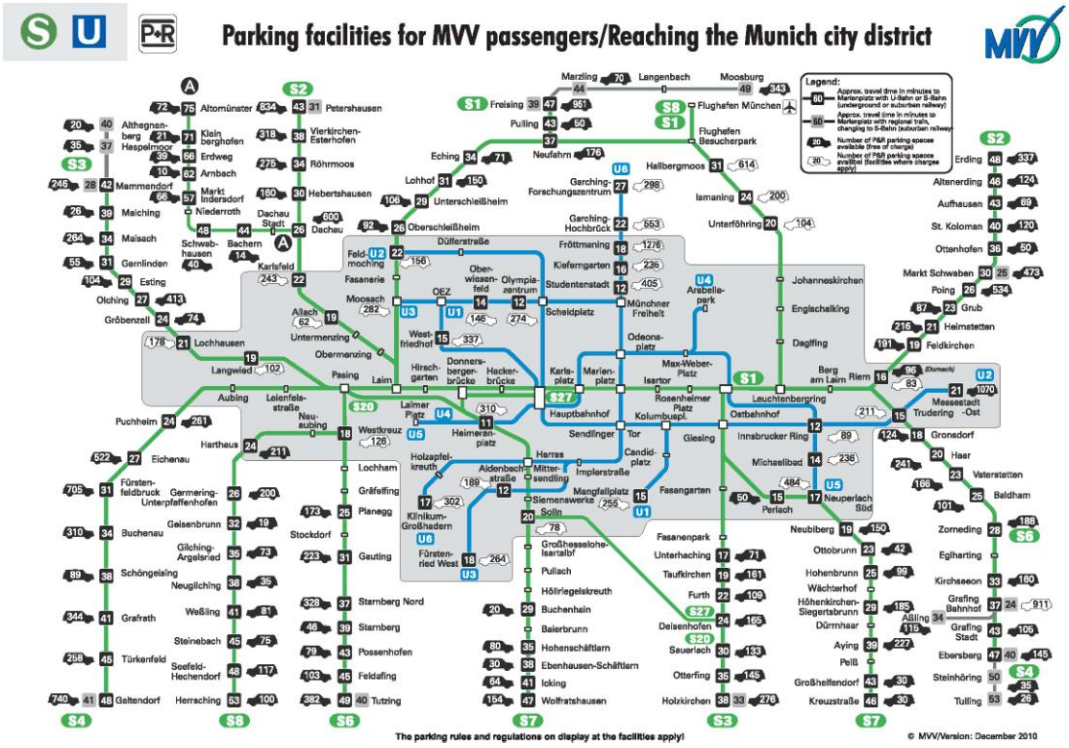


Figure 4.10 Park and Ride Map

Resource:http://www.mvvmuenchen.de/en/home/mvv_network/transportnetworkmaps/parkride/

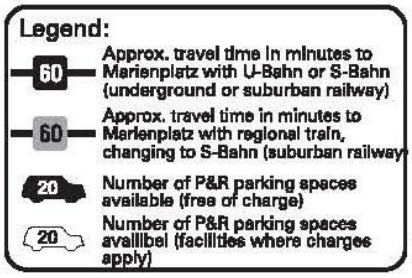


Figure 4.11 Legend of Park and Ride Map

Resource:http://www.mvvmuenchen.de/en/home/mvv_network/transportnetworkmaps/parkride/

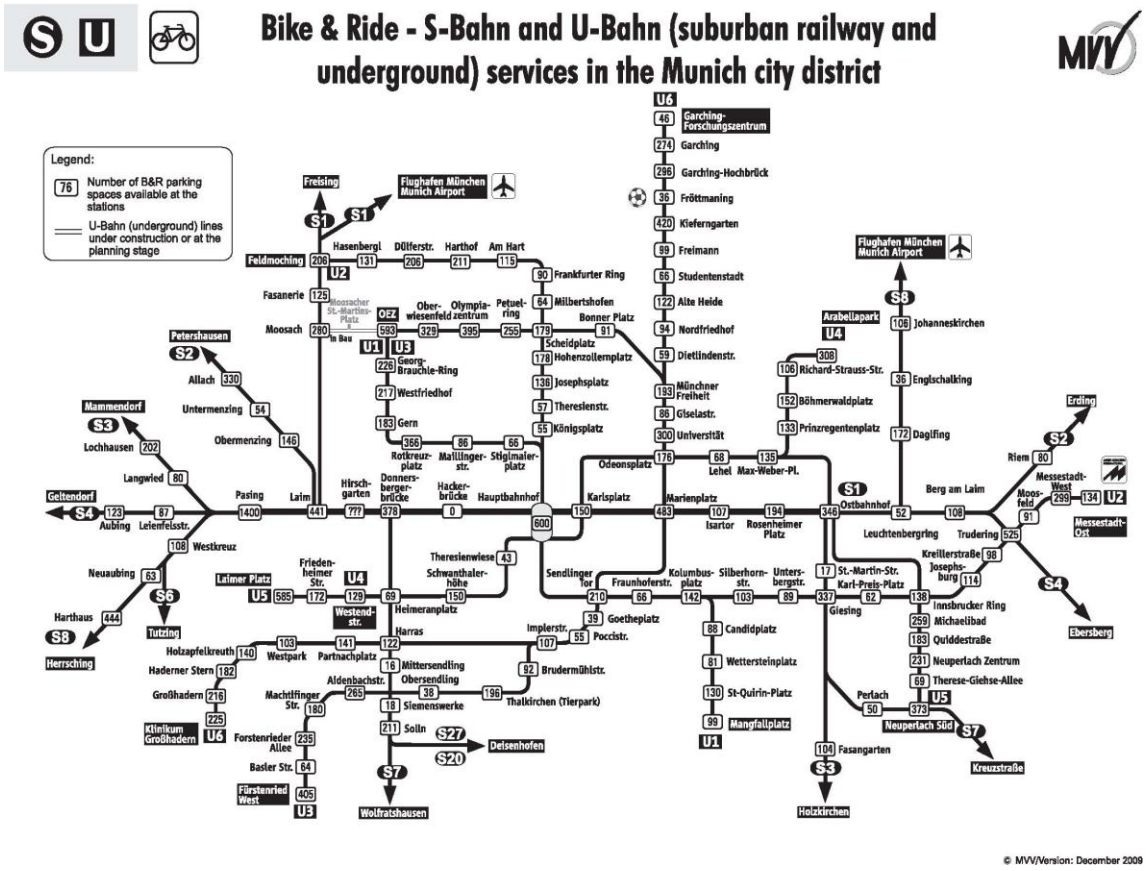


Figure 4.12 Bike and Ride Map

Resource:http://www.mvvmuenchen.de/en/home/mvv_network/transportnetworkmaps/bikeride/

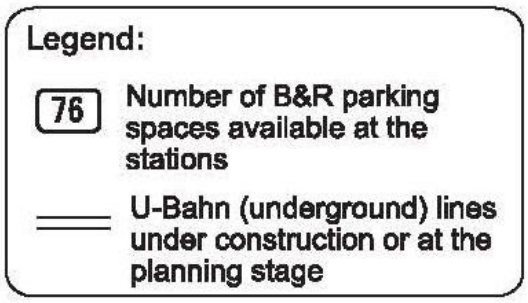


Figure 4.13 Legend for Bike and Ride Map

Resource:http://www.mvvmuenchen.de/en/home/mvv_network/transportnetworkmaps/bikeride/

COPENHAGEN- DENMARK

Copenhagen is the capital city of Denmark and has approximately 1.2 million inhabitants. Public transportation of the city consists of metro, suburban rail (s-tog) and Danish State Railways (DSB lines). The city also provides safe and segregated bicycle lanes with their own signal systems. According to resources 36% of all citizens cycle to work, school or university and government wants to increase this percentage to 50% by 2015.

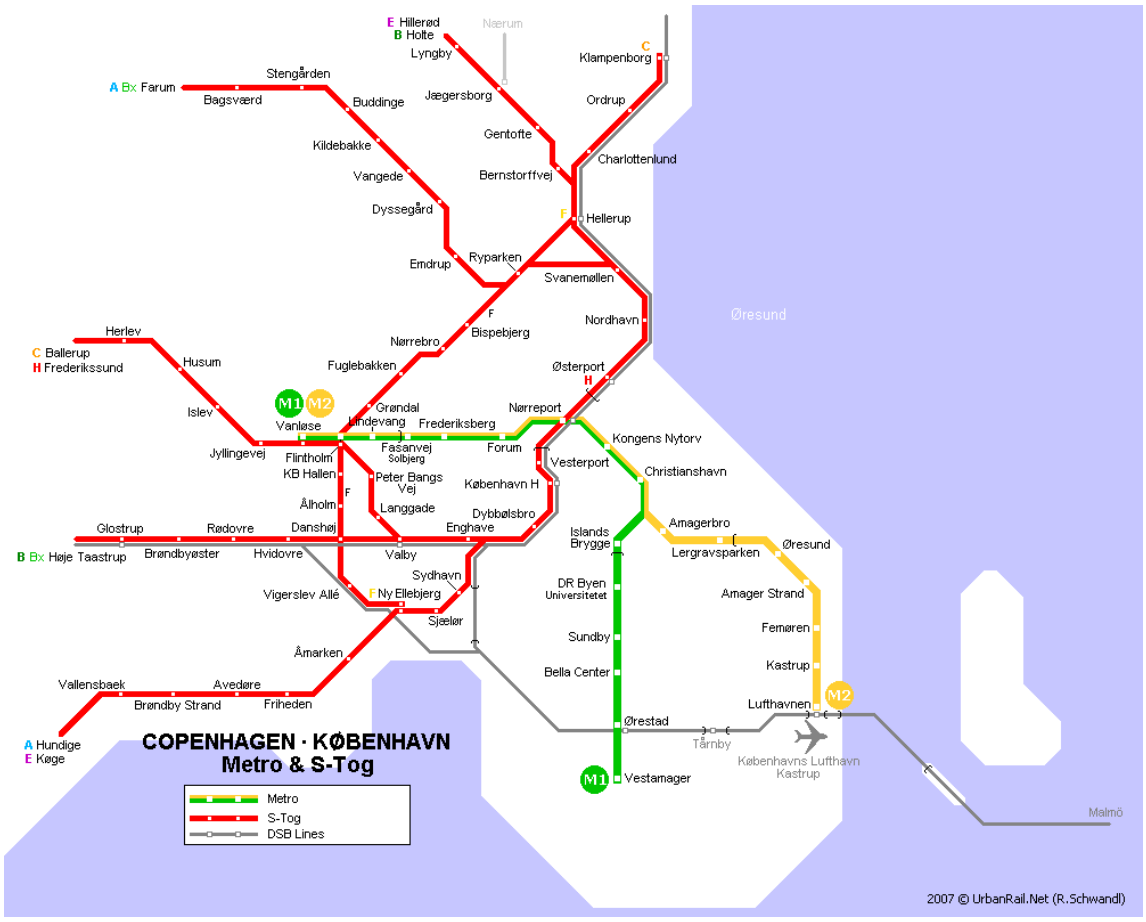


Figure 4.14 Rail System Map of Copenhagen

Resource: http://www.urbanrail.net/eu/kobenhavn/kobenhavn.htm

Danish government intends to improve its transportation considering environment. The intention is to have better infrastructure and sustainable transportation. In respect to this attempt government has listed some objectives such as: (http://www.trm.dk/da/)

- "Less CO2 – transport-associated CO2 emissions must be reduced. The trend must be reversed.
- Greener vehicular traffic – shift to green car tax.
- More public transport and cycling – public transport and bicycles must carry the greatest part of the projected growth in traffic.
- A better railway network – the rail network must be reliable, safe and state-of-the art.
- Better roads – congestion must be reduced.
- New green technologies – Denmark must be a green technology test bed for transport.
- Greater regard for nature – bridges, roads and railways must not destroy irreplaceable natural assets.
- Reduced noise and air pollution in urban areas – cars are the main source of noise and air pollution in our towns and cities." (http://www.trm.dk/da/)

Table 4.1 Accessibility of First Three Most Livable Cities Depending on the Mercer's and Monocle's survey

The Most Livable Cities	**Population**	**Transportation Modes**	**Feeder Policies**
Vienna, Austria	1.7 million	Tramways Underground systems Local Rail Metropolitan Rail	Intermodality Park & Ride
Zurich, Switzerland	375.000	Tramways Suburban Rail Funicular Bus River & Lake Boats	Intermodality Easy travel with prams & bikes (Bike & Ride)
Geneva, Switzerland	186.000	Tramways Trolleybus Suburban Rail	Intermodality
Munich, Germany	1.3 million	Tramways Underground systems Suburban Rail	Intermodality Park & Ride Bike & Ride
Copenhagen, Denmark	1.2 million	Metro Suburban Rail State Railways Cycling	Intermodality Sustainable Transportation Strategies

Examining the most livable cities designated by Mercer's and Monocle's survey shows that accessibility as one criteria of livability is provided by well organized transportation system. In all these five cities rail systems have been preferred for public transportation and in some cities rail systems are feed by buses. Intermodality, which is a transportation strategy that increases utilization and feasibility of public transportation as it is has been explained in Chapter 3, is also provided in all these cities as an important encouraging mode for the efficient use of public transportation. Beside these, transportation policies like park and ride and bike and ride are also provided.

As it has been stated in Chapter 1 of this research, Famagusta city is selected as the case study. Provided that the characteristics of the city are explained in the further chapters, the most prominent feature of the city with regard to accessibility is that the city has 35.000 inhabitants and it has a university with 11.000 students which mean that the city has young population. Most students are coming from other countries and they extremely need public transportation. In order to be able to make the most appropriate proposal to increase accessibility and hence livability of the city, in addition to the findings about the most appropriate modes of transportation for livable cities in general, it is worth to analyze some similar cities in terms of population. Correspondingly, different examples of cities with population less than 100.000 inhabitants such as Schoneicher-Rudersdorf/Woltersdorf and Strausberg in Germany, Leipaja in Latvia and Gmunden in Austria are analyzed.

4.3. Public and Private Transportation Modes in Some Selected European Cities

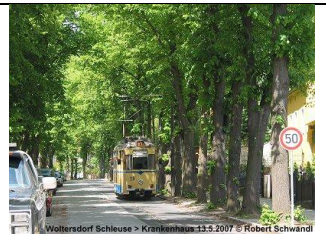
The examples are chosen not only according to their population sizes but also according to their public transportation modes. Considering that there is a tendency for utilizing environmentally friendly modes of transportation for increasing livability of the cities, environmentally friendly and petrol driven types of public transportation modes have been determined as the other selection criteria of the cities. From this perspective examination of the 'rail systems in European cities' section of the urban rail website, reveals that the cities; Schoneicher-Rudersdorf/Woltersdorf and Strausberg in Germany, Leipaja in Latvia and Gmunden in Austria would be the most suitable examples to this end. Rail systems are mostly used in these cities (Schoneicher-Rudersdorf/Woltersdorf

and Strausberg in Germany, Leipaja in Latvia and Gmunden in Austria) and integration of modes is applied. The inner city railways which are light rail systems or tramways are linked to the intercity railway lines which are heavy urban rails. Wide and safe sidewalk is provided for pedestrians as the feeder mode for rail systems.

Table 4.2 Transportation System of Schoneicher-Rudersdorf, Woltersdorf, Germany

City/ Country	***Information about the City***		***Map of the Railway***
Schoneicher-Rudersdorf, Woltersdorf/ GERMANY	***Population***	35.000 people	
	Length of The Tram Line	19.7 km	
	Information		Schoneicher, Rudersdorf and Woltersdorf are three towns, together having a population approximately 35.000, close to the city of Berlin in Germany. These small towns have light rail systems as public transportation connected to the main railway stations of other larger cities. Schoneicher-Rudersdorf street car line (yellow line) is starting from S-Bahn (Berlin railway line- the purple line) station Friedrichshagen. The length of this line is 14.1 km, some vehicles are modernized trams and some of them are historic tram. It is partly single-track on the line and needs 20-minutes to complete its line. Woltersdofer street car-tramway (blue line) is starting from S-bahn (Berlin Railway line) station Rahnsdorf. The 5.6 km length railway has mostly single-track on the line and needs 20-minutes to complete its line.

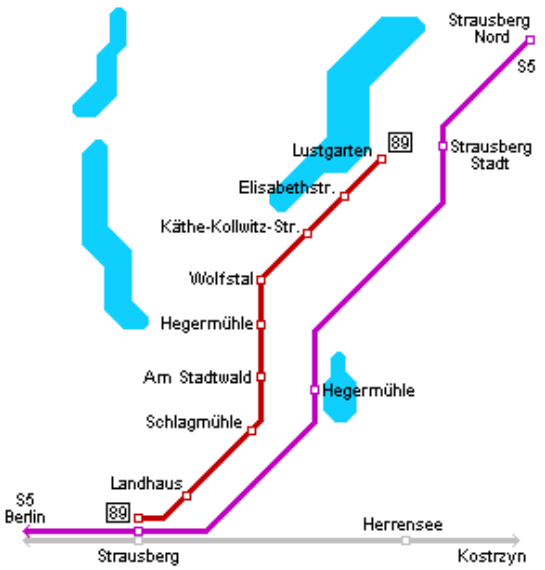




Photographs: Street Cars in the three towns Resource: http://www.isarsteve.de/?p=53

Resource: http://www.urbanrail.net/eu/mol/wolt-schoen-rued.htm

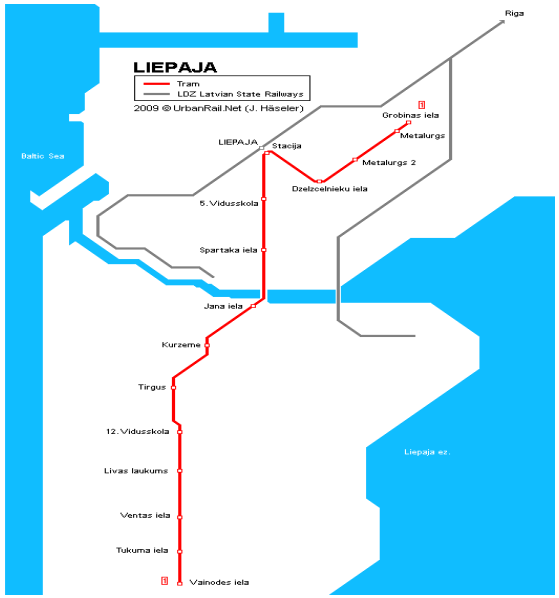
Table 4.3 Transportation System of Strausberg, Germany

<table>
<tr><th>City/ Country</th><th colspan="2">Information about the City</th><th>Map of the Railway</th></tr>
<tr><td rowspan="3">Strausberg/ GERMANY</td><td>Population</td><td>26.000 people</td><td rowspan="2"> 

Resource: http://www.urbanrail.net/eu/de/mol/strausberg.htm</td></tr>
<tr><td>Length of The Tram Line</td><td>5.8 km</td></tr>
<tr><td colspan="2">Information</td><td>Strausberg is another small town with 26.000 inhabitants in east of Berlin. The town center is linked to the S-bahn railway station with a 5.8 km tramway line (brown line). It is single line in town and the rolling stock is bidirectional.
  

Photographs: Tramway in the town (on the left) & Tramway passing through a pedestrianised square
Resource: http://www.skyscrapercity.com/showthread.php?t=779550</td></tr>
</table>

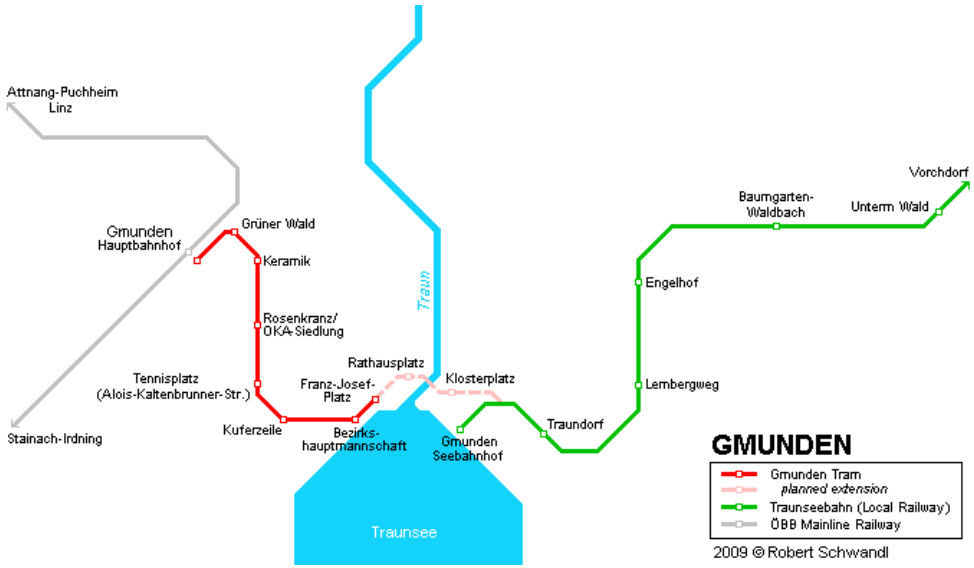
Table 4.4 Transportation System of Liepaja, Latvia

<table>
<tr><th>City/ Country</th><th colspan="2">Information about the City</th><th>Map of the Railway</th></tr>
<tr><td rowspan="3">Liepaja/ LATVIA</td><td>Population</td><td>85.000 people</td><td rowspan="2"> 

Resource: http://www.urbanrail.net/eu/liepa/liepaja.htm</td></tr>
<tr><td>Length of The Tram Line</td><td>5 km</td></tr>
<tr><td colspan="2">Information</td><td>The city Liepaja is in western Latvia, by the Baltic Sea. It has population of 85.000 people. The city has one tramway line, approximately 5 km long, for public transportation. One of the stations of this line (red line) is situated close to the Latvian state railways (gray line) in order to link city with other cities in the country.
  

Photograhs: Tramways in the city
Resource: http://www.skyscrapercity.com/showthread.php?t=779550</td></tr>
</table>

Table 4.5 Transportation System of Gmunden, Austria

<table>
<tr><th>City/ Country</th><th colspan="2">Information about the City</th><th>Map of the Railway</th></tr>
<tr><td rowspan="3">Gmunden/ AUSTRIA</td><td>Population</td><td>14.500 people</td><td rowspan="2"> 

Resource: http://www.urbanrail.net/eu/gmund/gmunden.htm</td></tr>
<tr><td>Length of The Tram Line</td><td>2.3 km</td></tr>
<tr><td colspan="2">Information</td><td>Austrian city Gmunden has 14.500 inhabitants. The city provides 2.3 km- tramway line for public transportation. The line (red line) has link with the mainline (gray line) and planned to have connection with the local railway (green line) as well.
 

Photographs: Tramways in the city
Resources: http://www.urbanrail.net/eu/gmund/gmunden.htm</td></tr>
</table>

These four examples have shown the cities that have population less than 100.000 people, with rail systems. Although these cities are not much crowded when compared with many other cities with rail systems like, London, Amsterdam, Istanbul etc., they didn't prefer to solve their transportation system with some other modes. They could have easily manage transportation with busses and cars but they used safer modes for society, environment and economy which also contribute to the sustainability and livability at the same time. Because the rail systems which are provided as light rail systems in these cities, are mostly working with electricity that is environmentally friendly. Such systems can be feed by other environmentally friendly supportive modes of public transportation like hybrid busses and as private transportation modes like walking and non-motorized cycling. The integration of these modes all together will yield to increase livability in cities as they support the livability criteria explained in Chapter 2: equity, dignity, accessibility, empowerment, conviviality and participation.

However, it should be kept in mind that, it is impossible totally to prevent use of cars in cities. However, this type of competitive private transportation can be converted to be a supportive mode by using the policies like park and ride, bike and ride and kiss and ride. As it has been presented in Chapter 3, park and ride is a policy which is providing parking spaces for the cars near by a public transportation station or stop; bike and ride is similar to park and ride but it for non-motorized cycling; and kiss and ride is providing a short term parking area to drop off or embark passengers from stations or stops.

As to conclude all these determined most appropriate modes (rail systems, hybrid busses, walking and non-motorized cycling) should be provided with intermodality strategies and supported by determined transportation policies in order to increase accessibility for more livable cities.

Chapter 5

CASE STUDY: FAMAGUSTA

Famagusta is a coastal city of Cyprus in the Mediterranean Sea. The city has a long historical background, hence includes various traces of many different cultures. The city had witnessed many struggles and also had exposed to division. Since 1974, the part in the south-east of the city is closed to habitation (closed Maras/Varosha) due to the political reasons. Prior to this, the city was an important tourism and trade center. Maras (Varosha) district was acting as a popular commercial, touristic and recreational activity center and the walled city was important with its own urban pattern and historical values from tourism point of view as well as a trade center with the port. However, as a result of exclusion of Maras from the urban structure, the city is growing towards north-west direction along the sea shore. Additionally the establishment of the university has accelerated this trend.

It should be noted that due to international embargoes the city has lost its importance as a popular tourism center. In line with this unfavorable situation, which is somehow supported by the lack of a master plan for the city, the city is growing haphazardly and sprawling towards agricultural lands in the north-west direction. Aside from the traditional core in the walled city, there is no any city center in Famagusta. Commercial activities are mostly developing on primary distributors (among them, the one towards

the university being the most attractive one- known as Salamis Road) transforming them into activity spines.

The piecemeal development of the city, the lack of a master plan and inadequate public transportation, and also the overloaded primary distributors as the activity spines seem to be among the major problems that the city is faced with. As a result of such problems, accessibility counts as one of the most important problematic issues which affect the livability of the city.

Such car-oriented cities like Famagusta suffer from many other problems like; urban sprawling, air pollution, congestion in traffic, car-parking, unhealthy communities, unsafe roads, unlivable streets and so on. These problems are all result in decreasing of accessibility and as accessibility greatly affect livability of a city, livability decreases as well. Thus, accessibility of Famagusta will be analyzed in this section in order to be able to provide proposals for public transportation, which would serve to heal the problems that stated above and increase livability of the city.

Accordingly, in this chapter, firstly, historic and physical development of the city will be summarized with an emphasis on street network and accessibility. Secondly, since an understanding of population, existing districts, urban form and street hierarchy is vital for proposing an appropriate public transportation mode, population, existing districts, urban form and street hierarchy of the city will be clarified. Additionally, the results of the questionnaire survey for accessibility measurement and assessment of the city will be discussed in this section.

5.1. Information on The City of Famagusta

Before directly focusing on the accessibility of the city, it is important to overview the evolution and physical development of the city. Thus in this section history, districts, population and development of the city will be presented.

5.1.1. History and Physical Development of The City

As it is mentioned in the preceding lines, Famagusta has a long historical background. The periods that the city has developed throughout history, can be listed in a chronological order as follows;

- 648-1192: the early periods, foundation of the city
- 1192-1489: the Lusignan Period
- 1374-1464: the Genoese Period
- 1489-1571: the Venetian Period
- 1571-1878: the Ottoman Period
- 1878-1960: the British Period
- 1960-1974: Cyprus Republic
- After 1974: Divided Cyprus

It is said that Famagusta had been built upon the old lagoon settlement of Arsinoe, founded by the Egyptian King Ptolemy II in 300 BC. Up to the destruction of Salamis (an ancient coastal town, on same coastal line with Famagusta), Famagusta had survived as a small fishing town. When Salamis was destructed, the inhabitants moved to Famagusta (648 AD) and developed city to be a small commercial port. In the Lusignan period Famagusta became an important trading center between the East and the West

with its natural harbor, therefore it was inevitable to construct a citadel and a port. Within this period Famagusta was invaded by Genoese in 1374. Until 1464 they used the city for military purposes, therefore during this period the city had lost its importance of being a commercial center.

Most important morphological elements of the Lusignan period were the port and nearly three hundred constructed churches. The Lusignan kings palace was in the center of the city opposite the St. Nicholas cathedral dominating the largest square which is still very important for the city. Although there is information about the morphological elements of Famagusta, there is no evidence about street pattern of the city in this period. (Doratli, N., Hoskara, S., Zafer,. N., Ozgurun, A., 2003)

After Lusignan period, the city had been transformed into a fortified city as a military base by Venetians, in other words Venetians continued to use the city for military purposes (Pumpyansky, A., 2006). Many buildings in the city today such as religious and public buildings (cathedrals, churches, palace etc), bastions, citadel, moat, sea gate and land gates were built in that Medieval Era. The streets were developing mostly to link these important buildings of the city and also connect the walled city to the periphery developments.

Figure 5.1 Fortified city-Famagusta in Venetian Period
Resource: www.cypnet.co.uk/ncyprus/city/famagusta/maps/famagosta-ve.jpg, May 2011

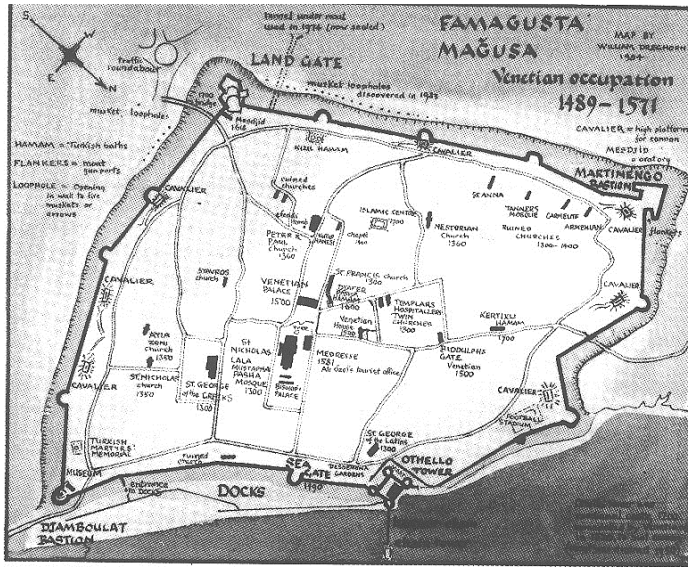


Figure 5.2 Linkages of the city (1489-1571)
Resource: www.stwing.upenn.edu/~durduran/drfm1.html#map, May 2011

When the city was conquered by Ottomans in 1571 many people from Anatolia came to the island. With the arrival of Muslims to the city, the non-muslims were forced to move out of the Walled City. These people had to move to Maras (Varosha) and Asagi Maras (Kato Varosha) areas. Ottoman Empire was organizing the cities of the island with the

Islamic culture and life styles. With cul-de-sacs the organic urban pattern was emerging in the Walled city of Famagusta. Resources mention that the two suburbs- Maras and Asagi Maras, were more densely populated and more developed than the Walled city. (Onal, Dagli, Doratli, 1999) With the development of these suburbs, streets outside the walled city started to develop.

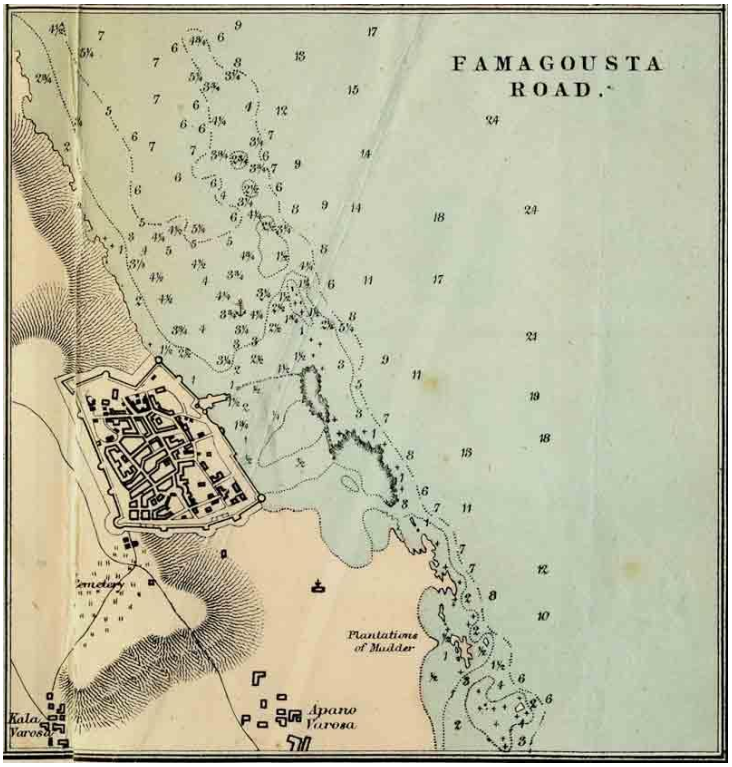


Figure 5.3 Famagusta map in 1878
Resource: allikypros.files.wordpress.com/2010/01/famagustamap1878.jpg, May 2011

Figure 5.4 Famagusta Harbor in 1870's

Resource: Royal Commonwealth Society Library, Cambridge University Library, University of Cambridge (2004) [Panorama of Famagusta, 1870's], http://www.dspace.cam.ac.uk/handle/1810/965

In 1878, Ottoman Empire hired the island to British and the British Period had been started. During that period, Famagusta port was expanded and its importance increased. Expansion of the city towards south, outside the walls had been accelerated during this time. The two ethnic groups (Turks and Greeks) were separated as Turks in the walled city and Greeks outside the walls in the Maras district. The British Government had constructed an administrative center (which is still functioning to a limited extend with the same purpose today) between the walled city and the Maras district. Depending on the requirements of the citizens new residential, commercial, touristic and recreational areas were developing towards the south (Maras). New developments in the walled city were, which were mostly in contrast with the existing tissue, started with the new legislation enacted in 1946 named as 'Streets and Building Regulations- Cap 96'. (Doratli, N., Hoskara, S., Zafer,. N., Ozgurun, A., 2003)

British Government had also constructed a railway on the island connecting Famagusta, Nicosia, Morphou and many small settlements between these cities (Onal, S., Dagli, U., Doratli, N., 1999). Main station and control center of the railway was located within Famagusta's administrative center. The railway, carrying passengers and freight, had made great impacts on the island society during this period; even it had transformed Famagusta from being an old and dead town to a modern harbor city of Middle East. Although Cyprus Government Railway had done great contributions to island's society and government, it couldn't make profit, couldn't compete against the new highway and was completely closed in 50 years. (Hadjilyra, M.A., 2006)

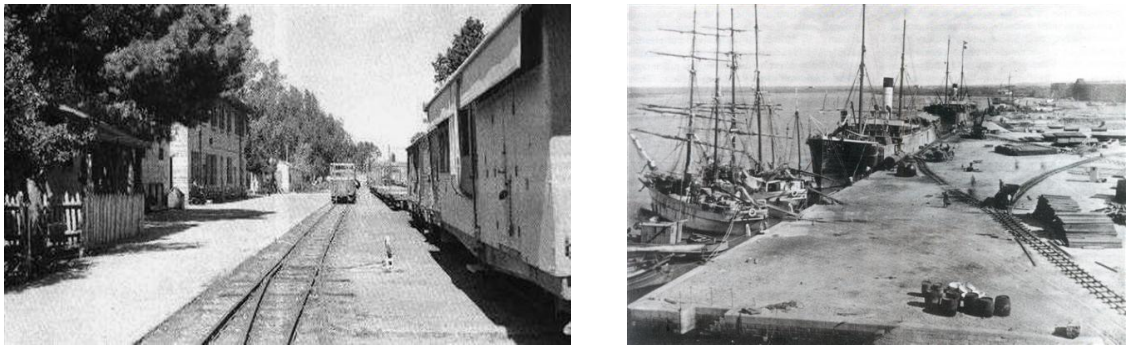


Figure 5.5 Famagusta Railway Station, 1952 (on the left), Famagusta Harbor, 1905 (on the right)

Resource: www.narrow-gauge.co.uk/gallery/52, April 2011

With the 1974 war, huge changes had occurred in Famagusta. The island was divided into two parts (Southern and Northern sides) and Maras was closed to habitation. Hence, an important threshold which had blocked the city's development emerged. When the High Institute of Technology, which later has become Eastern Mediterranean University, was established in 1979, the vision and direction of development of the city was completely changed.

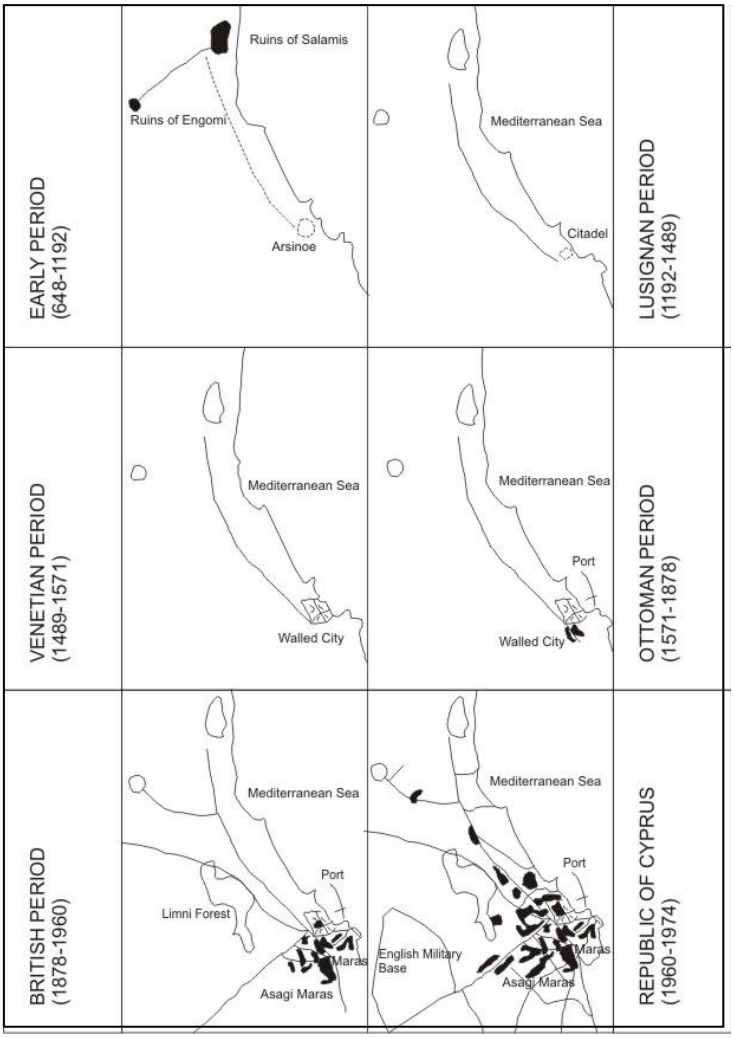


Figure 5.6 Development of Famagusta According to Periods
Resource: Onal, S., Dagli, U., Doratli, N., 1999

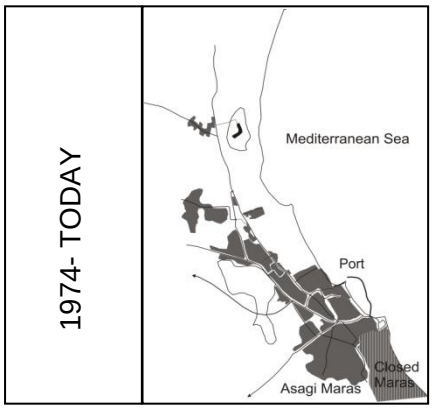


Figure 5.7 Development of Famagusta From 1974 to today

5.1.2. Districts and Population

Today Famagusta is composed of 5 main parts:

- Walled city
- Asagi Maras
- Closed Maras
- Newly developed quarters
- Tuzla

These main parts have many quarters as shown in the map below. Asagi Maras district includes, Namik Kemal, Piyale Pasa, Canbulat, Zafer, Pertev Pasa and Lala Mustafa Pasa quarters. Newly developed quarters consist of Dumlupinar, Baykal, Canakkale, Sakarya and Karakol. The city has been blocked by the closed area in the south-east and on the west by Golcuk Forest. Therefore the only available development orientation for the city is north-west direction.

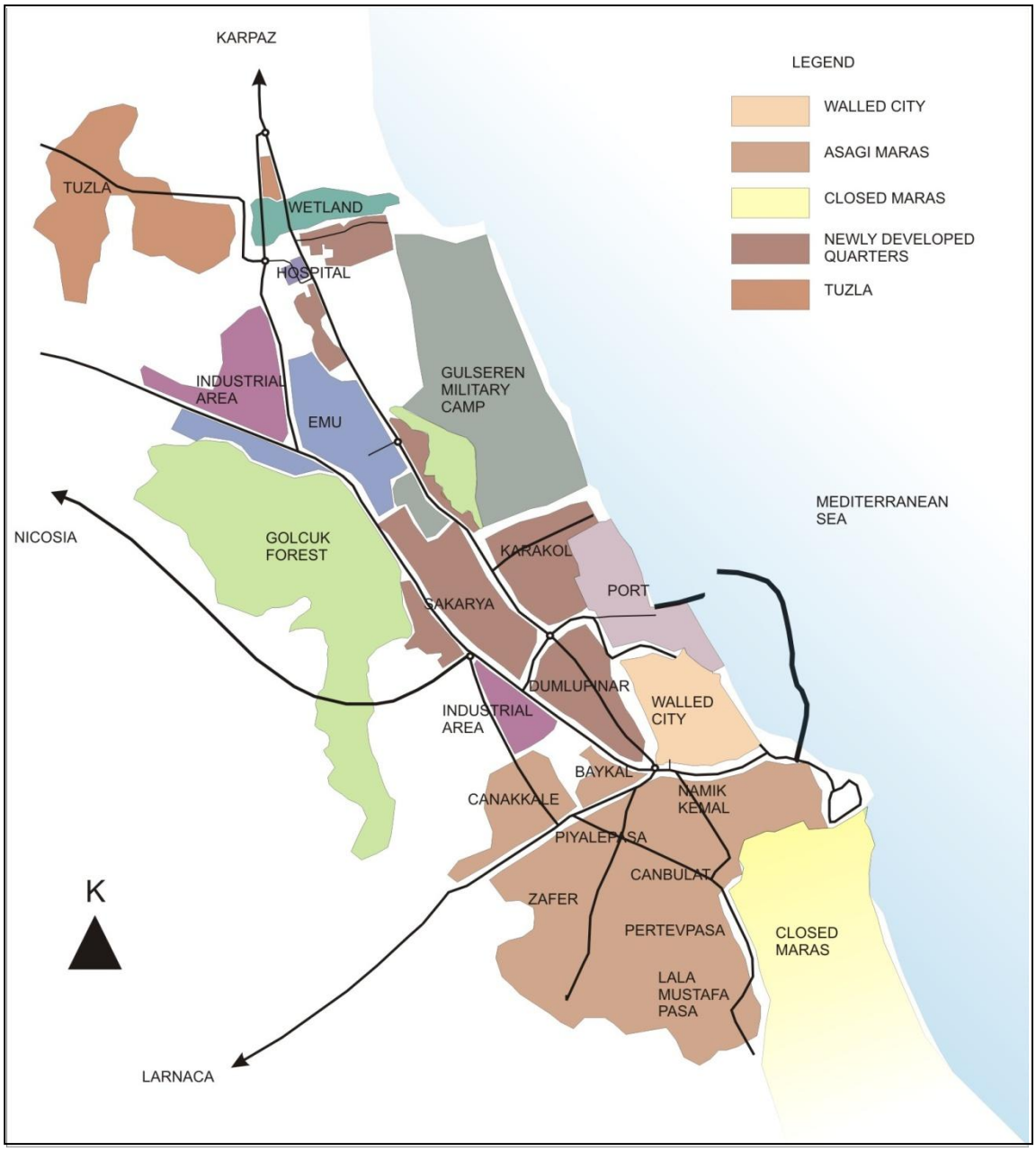


Figure 5.8 Districts of Famagusta

According to 2006 census, total population of Famagusta is 35,381. Comparing the 1996 and 2006 census, it can be seen that Tuzla's population highly increased in 2006. According to 2006 census results Sakarya and Karakol quarters are the most populated areas. These two quarters are developed after the exclusion of Maras from the urban

pattern, which proves that the city is growing on north-west direction and the university is an important attraction.

Table 5.1 Population of Famagusta according to quarters (1996 and 2006)

	2006 Results			1996 results			Change		
Quarters	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**
ANADOLU QUARTER	**1,340**	687	653	**1,021**	529	492	**31.2%**	29.9%	32.7%
BAYKAL QUARTER	**3,136**	1,684	1,452	**2,245**	1,245	1,000	**39.7%**	35.3%	45.2%
CANBULAT QUARTER	**2,151**	1,086	1,065	**3,029**	1,525	1,504	**-29.0%**	-28.8%	-29.2%
ÇANAKKALE QUARTER	**2,309**	1227	1082	**1,909**	1,017	892	**21.0%**	20.6%	21.3%
DUMLUPINAR QUARTER	**2,702**	1,416	1,286	**1,765**	979	786	**53.1%**	44.6%	63.6%
HARİKA QUARTER	**393**	201	192	**269**	140	129	**46.1%**	43.6%	48.8%
KARAKOL QUARTER	**5,585**	3298	2287	**3,133**	1,973	1,160	**78.3%**	67.2%	97.2%
LALA MUSTAFA PAŞA QUARTER	**2,482**	1,245	1,237	**2,002**	1,029	973	**24.0%**	21.0%	27.1%
NAMIK KEMAL QUARTER	**1,083**	569	514	**1,602**	993	609	**-32.4%**	-42.7%	-15.6%
PERTEV PAŞA QUARTER	**1,213**	672	541	**1,367**	691	676	**-11.3%**	-2.7%	-20.0%
PİYALE PAŞA QUARTER	**1,657**	861	796	**1,136**	585	551	**45.9%**	47.2%	44.5%
SAKARYA QUARTER	**5,362**	3102	2260	**3,452**	1,982	1,470	**55.3%**	56.5%	53.7%
SURİÇİ QUARTER	**2,026**	1,111	915	**2,316**	1,461	855	**-12.5%**	-24.0%	7.0%
TUZLA QUARTER	**1,877**	1,012	865	**702**	376	326	**167.4%**	169.1%	165.3%
ZAFER QUARTER	**2,065**	1055	1010	**1,689**	883	806	**22.3%**	19.5%	25.3%
TOTAL	**35,381**	**19,226**	**16,155**	**27,637**	**15,408**	**12,229**	**28.0%**	**24.8%**	**32.1%**

Resource: SPO, 15.12.1996 and 30.04.2006 Census,
http://www.magusa.org/English/population.htm

As it has been mentioned in the previous lines there is no any defined city center of Famagusta today. Most of the commercial and entertainment activities (shops, cafes, bars and restaurants) are taking places on the main distributors of the city. Especially the road, which links every parts of the city with the university campus as well as the new developing housing areas around Tuzla, is overloaded by such activities, hence has been

transformed to the most popular activity spine. This road is also serving for the most populated quarters of the city which are Karakol and Sakarya.

Additionally the most important primary distributor, which is also linking city's quarters to the governmental hospital, has become very crowded and now is faced with heavy traffic. Car-parking is another huge problem on this activity spine. There are not enough car parking lots and only side parking is available but limited in number, thus many cars are parked on the pavements. This situation also affects walkability and street quality.

Figure 5.9 Commercial activities concentrated on the primary distributors

5.2. Analyzing Accessibility in Famagusta

On the basis of observations, it can be said that Famagusta city has a poor accessibility which is extremely affecting its livability. The problems highlighted in the previous lines, such as the lack of master plan, a proper public transportation and a defined city center, overloaded activity spines, haphazard development of the city can be considered as the major factors negatively affecting the accessibility of the city.

Public transportation, which extremely affects accessibility level in a city, is only provided by private companies (Itimat, Gocmen, Gece) between cities and from airport to the cities (Kibhas). In Famagusta, Eastern Mediterranean University provides free bus service on certain routes. As stated by Derya Oktay in her book "Kentsel Yasam Kalitesi", according to the vast majority of the citizens of Famagusta (72.3%) there is no public transportation in the city. (Oktay, D., 2010) According to a local newspaper of Cyprus, citizens are not satisfied with existing public transportation, they are complaining about insufficient and poor quality of public transportation system. (Beyazoglu, I., Kibris Gazetsi, 2007) However, in order to be more precise, there is a need to make further evaluation which is based on some measurable criteria (as it has been discussed in Chapter 2).

The measurable criteria of accessibility are determined within livability perspective, as accessibility is a dimension of livability. In this context, five indicators of accessibility, which are determined in Chapter 2, are considered in this measurement: vehicular accessibility, non-vehicular accessibility, streetscape, integration of modes, and safety of roads. These indicators are measured by their related criteria. (Table 5.2)

Table 5.2 Relationship between functional place quality aspects, accessibility indicators and their criteria

Functional Place Quality	**Indicators of Accessibility**	**Criteria of the Indicators**
Pedestrian Journeys	Non-Vehicular Accessibility	Street type sidewalks Pedestrian ways Cycling ways
	Safety of Roads	Traffic calming Segregated bike lanes Safe sidewalks
Public Transportation Quality	Vehicular Accessibility	Public transportation Road type/ Transport Infrastructure
	Integration of Modes	Integration of different public transportation modes Integration of private transportation & public transportation modes
Vitality and Viability of Services	Streetscape	Street furniture/Landscape elements Cleanliness Car parking (visual intrusion by side parking)

These criteria shown in the table above are arranged as a likert scale to conduct a questionnaire survey with Famagusta citizens. (Table 5.3)

Table 5.3 Evaluation of Accessibility

Indicators of Accessibility	**Criteria of the Indicators**	**Evaluation**					
		Not Available	**Very Poor**	**Poor**	**Average**	**Good**	**Very Good**
Vehicular Accessibility	Public transportation	0	1	2	3	4	5
	Transport Infrastructure	0	1	2	3	4	5
Non-vehicular Accessibility	Street type sidewalks	0	1	2	3	4	5
	Pedestrian ways	0	1	2	3	4	5
	Cycling ways	0	1	2	3	4	5
Streetscape	Street furniture/Landscape elements	0	1	2	3	4	5
	Cleanliness	0	1	2	3	4	5
	Car parking	0	1	2	3	4	5
Integration of modes	Integration of different public transportation modes	0	1	2	3	4	5
	Integration of private & public transportation modes	0	1	2	3	4	5
Safety of Roads	Traffic calming	0	1	2	3	4	5
	Segregated bike lanes	0	1	2	3	4	5
	Safe sidewalks	0	1	2	3	4	5
Total Score							

However, before directly measuring the accessibility of the city depending on the criteria, which are determined through livability perspective, urban macroform and street network of Famagusta should be examined, since accessibility is a notion of urban form, development and growth apart from being a dimension of livability. Examination of urban macroform and street network would provide information about the street hierarchy of the city which will be useful in proposing public transportation for improving accessibility and consequently increasing livability of the city.

5.2.1. Urban Macroform and Street Network

As it has been mentioned in the previous chapters, understanding of the urban macroform & street network is significant for assessment of accessibility. Thus, in this section Famagusta's macroform and street network will be examined.

URBAN MACROFORM OF FAMAGUSTA

In order to read the urban macroform it is needed to understand basic shape of the city, type of the center and linkages of the city (street network). When the city shape is conceptually drawn, it can be seen that it tends to have a linear form however the shape is not clear (Figure 5.11). Additionally, since the city has no any defined center, it cannot be said that it is monocentric or polycentric. This is a result of haphazard development of the city due to the absence of a master/structure plan. Piecemeal/haphazard development is also encouraged by a variety of thresholds of the city, which are military zone, closed Maras, forest and wetlands. These thresholds are also acting as obstacles against the development of a linear form. (Doratli, N., Numan, I., Dincyurek, O., 2001).

Figure 5.10 Thresholds of Famagusta

Figure 5.11 Basic shape of Famagusta

STREET NETWORK

In general terms, the street network of the city is shifted grid in most parts of the city. Only walled city has an organic street network. It can be said that there is a disorganized movement pattern in the city.

Due to the absence of a master plan for the city, the street network has been developed in a shifted grid fashion in most parts. The new streets are opened in line with the Chapter 96 (Fasil 96) 'Roads and Buildings Regulation Law'.

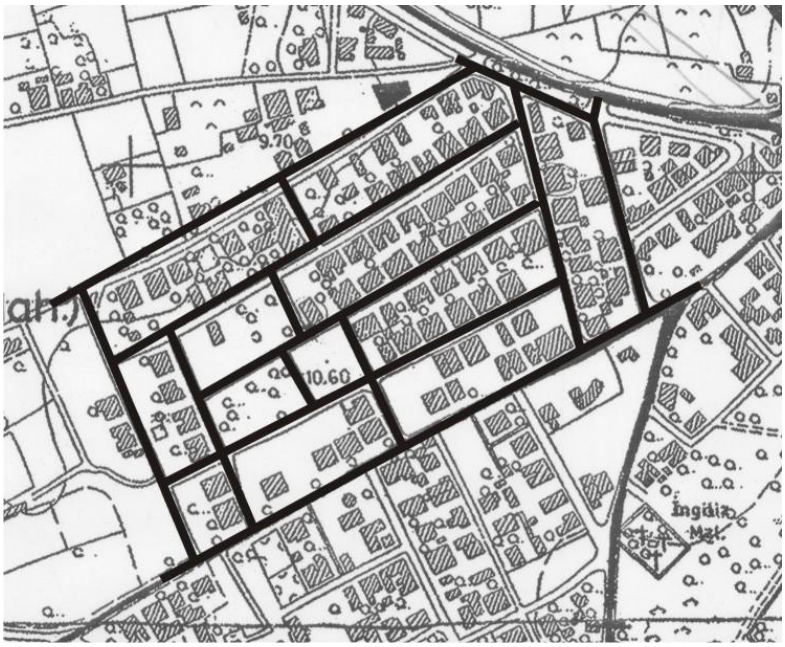


Figure 5.12 Shifted Grid Street network in Baykal Quarter

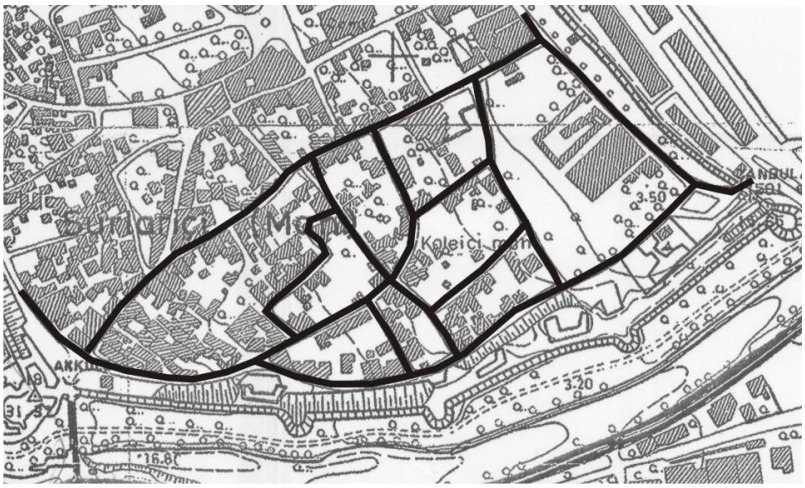


Figure 5.13 Organic Street Network in the Walled City

According to the North Cyprus Highway Administration, the street hierarchy can be classified as; the roads between cities are divided roads with a width of 21 meters, the primary distributors are having 10 meters, district distributors 8 meters and the local distributors 6 meters.

The primary distributors are the most important elements for flowing of a city, on the other hand district and local distributors are also important as they are providing permeability in the city. Therefore in the accessibility assessment the primary, district and local distributors of Famagusta will be considered. The primary distributors of Famagusta are: (Figure 5.14)

- Ismet Inonu Boulevard (P1)
- Salamis Road (P2)
- Gazi Mustafa Kemal Boulevard (P3)
- Fevzi Cakmak Boulevard (P4)
- Onbes Agustos Boulevard (P5)
- Topcular Boulevard (P6)
- Polatpasa Boulevard (P7)
- Sehit Ibrahim Kazim Boulevard (P8)

The district distributors are:

- Erdogan Acar Street (D1)
- Esref Bitlis Boulevard (D2)

- Cahit Sitki Taranci Street (D3)
- Savas Street (D4)
- Ziya Gokalp Street (D5)
- 9 Mart Street (D6)
- Ibrahim Hasan Street (D7)

And the local distributors are:

- In Karakol District
    - Anafartalar Street (L1)
- In Sakarya District
    - Kurtulus Street (L2)
- In Asagi Maras
    - Deniz Piyade Street (L3)
    - Necati Taskin Street (L4)
- In Walled City
    - Cengiz Topel Street (L5)
    - Yesil Deniz Street (L6)
    - Canbulat Street (L7)

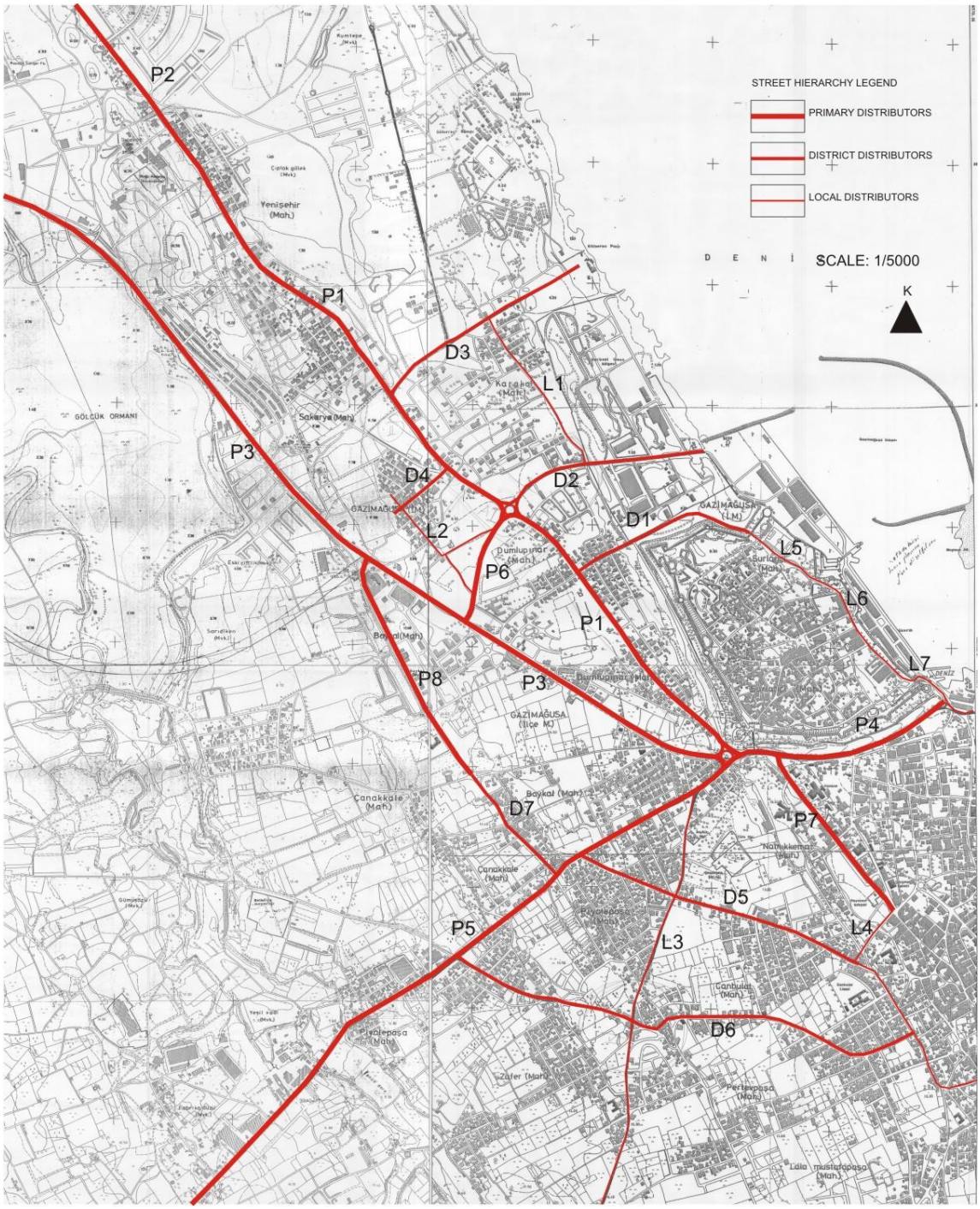


Figure 5.14 Street Hierarchy of Famagusta

Searching historic and physical development, districts and population of the city, would provide necessary data for new transportation system proposal or improvements of

existing accessibility conditions. Historic background of cities or communities is providing clues about their future. On the other hand, districts and population data are the information showing 'how to shape' the future of that city. Deeper analysis of the city which is composed of urban macroform and street network analysis will be considered in proposing a transportation plan. In order to decide about the routes to be used for public transportation the street hierarchy data will be needed.

All of the information, which are historical and physical development, districts, population, urban macroform, street network and hierarchy, analyzed in this section, will be used to make contributions for increasing accessibility of the city together with the accessibility measurement results.

5.2.2. Measuring Accessibility in Famagusta

In this section, it is aimed to measure and assess accessibility of Famagusta in order to provide information about the current conditions. This information would be used in deciding contributions to be applied through the new transportation system proposal.

In order to determine the attitude/opinion of the citizens of Famagusta, with regard to accessibility, a questionnaire survey has been conducted throughout the city. The questionnaire, which is composed of accessibility evaluation table (Table5.3, p.96), is distributed almost equally to different parts of the city and the results are showing the opinions of the citizens about accessibility of the city. The questionnaires have been distributed equally to 50 citizens from 5 quarters of Famagusta. 10 citizens from each quarter (Walled City, Karakol, Sakarya, Asagi Maras and Tuzla) have answered the questionnaire. The ages of forty six percent (46%) of the participated citizens were

between 18 and 29. Twenty six percent (26%) were between 30 and 39, twenty percent (20%) were between 40 and 49, and eight percent (8%) were between 50 and 60.

As it has been shown in Table 5.3, accessibility can be measured with the proposed evaluation table. Five indicators of accessibility with their criteria, is scored between zero- five. Zero is for not available, one point for very bad, two points for bad, three points for average, four points for good and five points for very good. It has been assumed that if the total score is below 39 that mean the accessibility of the city is below average, if it is above 39 then the accessibility is above the average. According to this result, the needed contribution for increasing accessibility in the city will be determined.

Table 5.4 Percentages of the questionnaire results

Indicators of Accessibility	**Criteria of the Indicators**	**Evaluation**					
		Not Available	**Very Poor**	**Poor**	**Aver age**	**Good**	**Very Good**
Vehicular Accessibility	Public transportation	**58%**	16%	9%	16%	4%	0%
	Transport Infrastructure	14%	14%	24%	**30%**	16%	2%
Non-vehicular Accessibility	Street type sidewalks	10%	10%	14%	**30%**	28%	8%
	Pedestrian ways	**36%**	12%	14%	20%	14%	4%
	Cycling ways	**78%**	12%	10%	0%	0%	0%
Streetscape	Street furniture/Lands cape elements	**34%**	18%	10%	20%	16%	2%
	Cleanliness	6%	20%	10%	**38%**	22%	4%
	Car parking	20%	4%	22%	**36%**	14%	4%

Table 5.4 (continued) Percentages of the questionnaire results

Indicators of Accessibility	Criteria of the Indicators	Evaluation					
		Not Available	Very Poor	Poor	Average	Good	Very Good
Integration of modes	Integration of different public transportation modes	**88%**	4%	6%	2%	0%	0%
	Integration of private & public transportation modes	**78%**	2%	8%	10%	2%	0%
Safety of Roads	Traffic calming	10%	12%	20%	**34%**	18%	6%
	Segregated bike lanes	**82%**	2%	14%	0%	0%	0%
	Safe sidewalks	20%	16%	22%	**26%**	14%	2%

When the results of the questionnaire were checked, the average of the total score of all questionnaires is 20.4, which means that the accessibility of Famagusta is below average and there is a need for a new transportation system, improvements, strategies and policies.

Table 5.5 Accessibility Evaluation Results Interval

Accessibility Evaluation	Below Average	Above Average
Total Score of the Evaluation	0-38	39-64
Necessary Contributions	New Transportation System Improvements Strategies Policies	Improvements Rehabilitation Strategies Policies

The results of questionnaire for each criterion have been calculated as percentages and shown by pie charts. The pie charts are reflecting the opinions and attitudes of Famagusta citizens who are participated in the questionnaire survey.

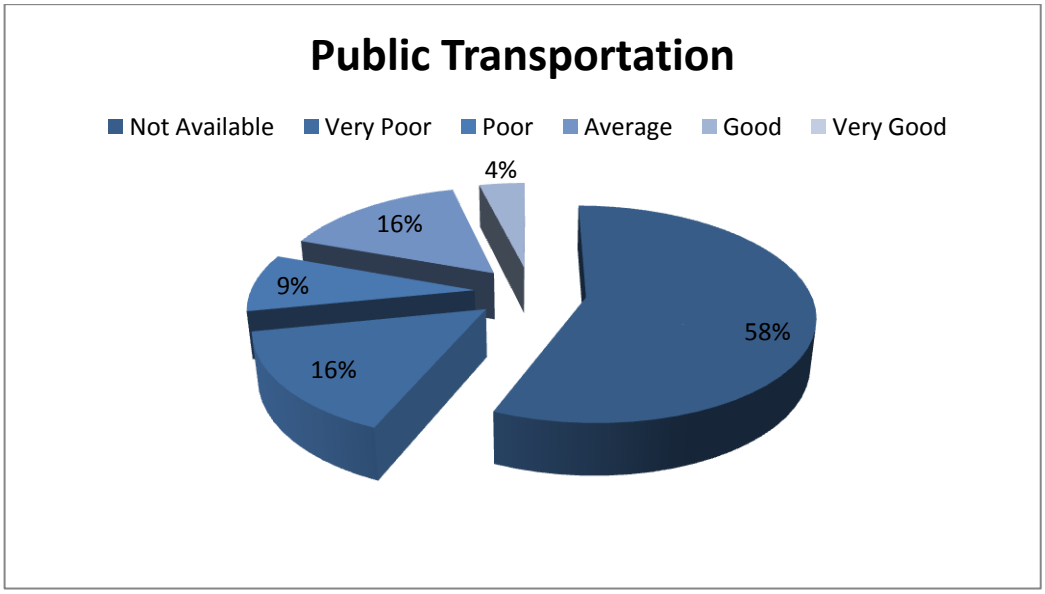


Figure 5.15 Questionnaire Results for Public Transportation

The results for public transportation show that more than half (58%) of the participated citizens of Famagusta think that there is no public transportation in the city. None of the participated citizens voted that the public transportation as ‘very good’ and only four percent (4%) has voted as ‘good’. That means there is a great need for proposing new public transportation system in the city.

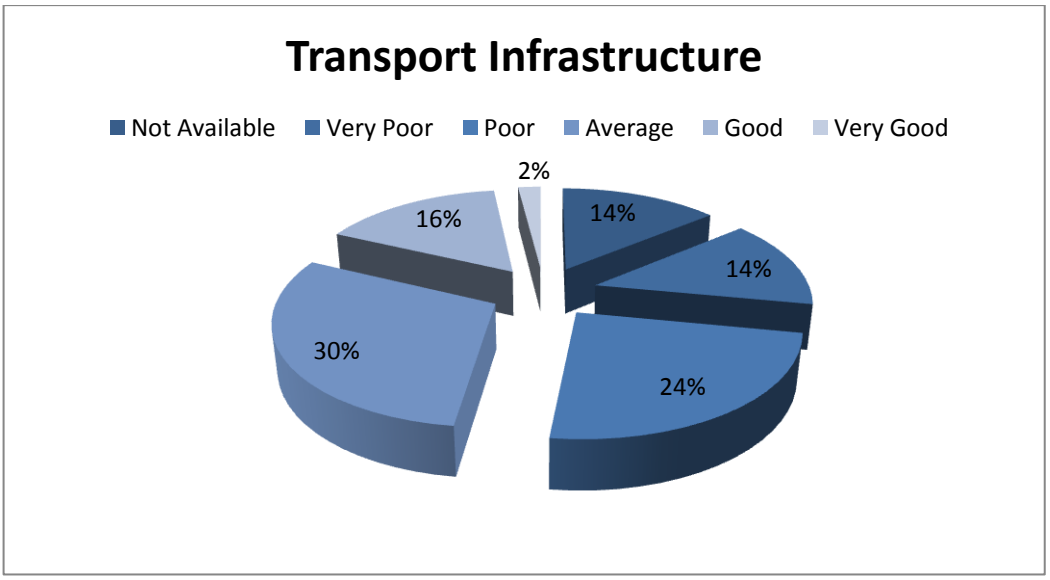


Figure 5.16 Questionnaire Results for Transportation Infrastructure

Thirty percent (30%) of the participants think that the transportation infrastructure is average. However a considerable majority (24%) voted that it is 'poor'. The results prove that there is a need for improvements for the transportation infrastructure.

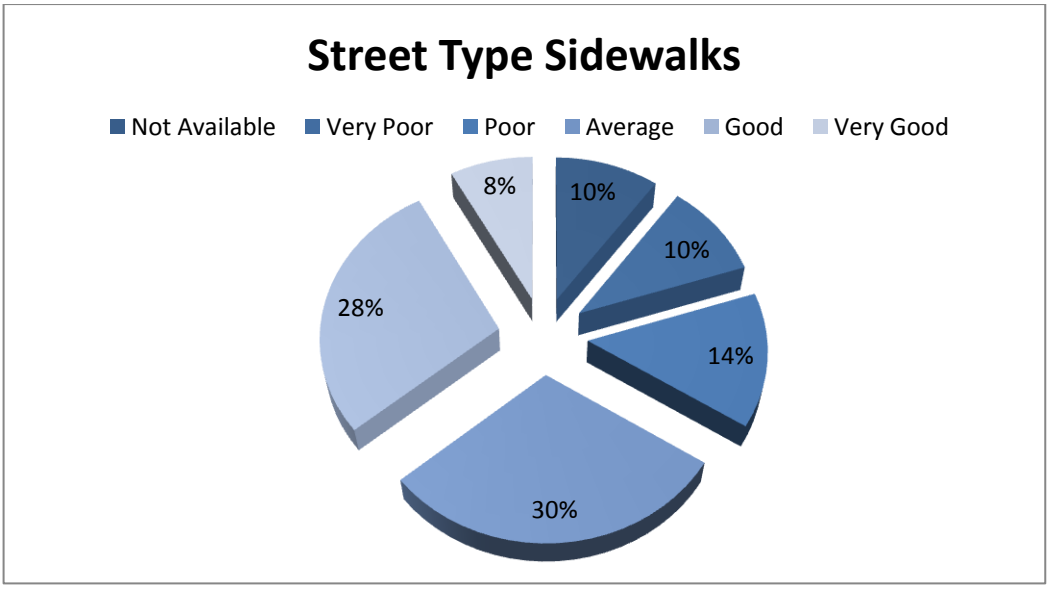


Figure 5.17 Questionnaire Results for Street Type Sidewalks

Street type sidewalks in the city seem to be average according to participants, since thirty percent (30%) voted as ‘average’. Twenty eight percent (28%) of participant think that they are good. These results show that street type sidewalks should be improved to reach better quality.

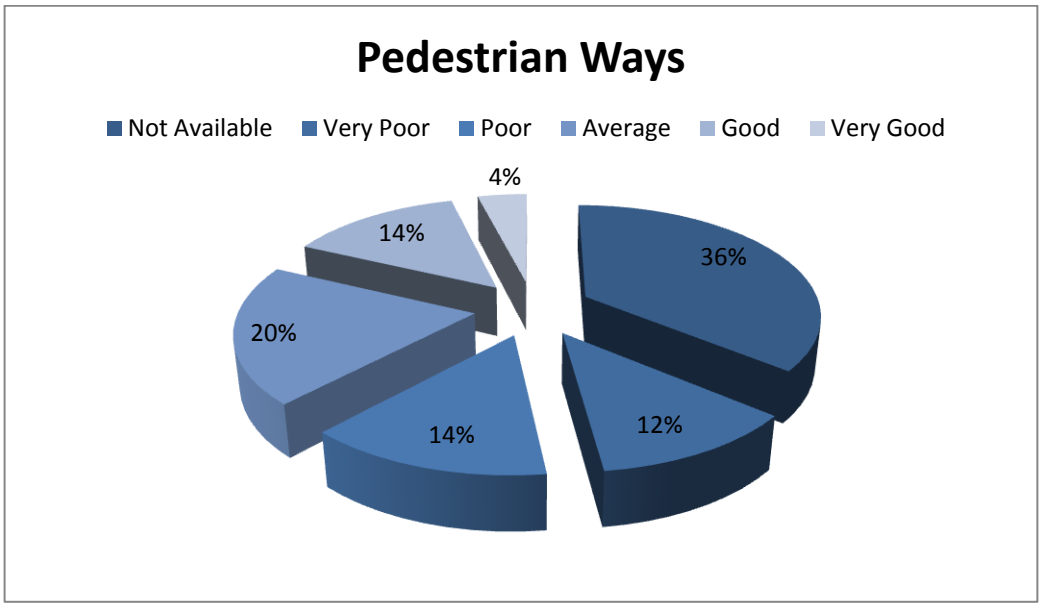


Figure 5.18 Questionnaire Results for Pedestrian Ways

Most of the participated citizens (36%) think that there is no pedestrian ways in the city. Only four percent (4%) voted ‘very good’ for pedestrian ways. The results points out that the new transportation system should include pedestrian ways.

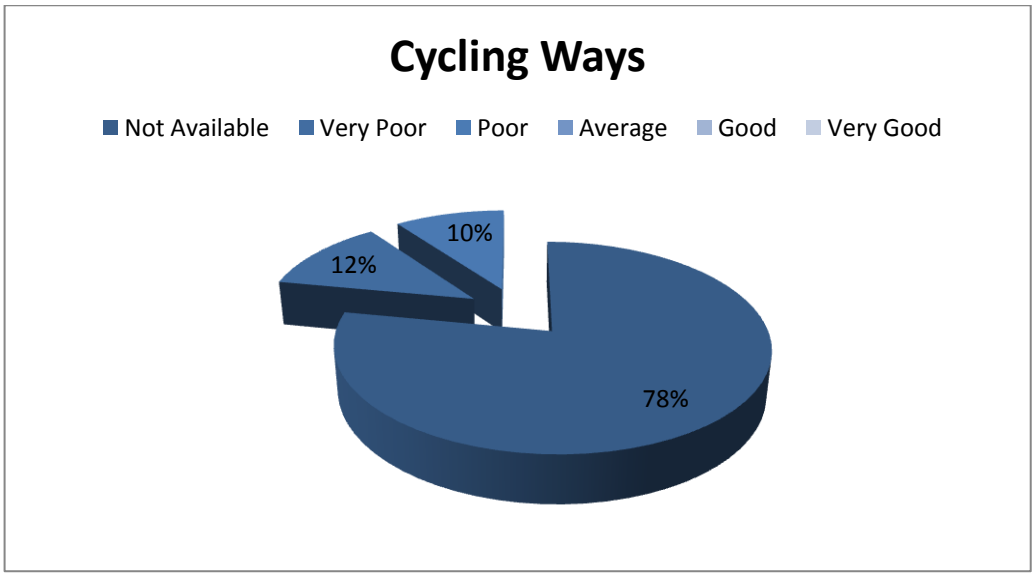


Figure 5.19 Questionnaire Results for Cycling Ways

Vast majority of participants (78%) voted that there is no cycling ways in the city. Hundred percent of participated citizens voted for cycling ways below 'average'. The results prove that a project which would include cycling ways should be proposed.

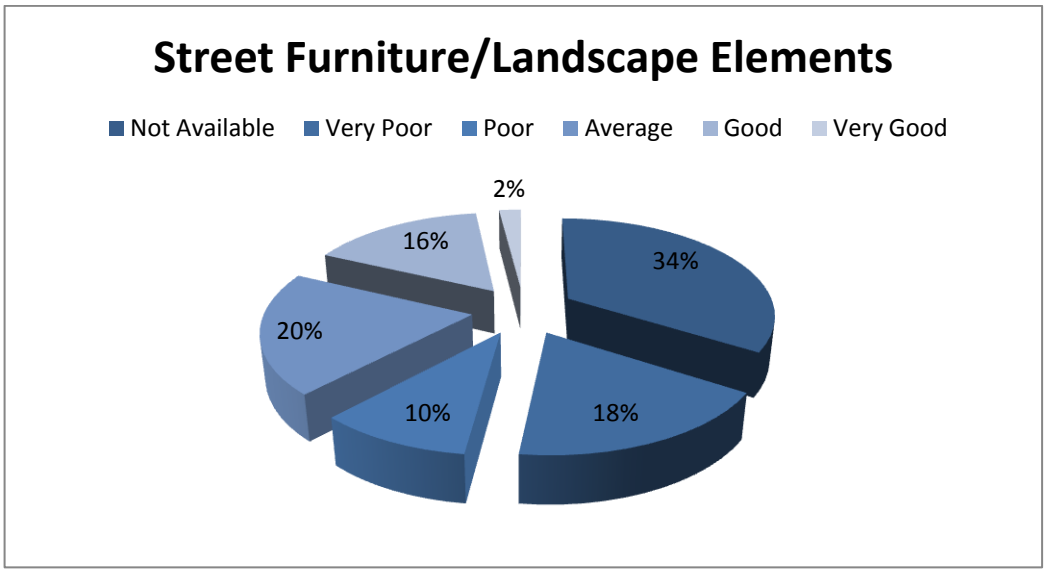


Figure 5.20 Questionnaire Results for Street Furniture/Landscape Elements

This criterion is also voted as not available in Famagusta. Most of the participated citizens (34%) think that there are no street furniture or landscape elements in the city. The results show that new landscape design projects and establishment of street furniture are necessary for increasing streetscape in the city.

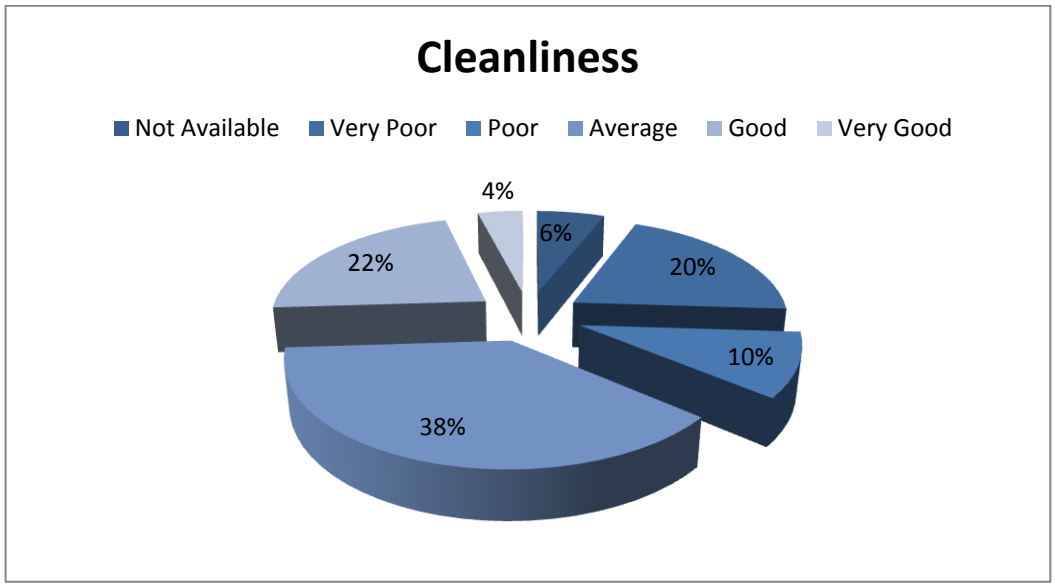


Figure 5.21 Questionnaire Results for Cleanliness

Majority of participants (38%) think that cleanliness of the city is average, and the second majority (22%) think that it is good. Therefore, cleanliness should have new strategies for improving streetscape in the city.

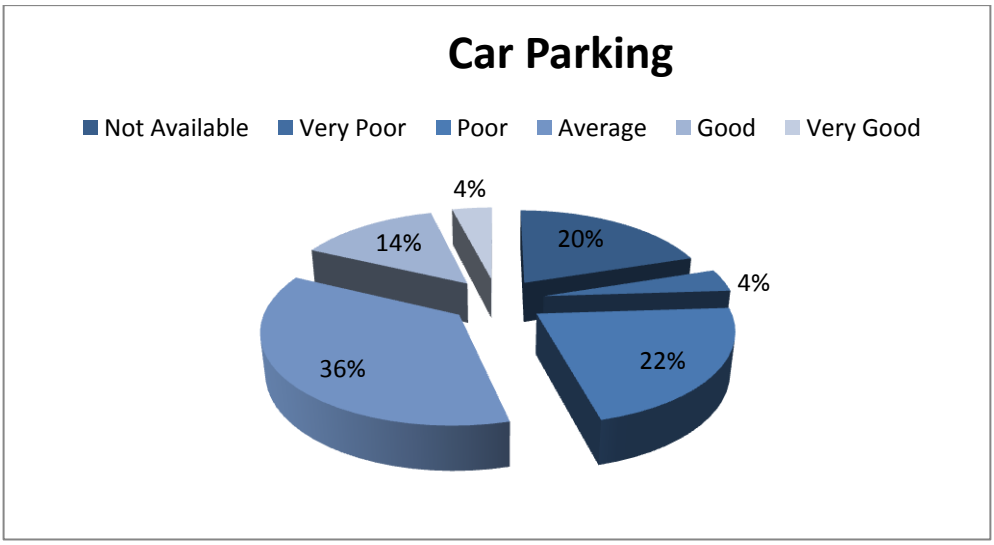


Figure 5.22 Questionnaire Results for Car Parking

Car parking in the city is 'average' for the most of the participants (36%), 'poor' for twenty two percent (22%), 'very poor' for four percent (4%) and 'not available' for twenty percent (20%). Considering the total percentage for 'average' and below average which is eighty two percent (82%), it can be said that there should be new strategies and policies for car parking as well.

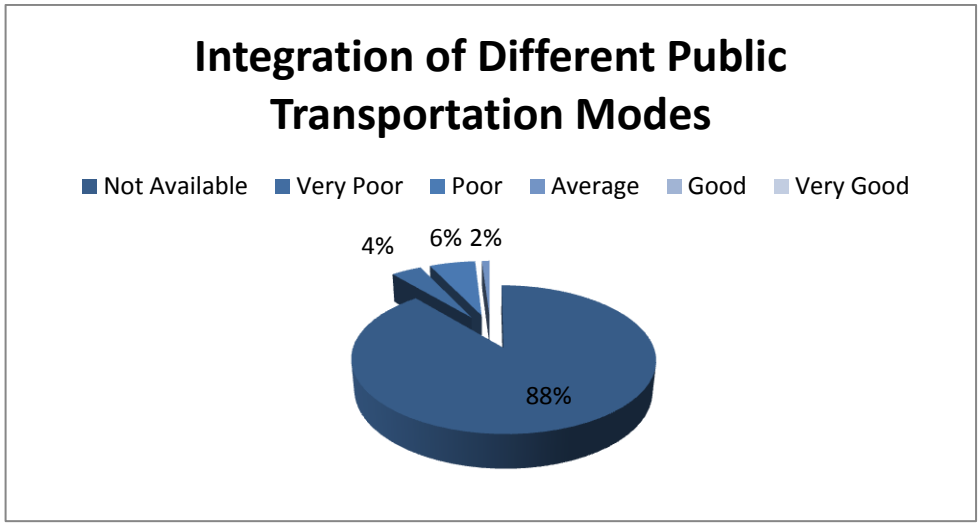


Figure 5.23 Questionnaire Results for Integration of Different Public Transportation Modes

Eighty eight percent (88%) of the participated citizens voted as ‘not available’ for the criterion. It is not surprising to have such a result, since vast majority thought that there is not public transportation in the city. With these results, it is inevitable to include integration of modes in the new transportation system proposal.

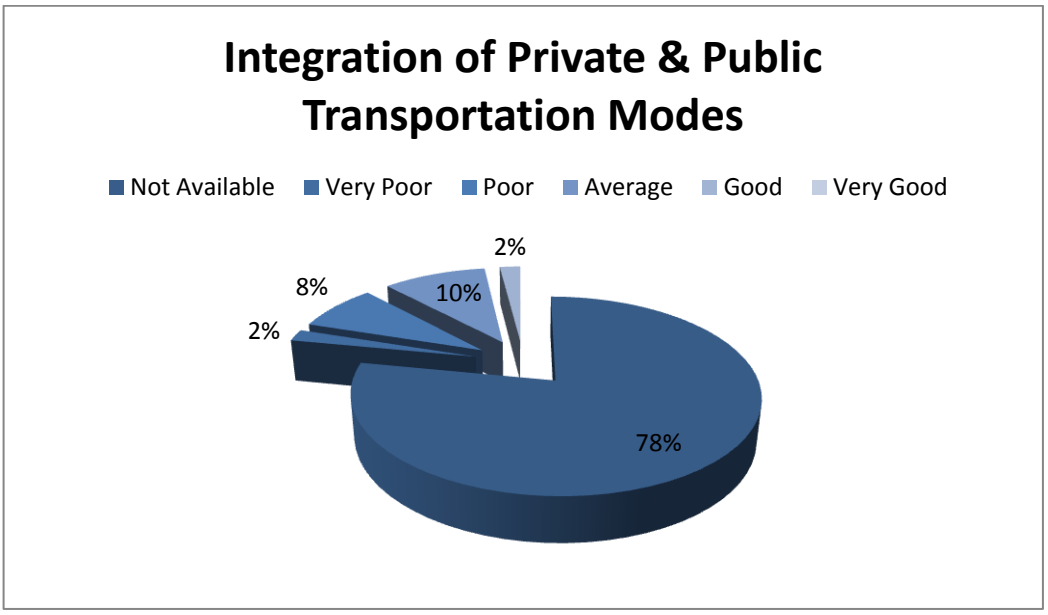


Figure 5.24 Questionnaire Results for Integration of Private& Public Transportation Modes

The result for this criterion is similar to the result of the criterion ‘integration of different public transportation modes’. Most of the participants think that there is not such as integration in the city, therefore it should be considered in the new transportation system proposal.

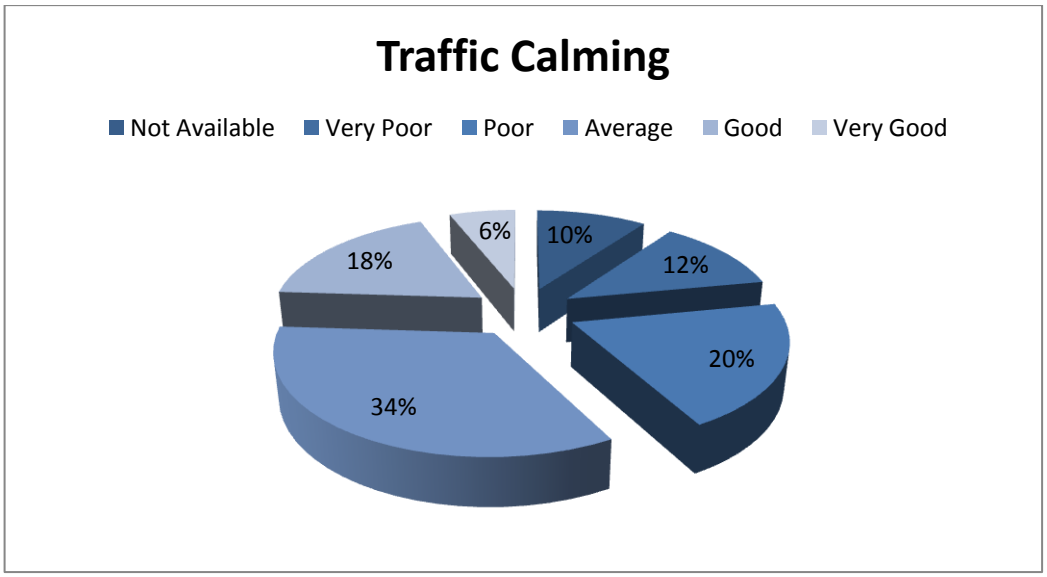


Figure 5.25 Questionnaire Results for Traffic Calming

Traffic lights, roundabouts, ramps, etc. are the types of traffic calming. Most of the participants (34%) think that the traffic calming in Famagusta is fair (average). That means there should be improvements about traffic calming to make provide safer roads in the city.

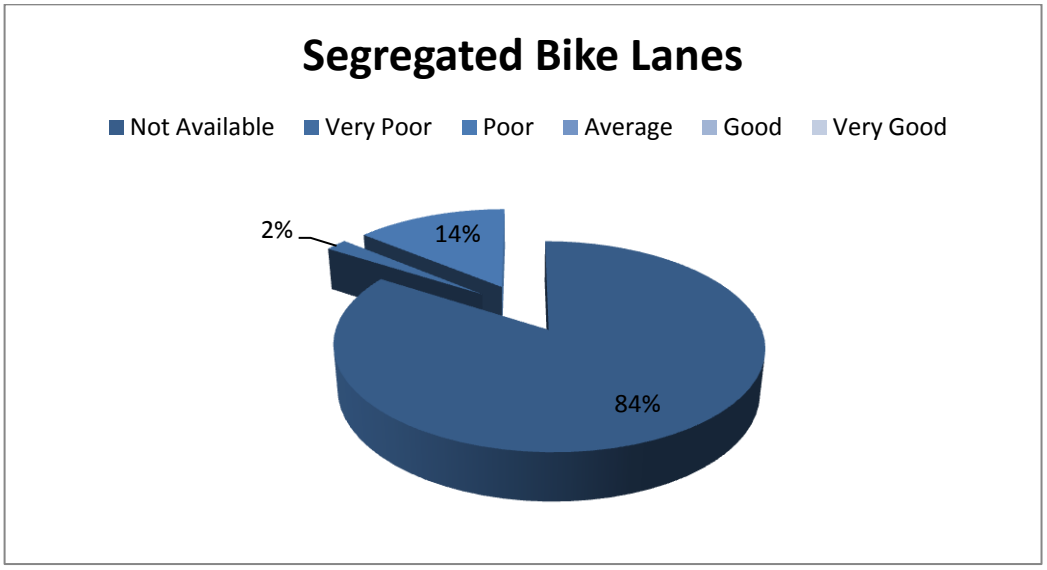


Figure 5.26 Questionnaire Results for Segregated Bike Lanes

All of the participants voted below average for the segregated bike lanes. Most of them (84%) think that there are no segregated bike lanes in the city. Two percent (2%) of participated citizens voted as ‘very poor’ and fourteen percent (14%) voted as ‘poor’ for this criterion. These results require including segregated bike lanes in the new transportation system.

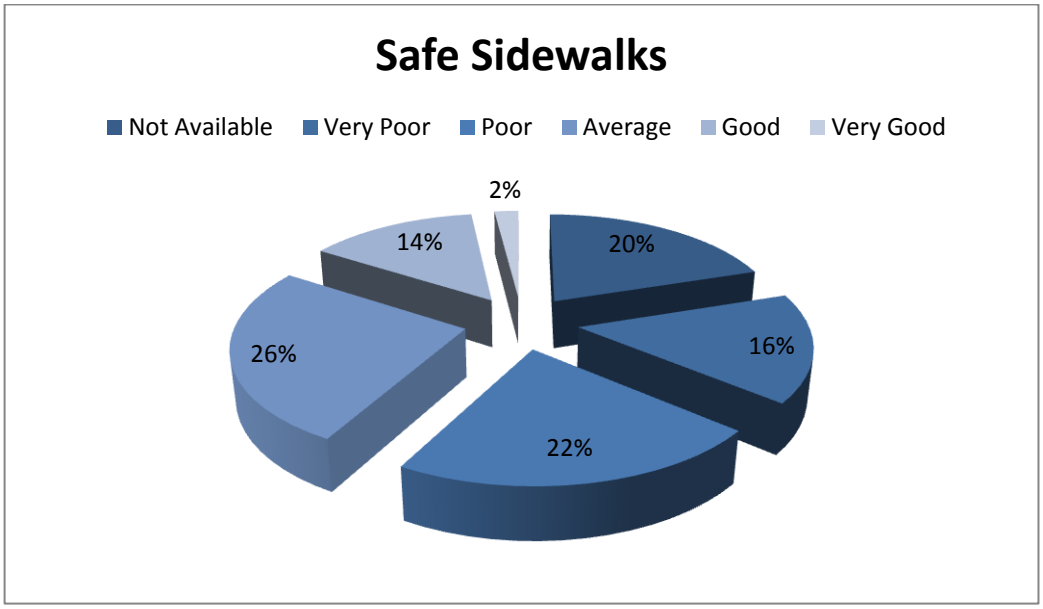


Figure 5.27 Questionnaire Results for Segregated Bike Lanes

Only sixteen percent (16%) of participants voted as ‘good’ and ‘very good’ for safe sidewalks in the city. Majority think that this criterion is either average or below average and twenty percent of participated citizens think that there are no safe sidewalks in the city. Consequently, designing safer sidewalks should be a goal in the new transportation system.

Considering the total results of the questionnaire, it is seen that seven criteria of the accessibility indicators out of thirteen have been voted as ‘not available’ and other six criteria have been voted as ‘average’. Also average of all scores is below the assumed average with the score of 20.4. Examining the results of this questionnaire, it is proved that accessibility of Famagusta is below average and a new transportation system with strategies and policies including all accessibility criteria should be proposed.

The photographs from few points of Salamis Road and Ismet Inounu Boulevard are showing the existing conditions of street type sidewalks, car parking, and street furniture.

Figure 5.28 Side Parking and Street Type Sidewalks in Famagusta

Resource: Elda Istillozlu, July 2011

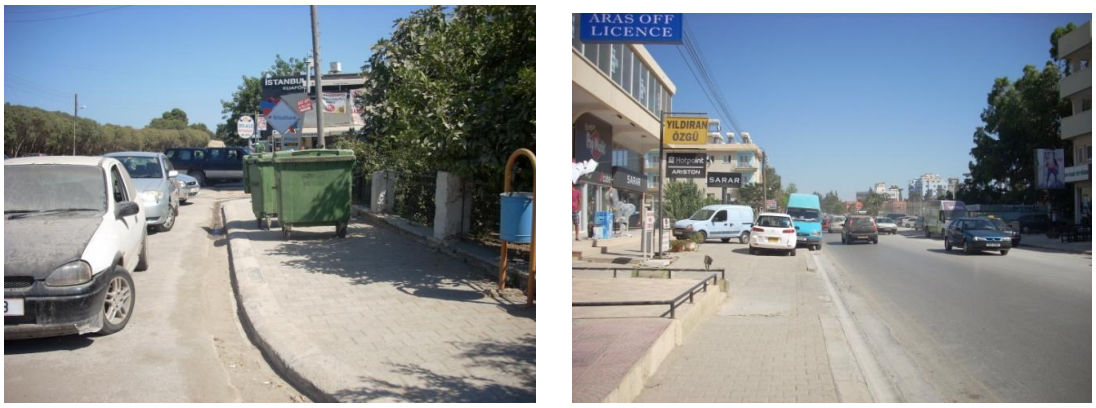


Figure 5.29 Street Furniture and Street Type Sidewalks in Famagusta

Resource: Elda Istillozlu, July 2011

In previous chapters modes of transportation and strategies of transportation have been explained, furthermore the most appropriate modes of transportation for more livable cities have been discussed. With the information obtained in these chapters (chapter 2, 3 & 4), accessibility in the city of Famagusta has been analyzed here. With the result of poor accessibility in Famagusta, it is revealed that a new transit oriented transportation system should be proposed. In this sense, the new proposals will be provided in the next chapter in order to increase accessibility and consequently livability in Famagusta.

5.3. Public Transportation Proposal for Famagusta

After literature survey, the selected city Famagusta has been analyzed in terms of its accessibility. The results of the analysis and assessments as well as the observed problems (urban sprawling, air pollution, congestion in traffic, car-parking, unhealthy communities, unsafe roads, unlivable streets etc) caused by existing transportation system in the city which is car oriented, have shown that the accessibility of the city is poor. As accessibility negatively affects livability of a city as being one of the

dimensions of livability, improving accessibility has become inevitable for increasing livability of the city.

With regard to the research, it is claimed and illustrated that transit oriented cities are more accessible and consequently more livable. Some cities around Europe have been selected to be examined in terms of their accessibility (Chapter 4). Criteria for the selection were population and transportation systems of the cities.

Examining the examples has provided clues about the appropriate transportation system for the cities with a population below 100.000. In this sense, before proposing a new transportation system for Famagusta, the most suitable mode of transportation for increasing livability in the city should be discussed. Then new transportation system for motorized and non-motorized transportation will be proposed in this chapter based on transit oriented system in other words increasing accessibility by public transportation.

5.3.1. The Most Suitable Modes of Transportation for Increasing Livability in Famagusta

Searching and understanding the transportation modes (Chapter 3), the most suitable modes of transportation for increasing livability have been disgusted in Chapter 4. Illustrations in Chapter 4 reveal that environmentally friendly systems (rail systems & hybrid buses) among public transportation modes and non-motorized systems (walking & cycling) among private transportation are the most suitable systems.

It is impossible to prevent private car usage in car oriented cities like Famagusta; however through policies (like park and ride, kiss and ride or bike and ride), it can be

reduced and used as a feeder mode for public transportation. In other words considering citizens' life styles, although private cars are not environmentally friendly mode of transportation, it should be provided as a feeder mode for public transportation.

Famagusta is not a very crowded city with a population around 35,000 people. Therefore tramways, which are light rail system and have lower passenger capacity comparing to a metro system, seems to be the most appropriate mode of public transportation. This mode should be supported by pedestrian and cycler access would increase accessibility and livability of the city. Additionally, hybrid buses could also be used as school and university services which could have more flexible routes then the rail systems.

The rail systems, hybrid buses, walking, non-motorized cycling and cars which are determined as the most suitable transportation modes for increasing livability of Famagusta will be considered for proposing a *new transit oriented transportation system*.

5.3.2. Proposal & Policies for Motorized Transportation

Assessment and measurement of accessibility of Famagusta, reveals that there is a need for a new transportation system in order to increase livability of the city. The new transportation system would be expected to solve all the problems of the city related to transportation. The observations have shown that the city has no defined city center; however there are activity spines, in other words, the entire commercial, entertainment and some public services are concentrated on the main distributors of the city. Thus, the new system would be composed of well integrated motorized and non-motorized transportation which would include the most appropriate modes of transportation.

Before proposing a motorized transportation, the vehicular accessibility and integration of modes sections of the accessibility questionnaire should be considered.

Table 5.6 Percentages of the questionnaire results for the sections of vehicular accessibility and integration of modes

Indicators of Accessibility	**Criteria of the Indicators**	**Evaluation**					
		Not Available	**Very Poor**	**Poor**	**Average**	**Good**	**Very Good**
Vehicular Accessibility	Public transportation	**58%**	16%	9%	16%	4%	0%
	Transport Infrastructure	14%	14%	24%	**30%**	16%	2%
Integration of modes	Integration of different public transportation modes	**88%**	4%	6%	2%	0%	0%
	Integration of private & public transportation modes	**78%**	2%	8%	10%	2%	0%

As it has been mentioned in the previous chapter (Chapter 5), most of the participated citizens think that there is no public transportation in the city, transportation infrastructure is average, and there are neither integration of different public transportation modes nor integration of private and public transportation modes in the city.

Providing public transportation is a necessity for increasing accessibility in the city. Light rail systems and hybrid buses are the most suitable modes for providing in Famagusta as it is expressed before. A street car can be proposed in the walled city.

Integration between these modes is extremely important for the usage of these modes. The rail system would have stop at the bus terminal and other bus stops. Intermodality should be provided at the most important node of the city where the bus terminal is located for intercity transportation and the walled city gate (The Land Gate) is situated. Also cars as a private transportation mode should be included in the system as supporter mode. Park and ride and kiss and ride would be provided at the bus and rail stops for integration of private and public transportation. Park and ride will be proposed in the tramway stations as it is shown in Figure 5.28. Kiss and ride will be provided as pockets in the roads close to the stations.

The tramway stops should be located and designed by considering the climatic conditions of the island. The climate is very hot in summer and warm in winter. Therefore especially in summer times it is quite difficult to walk long distances in the city. The railway should have stops in every 600 or 800 meters in order to be feasible regarding the climatic conditions.

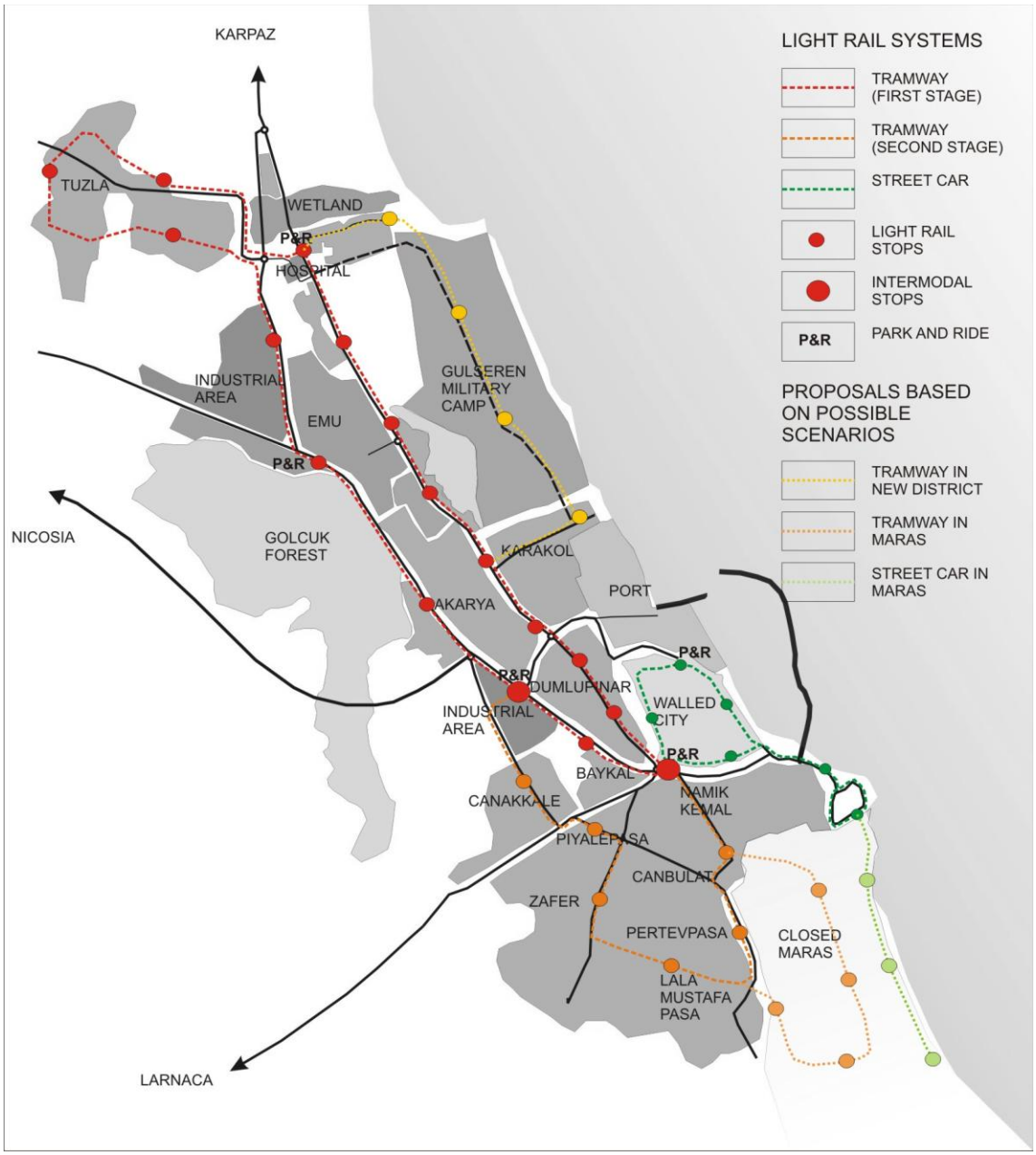


Figure 5.30 Proposed Light Rail Systems Routes

There is a possibility of reopening the Closed Maras for settlement and this possibility is considered while determining the routes of the light rail system. The second stage of tramway has stops near the border. In the event of reopening of Closed Maras, the

tramway can be extended to serve for this district. On the other hand, the street car route could be extended to serve the shoreline along the Closed Maras. Another possibility which is transforming Gulseren Military Camp to a district of the city should be considered. In this case, there can be an additional tramway network connecting the new district with Karakol quarter and the first stage of the tramway. A new road connecting Salamis Road and Cahit Sitki Taranci Street which could be an alternative for Salamis Road. Additionally, proposing an alternative road could be a solution for applying one way system on the Salamis Road.

As it is mentioned in Chapter 5, primary distributors are 10 meters- 3.5 meters of each lane and 1.5 meters for each shoulder. The shoulders are generally used for side parking in the city. Side parking is another factor affecting streetscape and decreases accessibility. This could be removed with providing tram in the road which needs 3 meters lane. Parking should be in the proposed car parks but not on the roads.

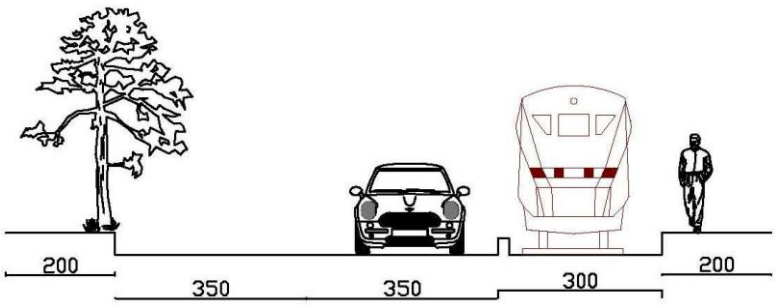


Figure 5.31 Section of Proposed Primary Distributor (Ismet Inonu Boulevard, Salamis Road, Gazi Mustafa Kemal Boulevard, Polatpasa Boulevard, and Sehit Ibrahim Kazim Boulevard)

District distributors are similar with the primary distributors. They are 8 meters in total- 3 meters for each lane and 1 meter for each shoulder. It is possible to avoid side parking and provide a tram lane on these roads.

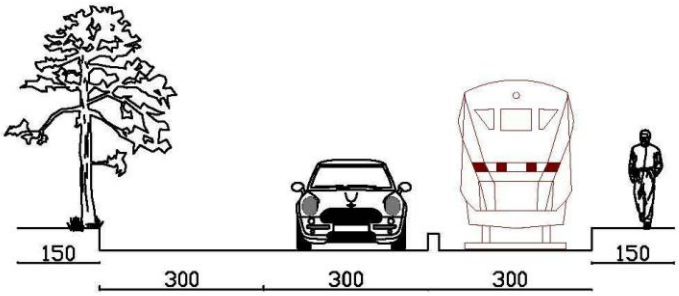


Figure 5.32 Section of Proposed District Distributor (Cahit Sitki Taranci Street, Ziya Gokalp Street, 9 Mart Street, and Ibrahim Hasan Street)

The local distributors are 6 meters- 3 meters for each lane- without shoulders. If one lane will be designated as tram lane, then the road should be one way. That means the local roads with tramway will be one way in the city.

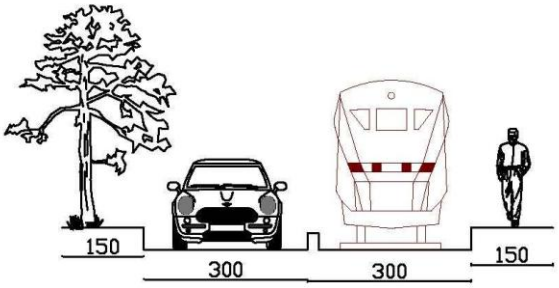


Figure 5.33 Section of Proposed Local Distributor (Deniz Piyade Street, Necati Taskin Street, Cengiz Topel Street, Yesil Deniz Street, and Canbulat Street)

The proposed motorized transportation will be supported by the non-motorized transportation modes which were determined as walking and cycling. In the next section the proposal for non-motorized transportation will be explained.

5.3.3. Proposal & Policy for Non-Motorized Transportation

As it is highlighted in previous lines, non-motorized transportation should have been worked with motorized transportation. In other words, walking and cycling, which are non-motorized transportation, are private modes of transportation and they should be act as supportive modes for motorized public transportation. Well organized pedestrian and cyclist circulation should be established in the city so that public transportation could be more feasible.

The results of the questionnaire conducted throughout the city have proved that there should be new proposal for non-motorized transportation in Famagusta. Before proposing a new system, the non-vehicular accessibility, streetscape and safety of roads sections of the questionnaire should be considered.

Table 5.7 Percentages of the questionnaire results for the sections of non-vehicular accessibility and safety of roads

Indicators of Accessibility	**Criteria of the Indicators**	**Evaluation**					
		Not Available	**Very Poor**	**Poor**	**Average**	**Good**	**Very Good**
Non-vehicular Accessibility	Street type sidewalks	10%	10%	14%	**30%**	28%	8%
	Pedestrian ways	**36%**	12%	14%	20%	14%	4%
	Cycling ways	**78%**	12%	10%	0%	0%	0%
Streetscape	Street furniture/Landscape elements	**34%**	18%	10%	20%	16%	2%
	Cleanliness	6%	20%	10%	**38%**	22%	4%
	Car parking	20%	4%	22%	**36%**	14%	4%
Safety of Roads	Traffic calming	10%	12%	20%	**34%**	18%	6%
	Segregated bike lanes	**82%**	2%	14%	0%	0%	0%
	Safe sidewalks	20%	16%	22%	**26%**	14%	2%

As it can be seen in the table above, most of the participants think that the street type sidewalks are average, and pedestrian ways and cycling ways are not available. The street type sidewalks should be improved according to the results. As participants think that the street furniture/landscape elements are not available, these elements will be provided for increasing both the quality of the sidewalks and the streetscape. Landscape elements (trees, flowerpots etc) could have been barriers between sidewalks and traffic. By this way, the sidewalks can be safer than it is now.

Pedestrian and cycling ways could be proposed in some parts of the city. For proposing such circulation, one way traffic system would have been applied. In order to apply such as system, traffic counting and a detail road analysis are needed. Also some of the roads with tramway lines could be pedestrianized with the policy of integration of public and

private transportation modes so that pedestrians, cyclist and tramway could use same road together, which would provide livable streets.

By applying one way system, segregated bike lanes could be established as well. If an alternative road could be proposed for the primary distributors of the city which are acting as activity spines, it could be possible to establish segregated bike lanes and safer pedestrian ways. This integration should be considered in future transportation plans for the city.

Traffic calming is also a criterion for safety of roads which is affecting non-motorized transportation. The participants think that traffic calming, which is provided by roundabouts, traffic lights, ramps and etc, is average in the city. Therefore it should be improved as well. There should be more traffic lights and ramps in the city. Traffic lights should also work for pedestrians in the crosswalks.

As it has been mentioned before, every trip starts with walking or cycling and ends with such a private mode of transportation. Therefore it is extremely important to care about non-motorized transportation in a public transportation plan. Hence, non-motorized transportation should be encouraged by the strategies mentioned above to increase usage of public transportation.

Briefly non-motorized transportation would increase usage of the public transportation which leads to healthier communities, cleaner air, more quite and livable streets, and also would increase accessibility which would provide more livable cities.

Chapter 6

CONCLUSION

Preliminary research on the livability issues has revealed that public transportation has great impacts on livability of cities. The argument has been discussed and proved by examining dimensions of livability in this study. Functional place quality as a dimension of livability is measured by accessibility indicators such as, pedestrian journeys, public transportation quality and vitality and viability of services (Yeang, 2006). Hence, relationship between public transportation, accessibility and livability of cities have been searched in detail and explained in this study.

The concepts of livability, livable cities, livable streets, quality of life and place, and dimensions of livability have been explained in Chapter 2. Examining accessibility dimension continued with deriving a methodology for measuring accessibility. The possible contributions for increasing accessibility, including the provision of public transportation, have been discussed. Consequently, public transportation issue has been handled in chapter 3. The modes of public and private transportation and strategies for transportation have been examined and illustrated. This information has been moved to Chapter 4 in order to be able to decide the most appropriate modes of transportation for more livable cities. The selected cities as examples have been analyzed and illustrated for supporting the decision of the most suitable modes.

After the literature survey, Famagusta city has been chosen as a case study, and the accessibility of the city has been assessed and measured in Chapter 5. The information about the city such as, historical and physical development, districts, population, urban macroform, street network and hierarchy have been studied. Additionally, a questionnaire survey has been conducted with 50 citizens of Famagusta in order to get their opinions and attitudes towards the accessibility level of the city. The results of the survey have shown that the accessibility is below average in Famagusta. Accordingly, in Chapter 6, a new transportation system has been proposed for increasing accessibility and consequently livability of the city.

6.1. Contributions of Public Transportation to the Livability of Cities

The deep research on the livability concept has shown that public transportation has great impacts on livability of cities. The relationship between them has been solved in the literature survey, as it is mentioned in previous lines. The urban problems determined by observations such as, urban sprawling, air pollution, congestion in traffic, car-parking, unhealthy communities, unsafe roads, unlivable streets and so on are the factors have all negative impacts on livability of the cities. These problems are the matter of accessibility which is a dimension of livability. Facing such problems is leading to examining accessibility. The examination of accessibility dimension shows that pedestrian journeys, public transportation quality, vitality and viability of services are the indicators of it. Considering these indicators, it can be stated that a transit oriented system, which is a system including the most appropriate public transportation modes and private transportation modes as supportive modes, provided in cities would increase its accessibility and consequently livability.

A set of criteria could be derived by studying accessibility indicators through livability perspective. Evaluating each criterion which are public transportation, transport infrastructure, street type sidewalks, pedestrian ways, cycling ways, street furniture and landscape elements, cleanliness, car parking, integration of different public transportation modes, integration of private transportation and public transportation modes, traffic calming, segregated bike lanes, and safe sidewalks would convey to the measurement of accessibility. Provision of the most appropriate modes of public transportation seems to be a solution for increasing the quality of each criterion of accessibility. These appropriate transportation modes would not only improve environmental conditions but also improve social and economical conditions of the city. Providing environmentally friendly modes of public and private transportation with intermodal system would create equity in terms of access; prevent loss of urban living spaces, visual intrusion, air and noise pollution; and reduce congestion and energy consumption, accordingly livability of cities would increase. Therefore, this study has revealed that streets and cities will become more livable with the availability of the most appropriate public transportation modes.

The methodology that has been derived for measuring accessibility can be applied to all cities for assessing and measuring their accessibility levels. This methodology can be used in academic environment as well as researches and urban transportation projects by planners, designers, researches and etc.

6.2. Famagusta Becoming More Livable With Public Transportation

The coastal city in Cyprus Island, Famagusta has been chosen as a case study in this research. It is a car oriented city, having many problems related with accessibility. The piecemeal development of the city, the lack of a master plan and inadequate public transportation, and also the overloaded primary distributors as the activity spines seem to be among the major problems that the city is faced with. Furthermore, with the other problems observed in the city such as traffic congestion, car-parking, urban sprawling, loss of urban open spaces etc., it is inevitable to questioning accessibility and livability of the city.

According to the research about the city, while it has a shifted grid street network in most parts, the urban macroform could not be read clearly. The city could have a linear shape but as long as there is a lack of master plan, the city could not be shaped clearly. Then the districts and population of the city have been analyzed, and it could be said that the city is more crowded towards the location of the university campus. There is no defined city center, however there are activity spines generated on the primary distributors. The analysis has also shown that the city has thresholds which are affecting the development and growth.

Beside all these information, a questionnaire survey has been conducted with citizens to assess the accessibility of the city. The questionnaire was prepared based on the derived methodology for measuring the accessibility through livability perspective. The results of the questionnaire have shown that accessibility of Famagusta is poor. Accordingly,

there should have been a new transportation system proposal for increasing accessibility and consequently livability of the city.

Table 6.1 The new Transportation System Proposal for Famagusta

Transportation Type	**Public Transportation**	**Private Transportation**
Non-Motorized Systems	-	Cycling Walking
Motorized Systems	Tramway Street Car Hybrid Bus	Car
Policies	Integration of modes	Integration of modes Bike and Ride Park and Ride Kiss and Ride

The new transportation system for Famagusta is composed of the most appropriate public transportation modes such as tramway and hybrid buses which are environmentally friendly systems, and supporter private transportation modes like walking, cycling and cars.

Intermodality was important for the new transportation proposal. Intermodality between different public transportation modes and between public and private transportation modes would be provided. For this strategy, policies like park and ride and kiss and ride would be proposed. Bike and ride could also be proposed if one way system is applied and bike lanes are provided.

All these proposals for transportation system of Famagusta, would contribute for providing and increasing equity, dignity, accessibility, conviviality, participation and empowerment in the city (Timmer & Seymoar, 2006). These contributions would result in increasing of livability in Famagusta.

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